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**QUEENS COLLEGE**

# **SUMMER UNDERGRADUATE RESEARCH PROGRAM**

**2024 REPORT**



# TABLE OF CONTENTS



Executive Summary ..... 3

Program Overview ..... 4

*Cohort Selection and Makeup* .....4

*Program Structure* .....6

*Funding* .....7

Outcomes ..... 8

*Participant Feedback* .....8

*Retention and Engagement* .....10

Conclusion ..... 11

Cohort Showcase ..... 12

*CIRE* .....12

*CUE* .....14

*Sherman Fairchild Foundation* .....14

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# EXECUTIVE SUMMARY

The Office of Undergraduate Research (OUGR) at Queens College continues to foster student engagement in research through the 2024 Summer Undergraduate Research Program (SURP). This program provided valuable research opportunities for students across multiple disciplines, culminating in presentations at the annual research symposium.

The 2024 cohort consisted of 34 students, some participating exclusively in the Summer Research Program, while others were part of year-round research initiatives like the Transfer Student Success Program (TS3), CUNY Immersive Research Experience (CIRE), and faculty-funded projects. The summer program directly supported 28 students through three funding sources, including CUNY Immersive Research Experience (CIRE), Coordinated Undergraduate Education (CUE), and the Sherman Fairchild Foundation, which covered student stipends, research materials, and mentor salaries.

Running from July 1st to August 21st, QC SURP offered a structured eight-week program in which students committed 30-35 hours per week to research, attended weekly seminars, and culminated their work by presenting research posters at the Queens College Summer Undergraduate Research Symposium. The program aimed to enhance student skills in research methodologies, academic writing, and professional development through tailored seminars.

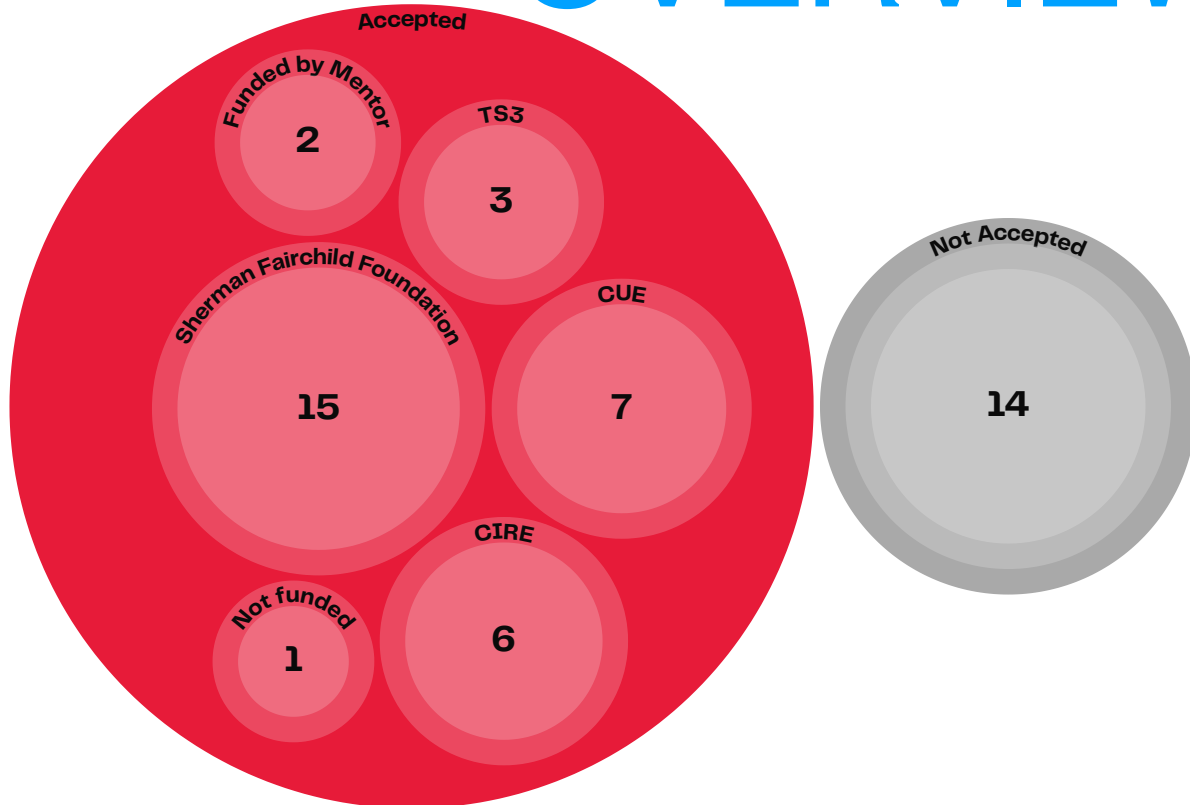
Key highlights from this year's program include high student retention rates, positive feedback on the mandatory seminars, high engagement, and high satisfaction of the program overall.

Recommendations for future iterations include expanding funding to accommodate more participants, or creating other incentives, and refining seminar content to better align with student needs, especially in areas like scientific writing and data analysis.

Overall, the restart of the Summer Undergraduate Research Program proved to be valuable for the Office of Undergraduate Research at Queens College by creating a research-driven academic environment for students across various disciplines.

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# PROGRAM OVERVIEW

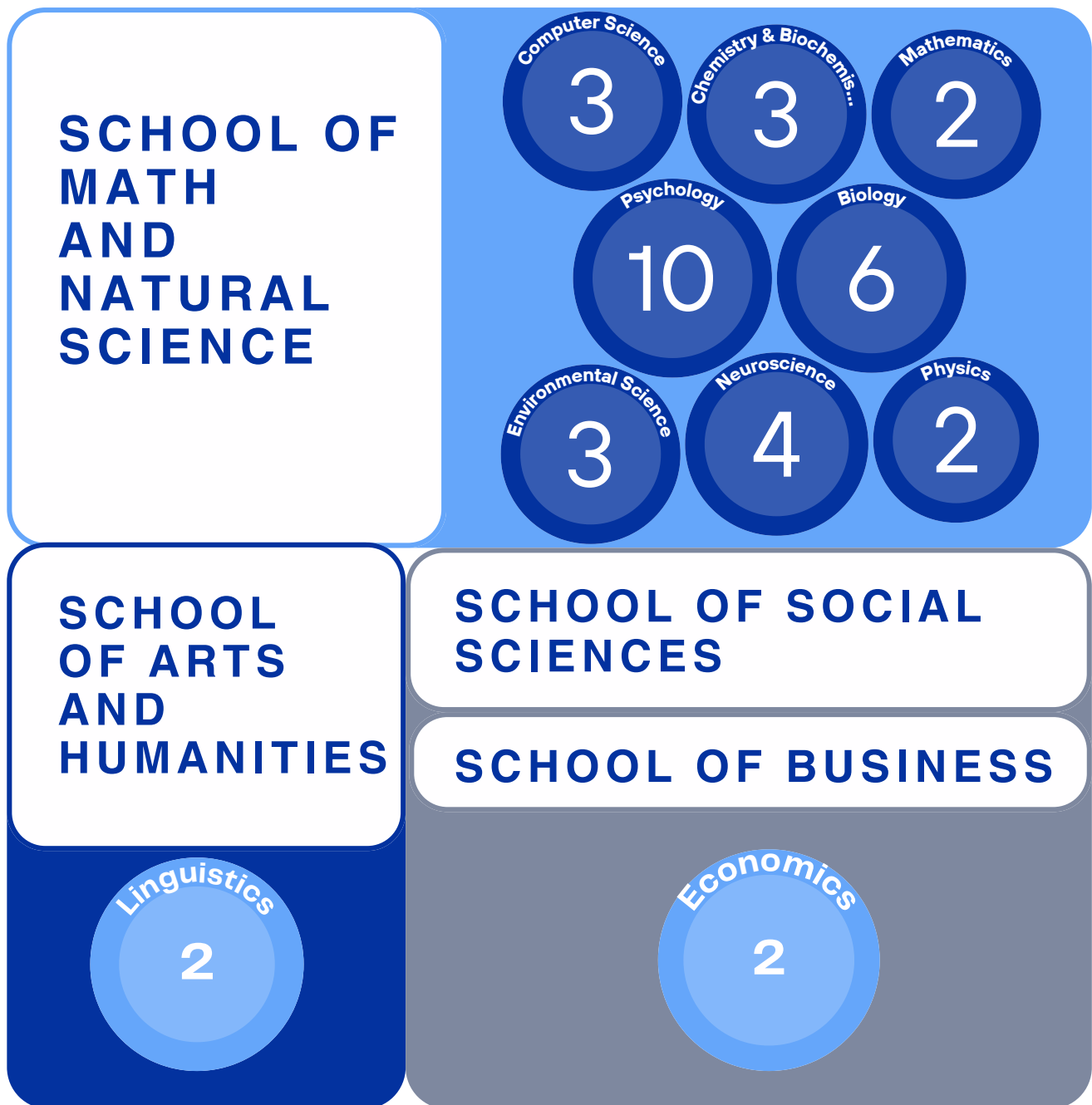


## COHORT SELECTION AND MAKEUP

The 2024 cycle was opened exclusively to undergraduate students at Queens College, across all disciplines, who had a research mentor. Students with existing funding were welcome to apply but were not guaranteed additional funding.

This year, a total of 48 students applied to the Summer Undergraduate Research Program, and 34 students were selected to participate. The Office of the Associate Provost for Innovation and Student Success was able to fund 28 students with funding from Coordinated Undergraduate Education (CUE), the CUNY Immersive Research Experience (CIRE), and the Sherman Fairchild Foundation. Three students were accepted from the TS3 program, which is funded by the Research Foundation of CUNY (RFCUNY). Two additional students were funded by their mentors, and one student participated without funding.

The 2024 Summer Undergraduate Research Program included a diverse group of students from both STEM and non-STEM disciplines, with the majority coming from the Math and Natural Sciences. Students in the School of Arts and Humanities, School of Social Science, and School of Business were funded through the Coordinated Undergraduate Education (CUE) initiative. This diverse participation highlights the importance of creating research opportunities across a wide range of academic fields.



## PROGRAM STRUCTURE

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The program structure was designed for students to experience full-time research while receiving support and professional development. Students participated in 30-35 hours of research per week and attended a mandatory weekly seminar with the option of attending an additional seminar meant to support them in preparing for the final symposium presentation and professional development. To assess their progress and address any challenges, students were required to attend a mandatory mid-point check-in. Additionally, optional weekly meetings with the program coordinator were available, offering students an opportunity to discuss their experiences, receive feedback, and stay aligned with their goals. This comprehensive approach ensured that students were well-supported and on track throughout their research journey.



## FUNDING

The 2024 Summer Undergraduate Research Program was supported by a combination of institutional and external funding sources. Funding initiatives, such as CUNY Immersive Research Experience (CIRE), Coordinated Undergraduate Education (CUE), the Sherman Fairchild Foundation (SFF), Transfer to STEM Student Success (TS3), and faculty mentors, provided direct funding for student stipends and research materials. The program allocated over \$100,000 in stipends, with additional funds designated for research expenses and mentor salaries. This financial support enabled the participation of a diverse group of students, offering them opportunities to engage in meaningful research across multiple disciplines, while also covering the costs of program activities such as seminars, orientation, and the final research conference.

### FINANCIAL SUMMARY

<b>Funding</b>	<b>Students</b>	<b>Stipend Allocation</b>	<b>OTPS Allocation</b>	<b>Mentor Salary Allocation</b>
<b>CIRE</b>	6	\$22,100.00	\$4,000.00	-
<b>CUE</b>	7	\$18,050.00	-	\$3,501.04
<b>SFF</b>	15	\$60,000.00	\$13,000.00	-
<b>Totals</b>	28	\$100,150.00	\$17,000.00	\$3,501.04

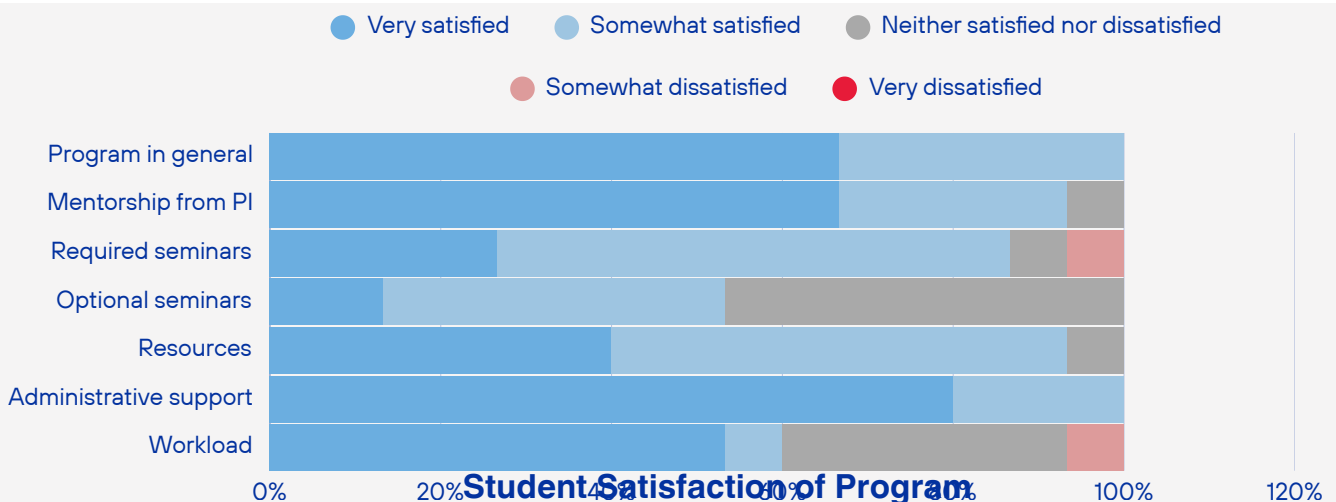
# OUTCOMES

The success of the program was assessed based on retention, engagement, program completion, and participant surveys. All funded students attended the mandatory seminars, with only a few justified absences, and every student successfully submitted a research poster. Out of 34 participants, only one student left the program early, and just one student did not present a poster at a symposium. These measures demonstrate strong overall participation and completion rates, indicating the program's success in maintaining high levels of engagement and commitment from the students.

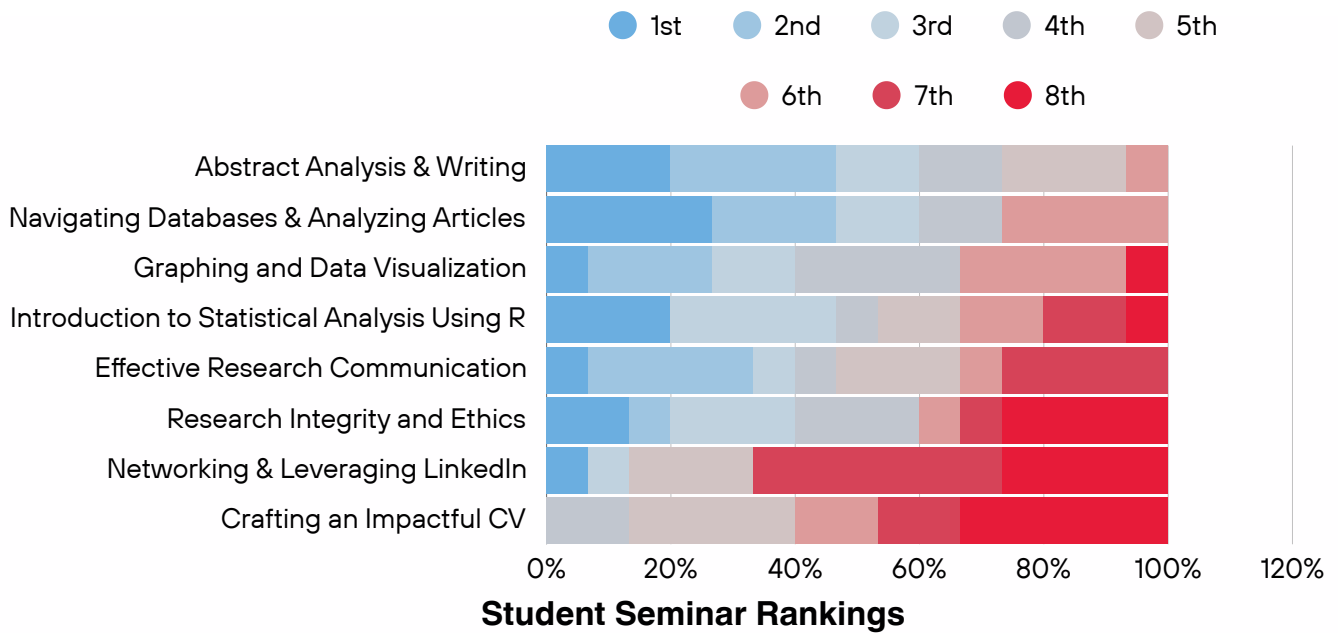


## PARTICIPANT FEEDBACK

Overall, students expressed high satisfaction with the Summer Undergraduate Research Program. Most rated their experiences with the program, mentorship, required seminars, resources, and administrative support as "Very satisfied." The optional seminars received mixed feedback; while some students found them highly beneficial, others felt the topics could be more relevant. This feedback reflects the program's success in providing valuable research experiences and highlights areas for improvement in future iterations.

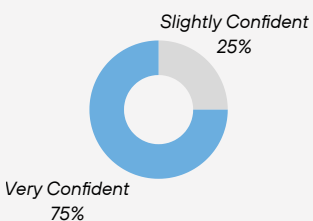


The required seminars were ranked by students, and the results showed that "Abstract Dissections and Writing Abstracts", "Research Databases and Papers", and "Data Visualization" were highly ranked. The results also showed , "Research Ethics" and "Networking and Leveraging LinkedIn" received mixed responses. Overall, the trend indicates that participants prefer seminars where they can learn skills that will enhance their ability to articulate and share their research effectively.

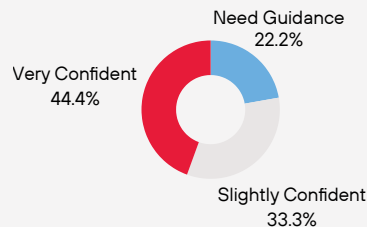


At the end of the program, students self-assessed their research-related skills, which were categorized into presentation & communication, data analysis, lab techniques, and research process. Most participants expressed confidence in their presentation and communication skills, while lab techniques, data analysis, and the research process revealed the need for further support.

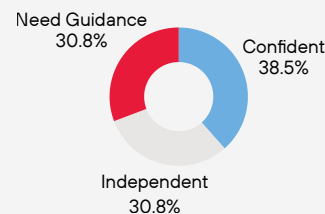
### Presentation Skills



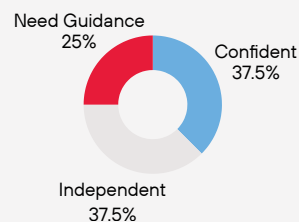
### Data Analysis



### Lab Techniques



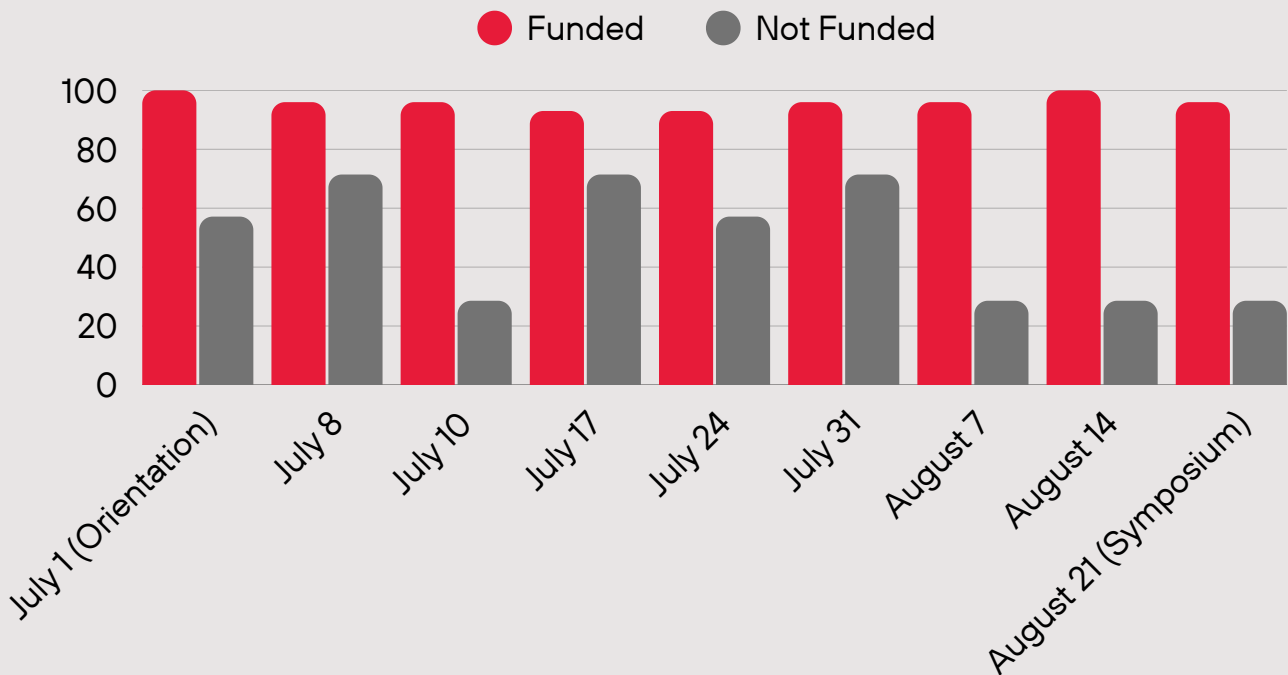
### Research Process



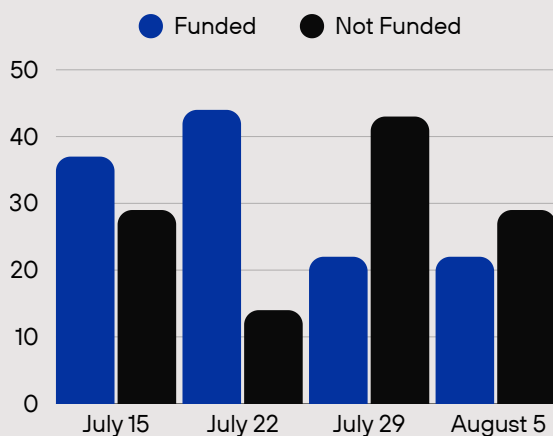
## RETENTION AND ENGAGEMENT

The program exhibited a strong retention rate, with only one student withdrawing. Most students remained actively engaged throughout the program, particularly those who were funded. Notably, students who were not funded exhibited lower engagement levels, except for one student who remained actively involved. Attendance at mandatory seminars was consistently high throughout the program, with a peak of 32 attendees at the orientation session and a gradual decrease to 28 participants at the final conference. Optional seminar attendance was lower, with attendance ranging from 8 to 13 participants, suggesting varying levels of interest or availability among students.

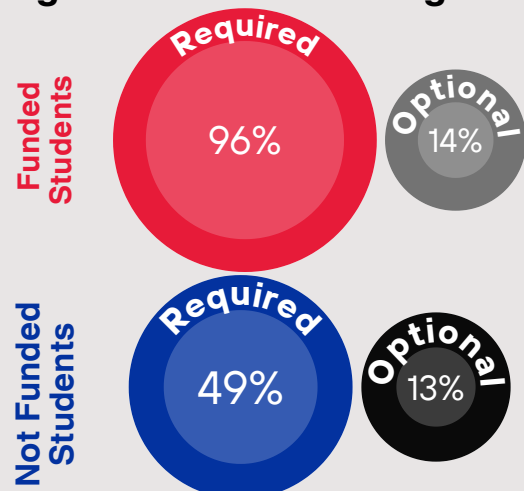
### Required Seminar Attendance



### Optional Seminar Attendance



### Average Attendance Through Program



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# CONCLUSION

The Summer Undergraduate Research Program was successful in providing research experiences and funding for many students. The program received significant engagement from funded students, all of whom created and submitted a poster. Additionally, almost all of them presented their posters at either the TS3 symposium or our summer symposium. This success can be attributed to the selected students, program design, and the support provided throughout the program.

While the program was successful, it faced some challenges that can be addressed for future cycles. One challenge was the differing levels of engagement between funded and non-funded students, with some non-funded students showing lower participation. Offering additional incentives for non-funded students, such as public transportation support, covering food costs, and creating a more inclusive program structure, could help increase their engagement. The optional seminars also lower engagement from students, even with the incentive of providing free lunch. For future cycles, it could be helpful to assess the needs of the cohort and plan a more targeted optional seminar schedule to address this issue. Additionally, making attendance at two to three optional seminars a requirement for students could help increase attendance.

To ensure that all students effectively participated in weekly check-ins and utilized them to address challenges, a mandatory mid-point check-in was implemented. Most students needed guidance in planning their poster presentations based on their progress. This led to many students feeling rushed to complete their projects for the symposium. For future cycles, implementing two mandatory check-ins, one at week two and another at week four, could provide ample time to address any issues and further support students. By addressing these areas, the Summer Undergraduate Research Program can build on its successes and provide an even more impactful research experience for future cohorts.

The program's ability to adapt and evolve based on participant feedback and engagement data is crucial for continuing its ongoing success and maintaining its relevance in supporting undergraduate research.

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MELANIE MEJIA

### Impact of IQ, age, sex, and mutation status on reaction time and accuracy on Attention Network Test

Melanie Mejia<sup>1</sup>, Sonia Soehnle<sup>1,2</sup>, Shira Basseil-Goller<sup>1</sup>, Eliash Saah<sup>1</sup>, Natalia Mejia<sup>1</sup>, Daniela Rodriguez<sup>1</sup>, Phoebe Macdowell<sup>1</sup>, Shanya Herzog-Feldin<sup>1,2</sup>, Declan Sung<sup>1,2</sup>, Veronica J Hintze<sup>1,2</sup>

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2 Department of Psychology, The Graduate Center, City University of New York

**Objectives:** The Attention Network Test (ANT) is a widely used task to measure attentional control. However, the impact of individual differences on ANT performance is not well understood. We investigated the impact of IQ, age, sex, and mutation status on ANT performance.

**Introduction:** The ANT is a computerized task that requires participants to respond to visual stimuli. It is designed to measure attentional control, which is the ability to focus attention on relevant information and ignore irrelevant information. The task involves responding to visual stimuli that are either congruent or incongruent with the location of the fixation point. The task is designed to measure attentional control, which is the ability to focus attention on relevant information and ignore irrelevant information.

**Participants:** Our sample consists of 141 child participants, ranging from ages 8-13 with the PM allele (n=42, 44.8%) (Bialystok and Scerif, 1982). Additionally, 141 adults were identified primarily with nucleolar markers and controls.

**Results:** We found that IQ, age, sex, and mutation status all significantly influenced performance on the ANT. Higher IQ was associated with faster reaction times and higher accuracy. Older participants also showed faster reaction times and higher accuracy. Males performed faster and more accurately than females. Participants with the PM allele showed faster reaction times and higher accuracy compared to those without the allele.

**Conclusions:** Our findings suggest that attentional control is influenced by individual differences in IQ, age, sex, and mutation status. These findings have implications for understanding the development of attentional control and the role of genetic factors in cognitive function.

**QUESTIONS & ANSWERS:**

- Will age have an impact on performance? Yes, older participants showed faster reaction times and higher accuracy.
- Will IQ affect performance? Yes, higher IQ was associated with faster reaction times and higher accuracy.
- Will sex influence performance? Yes, males performed faster and more accurately than females.
- Will PM allele influence performance? Yes, participants with the PM allele showed faster reaction times and higher accuracy.

**Acknowledgments:** This work was supported by the National Science Foundation (NSF) Grant 1510001.



SELASSIE MAWUKO

### Brain Extracellular Matrix Plasticity Following Peripheral Neuropathy

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**Introduction:** The extracellular matrix (ECM) plays a crucial role in brain plasticity and function. The ECM is a dynamic structure that actively regulates neuronal connectivity, synaptic plasticity, and cellular communication in the central nervous system. Recent research has highlighted the role of ECM in neurodegenerative diseases and various neurological conditions.

**Abstract:**

- Neuropathic pain alters ECM around hippocampal glial cells
- ECM remodeling changes in chronic pain
- Loss rigid ECM affects synaptic and cognitive function

**After nerve injury:**

- Mitochondria activate quickly, release inflammatory molecules
- Autophagy delay, mTORC1 long term, mTORC2 short term
- Autophagy changes, increased protein, altered signal
- Modifying ECM can reduce pain and memory loss
- Lowering ECM enzymes may alleviate pain, improve cognition

**AIM:** To investigate extracellular matrix (ECM) remodeling in the brain regions associated with chronic peripheral neuropathy using the open-source 3D model. This study will focus these parts of the brain: hippocampus, amygdala, and prefrontal cortex. We aim to:

- Quantify aggrecan expression and distribution around neurons in these regions
- Examine co-localization of aggrecan with neuronal markers
- Explore the temporal dynamics of ECM remodeling during neuropathy progression

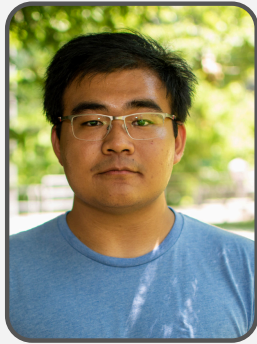
**Brain plasticity:**

- ECM remodeling facilitates structural changes in neural circuits
- ECM degradation can reopen windows of plasticity in the adult brain
- Changes in ECM composition affect learning and memory processes
- Altered ECM dynamics may contribute to maladaptive plasticity in chronic pain

**Methodology:** The hippocampal region, demonstrating aggrecan localization, will be used for the study. We will use immunohistochemistry (IHC) and confocal microscopy to visualize aggrecan and neuronal markers. We will also use 3D modeling to simulate the localization of these 2 targets. Statistics are counterchecked with the nuclear marker DAPI.

**Study Plan and Future Directions:**

- Hypotheses:
  - Examine aggrecan changes in CA1, CA3, and dentate gyrus
  - Correlate with memory deficits in chronic pain
- Analysis:
  - Analyze aggrecan distribution in hippocampal and dentate gyrus
  - Link to chronic and neuropathic pain
- Behavioral Correlates:
  - Assess aggrecan alterations in brain
  - Explore impact on object recognition memory
- Planned analyses:
  - Quantify aggrecan IHC intensity around neurons
  - Examine co-localization with synaptic markers
  - Correlate ECM changes with pain behavior
  - Test ECM-targeting interventions for pain relief



SWAN YI HTET

### Characterizing Crowdedness in TESS Images

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<sup>1</sup>Queens College Physics Department, <sup>2</sup>American Museum of Natural History

NASA's Transiting Exoplanet Survey Satellite (TESS) captures series of photometric images of nearby bright stars which enables studies of potential orbiting exoplanets & stellar variability.

**Issue:** With a large plate scale of 21 arcseconds per pixel, TESS photometry suffers from crowding issues, introducing contamination to the light curves.

**How accurate is the pipeline correction?** Random errors on the crowdedness estimate will cause systematic errors on signal amplitudes.

**Determining the precision of crowdedness corrections** applied by the TESS pipeline enables the propagation of this source of uncertainty to measured astrophysical parameters.

**Median Flux Model vs TESS TPF Data:** Comparison of our model of the flux distribution from the stars marked with red circles and the real TESS data (gray). Measure the fraction of light in the photometric aperture (red hatched region) coming from the target star gives the distribution of crowdedness values at right.

**TESS Catalog Value vs Measured Value:** Histogram showing the distribution of crowdedness values. Mean: 0.74453, Std: 0.00065.

**Demonstration for an example TESS image of TIC 65145453:**

- Catalog the TESS Target Pixel File (TPF) data, sky positions of nearby stars and their expected magnitudes from Gaia and the TESS Input Catalog.
- Using the TESS Pixel Response Function (PRF) models, we perform a Markov Chain Monte Carlo analysis with the `emcee` Python package, sampling distribution of flux vectors for all nearby stars.
- Calculate the crowdedness value in the photometric aperture for every image in the TPF.
- Compare the probability distribution of crowdedness to the value used by the TESS reduction pipeline to determine its precision.

**We incorporated in our analysis:**

- Uncertainty on the background flux
- Intrinsic variability of stars
- TESS photometric zero-point error

**Acknowledgments:**

- PRISM (prism.columbia.edu)
- GAIA (gaia.cosmos.esa.int/archive/stars)
- TESS (tess.gsfc.nasa.gov)
- emcee (emcee.readthedocs.io)
- TESS TPF (tessdata.nasa.gov/tess\_tpf)
- astropy (astropy.org)
- astroquery (astroquery.readthedocs.io)

**What's different about our approach?** We have applied this technique to many TESS TPFs to quantify the overall precision of the contamination corrections applied by the TESS pipeline.











**K. SHARON VEMU**

### The Association Between Sympathetic/Vagal Ratio and Internalizing and Atypical Behaviors in 5-Year-Olds

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#### INTRODUCTION

- The autonomic nervous system (ANS) regulates cardiac output via the parasympathetic vagus nerve, which is inhibitory. During stress, the "fight" or flight, allowing the sympathetic nervous system to take over and increase cardiac output.
- ANS dysregulation is characterized by sympathetic dominance and reduced parasympathetic activity during the resting state.
- The ANS also plays a role in emotion regulation and social affiliation in addition to stress responses, and its dysregulation has been linked to internalizing problems and atypical behaviors in children, adolescents, and adults.
- In this study, we aimed to investigate the association between sympathetic-parasympathetic balance using the sympathetic/vagal ratio and internalizing and atypical behaviors in 5-year-olds.

#### METHODOLOGY

- A subsample of the Stress in Pregnancy Study Cohort (n = 113, age = 5 years) participated in this wave of data collection.
- Resting-state sympathetic/vagal ratios were measured using the electrocardiogram, and the data were processed using the Ansohn/Emotion Data Acquisition and Analysis Software.
- Internalizing and atypical behaviors were measured using the Behavior Assessment System for Children, Second Edition (BASC-2).
- Correlation analyses were conducted to investigate the relationship between the sympathovagal ratio and internalizing and atypical behaviors.

#### RESULT

Sympathetic/Vagal Ratio at Rest and Internalizing Behaviors

A Pearson correlation revealed a weak, nonsignificant positive correlation between the sympathovagal ratio and internalizing behaviors,  $r(114) = 0.09$ ,  $p = .207$ .

Sympathetic/Vagal Ratio at Rest and Atypical Behaviors

A weak, nonsignificant positive correlation was found between the sympathovagal ratio and atypical behaviors,  $r(114) = 0.106$ ,  $p = .100$ .

#### DISCUSSION

- Our study did not find a significant association between sympathetic/vagal ratio and internalizing behavior or atypical behaviors.
- These results support previous research stating that reduction in vagal (parasympathetic) activity, leading to autonomic dysregulation, seems to develop between pre- and middle school years.
- Additionally, it is possible that the sympathovagal ratio may not be as strong an index of autonomic dysregulation as heart rate variability and vagal tone.
- This study calls for further research into the emergence of autonomic imbalance during child development.

#### ACKNOWLEDGEMENTS

Thank you to the families that have participated in this study and to the Stress in Pregnancy lab members.  
Funding: R21 Grant from the National Institute of Mental Health (PI Nomura)

#### REFERENCES



**KEVIN BEDOYA**

### Computational Modeling of Intracellular Transport

Kevin Bedoya, Department of Computer Science, Dr. Ong, Kagan, Department of Physics

#### Background

Cells transport cargo using two methods: (1) By diffusion, the cargo moves randomly (2) by carrying a motor protein that generates force. Diffusion is slow and inefficient, while motor-mediated transport is faster and more efficient. We model the transport of a cargo molecule using a stochastic process, and we compare the two methods.

#### Two-Dimensional Model

Diffusion:  $\frac{dx}{dt} = \sqrt{2D} \cdot \epsilon$

Motor-mediated:  $\frac{dx}{dt} = v + \sqrt{2D} \cdot \epsilon$

Where  $v$  is the motor velocity,  $D$  is the diffusion coefficient, and  $\epsilon$  is a Gaussian white noise.

#### Numerical Implementation

Monte Carlo simulation of the stochastic process. We use a time step  $\Delta t$  and update the position of the cargo molecule at each time step.

#### Results

The total distance traveled by the cargo molecule is significantly larger for the motor-mediated transport compared to diffusion.



**LARA ALTHAWADI**

### Understanding Striatal Circuitry Underlying Opioid-Seeking

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#### Introduction

- Opioid seeking relies on neural circuitry that involves direct and indirect pathways.
- Understanding the neural circuitry that underlies drug seeking is important for understanding addiction.
- We utilized optogenetic stimulation to activate and inactivate specific neurons in the striatum and measured their effects on drug seeking.
- Understanding these neural circuitry may aid in developing treatments for addiction.

#### Methods

Experiment 1: Optogenetic stimulation of D1-expressing neurons in the striatum.

Experiment 2: Optogenetic stimulation of D2-expressing neurons in the striatum.

#### Results

1. Stimulation of D1-expressing neurons in the striatum significantly increased drug seeking.

2. Stimulation of D2-expressing neurons in the striatum significantly decreased drug seeking.

#### Summary

- We examined the circuitry activated during morphine-induced reinstatement of conditioned place preference.
- Our findings indicate that both the direct (D1) and indirect (D2) pathways are engaged during reinstatement.
- We found that D1-expressing neurons underlie both reinstatement and relapse.
- We also found that D2-expressing neurons underlie relapse.
- This approach will allow us to examine specific neural activity with behavioral outcomes, moving beyond simple analysis to a more comprehensive understanding of these neural mechanisms in action.



**MANHA BULBUL**

### ISOLATION AND PURIFICATION OF BACTERIOPHAGES FOR BACTERIOIDES AND PSEUDOMONAS

#### ABSTRACT

Bacteriophages are a critical challenge in the treatment of bacterial infections. Bacteriophages are viruses that infect and kill bacteria. This study aims to isolate and purify bacteriophages from environmental samples and use them for the treatment of bacterial infections.

#### INTRODUCTION

Bacteriophages are viruses that infect and kill bacteria. They are the most abundant biological entities on Earth. Bacteriophages are used in the treatment of bacterial infections. This study aims to isolate and purify bacteriophages from environmental samples and use them for the treatment of bacterial infections.

#### METHODOLOGY

1. Collection and Filtration of Hospital Wastewater: Wastewater was collected from a hospital and filtered through a 0.22 µm filter to remove bacteria.

2. Enrichment of the Bacteriophage Culture: 1 ml of the filtered wastewater was added to each culture flask.

3. Plating the Phage: The culture was inoculated to allow for phages to grow and then spread and lyse through a 0.22 µm filter.

4. Purification Process: The lysate was centrifuged to remove debris and resuspended in a clean phage buffer.

5. Plating the Phage: The phage was inoculated to allow for phages to grow and then spread and lyse through a 0.22 µm filter.

#### RESULTS

#### CONCLUSION

This study successfully isolated and purified bacteriophages from hospital wastewater. The phages were able to infect and lyse both Bacteroides and Pseudomonas bacteria.

#### ACKNOWLEDGEMENTS

Dennehy Lab

