NEW YORK CITY COLLEGE OF TECHNOLOGY

CITY TECH

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A Geospatial Analysis of the Intersection of Livability and Sustainability in NYC
Arianna DiLillo, Sonya Weinstock
Prof. Anne Leonhardt

The study aims to bring awareness and a greater understanding of the intersections and differences between the concepts of Livability and Sustainability in New York City. Delving into this topic is crucial to assist future city planning and development to maintain the city's longevity and quality of life for its residents. Following the Economist Intelligence Unit (EIU) Index's definitions, Livability refers to the quality of life and long-term wellbeing of communities and individuals, whereas the Environmental Protection Agency (EPA) defines Sustainability as defined as the balance between equity, environment, and economy. Initially we diagrammed the different categories and aspects of Livability and Sustainability to study the overlaps, discrepancies, and connections between the various parameters. Through this visualization, we were able to pinpoint the focal ideas that apply to both Livability and Sustainability. We then began to focus on creating descriptive maps that help represent our areas of research in Staten Island and Brooklyn allowing us to have a better understanding of the comparison of Livability and Sustainability in these areas. We intend to further our research at a more micro level of the neighborhoods of Clove Lakes, Staten Island and Downtown Brooklyn. Documenting and studying the way these factors coincide within specific boroughs and neighborhoods will help with creating and maintaining a city that hosts a more sustainable and livable future for its citizens.

Rebuilding John Hurt's Legacy: Historic Preservation in the Deep South
Natalie Simons
Prof. Shelly Smith

The Mississippi John Hurt Museum was a modest three-room shack with a tin roof, located in Avalon, Mississippi—a historically all-Black town on the eastern edge of the Delta. This 200-year-old structure served as Hurt's childhood home, where he lived for most of his life. It housed memorabilia belonging to Hurt, as well as items donated by locals who knew him personally. Tragically, the museum was destroyed by fire in February 2024, the very same day it was allegedly added to the National Historic Registry. Should the museum be rebuilt in its original form, or are there more effective ways to honor Hurt's legacy? Furthermore, how might the museum's relative lack of national prominence influence efforts to restore it? This project aims to explore various strategies for rebuilding the museum by examining successful preservation models from other historic sites. Through comprehensive analysis, community engagement, and careful consideration of historical context, we will propose actionable

recommendations for revitalizing the museum and strengthening its connection to the local community.

Can Graphic Design Help Improve Overall Communication?
Ze Huang, Michael Lester
Prof. Maureen Neuringer

Understanding how to visually communicate concepts or information is a powerful asset to have when in a professional field. Knowing this brings into question whether or not learning how to visually communicate can improve a person's overall ability to present concepts or information clearly and effectively.This study aims to evaluate whether improving individuals' skills in visual communication can enhance their effectiveness in other forms of communication, such as speaking. The hypothesis is that a focus on presenting key ideas clearly and providing supportive context in visual formats may translate into improved clarity and organization in verbal expression. We started off by observing how they would give lectures and speeches prior to getting together with them and presenting concepts that would elevate their ability to communicate visually. From there we observed them giving lectures and speeches and evaluated them on how well they relayed information to their audience. From this research, we hope to learn if the effects of learning how to visually communicate information better could also directly improve communication overall in areas such as daily speech, teaching, effective communication in relationships, etc. By understanding how to dissect elaborate topics into coherent segments through visual aid, it could help those in professions who need to relay difficult to understand topics to keep in mind the importance of making sure their audience fully understands them.

3D-Printed Assistive Devices for Arthritis: Enhancing Independence with Affordable, Customizable Solutions
Melissa Fernandes, Jasmine Tran
Prof. Farrukh Zia

In order to help people with arthritis and similar disabilities carry out daily duties more easily and independently, this project focuses on developing inexpensive, 3D-printed assistive devices. Since arthritis frequently results in joint discomfort, stiffness, and decreased mobility, it is imperative to have accessible, adaptable instruments and devices. Conventional assistive technology is frequently expensive and might not be customized to meet the unique requirements of every patient. This project will use 3D printing technology to design and prototype ergonomic aids that address these issues,

including mobility aids, adaptive handles, and specialized tools. Some devices may require the use of electrical circuits for their operation. 3D modeling and Computer Aided Design (CAD) tools will be utilized for physical and electrical design and testing. To make sure the gadgets are useful, long-lasting, and simple to use, the iterative design approach will incorporate user feedback, prototyping, testing, and troubleshooting. A functional prototype demonstration, comprehensive technical documentation on the design, 3D printing procedure, and electrical circuit implementation, as well as an oral presentation outlining the project's potential to increase accessibility for arthritis patients, will all be included in the final deliverables.

Adaptive Multi-Agent Learning in Open Environments: Overcoming Challenges of Agent Attrition with Meta-Learning and Dynamic Reallocation

Derrick Keith, Parviz Subkhankulov, Ostap Tymchenko
Prof. Changkyu Kim

This research focuses on the challenge of multi-agent learning in open environments where agents work collaboratively towards a common goal yet may unexpectedly disappear. The absence of agents introduces significant non-stationarity, altering the dynamics of interaction and complicating the learning process. To address this issue, we propose a novel adaptive algorithm that enables remaining agents to effectively recalibrate their strategies in response to changes in team composition. Our approach leverages both meta-learning techniques and dynamic reallocation strategies, allowing agents to maintain alignment with the shared objective despite the challenges posed by agent attrition. Through extensive simulations in a custom-designed open environment, we demonstrate that our adaptive algorithm significantly enhances performance compared to static approaches, ensuring that teams can continue to strive towards their common goal even in the face of uncertainty. These findings underscore the importance of developing resilient multi-agent systems capable of sustaining collaborative efforts in dynamic settings, paving the way for more effective artificial intelligence applications.

Study and Analysis of the Design of a Robot Manipulator
Kimberly McLaurin
Prof. Farrukh Zia

This project focuses on designing a small-scale robotic manipulator (robot arm) prototype to provide hands-on experience with the mechanisms and movements fundamental to industrial robotics technology. Robotic arms are essential in fields such as warehouse management, factory automation, and manufacturing, due to their ability to perform precise, repetitive tasks. By building and testing this educational prototype, students gain insight into the practical application of industrial automation. Similar projects, such as the “Arduino Robotic Arm,” have demonstrated cost-effective models that mimic industrial robotic system movements. Our project builds on afore-mentioned foundations, integrating mechanical design with electrical circuits and coding to enhance understanding of robotic systems. The methodology combines hardware and software components, including gears, joints, sensors, actuators, and microcontrollers, to create a fully functional manipulator capable of real-world tasks like sorting and positioning objects. Testing will evaluate accuracy and consistency, ensuring components work in coordination to achieve desired motions. The final deliverables include a working prototype, detailed technical documentation, and a presentation, equipping students with foundational knowledge in robotic mechanisms and their industrial applications.

Transforming Computer Technology into Green Technology
Ruth Orlanne Gaboton
Prof. Farrukh Zia

Each year, many older end-of-life computer hardware devices are discarded as e-waste, which ultimately end up in landfills and add to hazardous pollution in the environment. In this research project, Electrical circuits, Computer hardware and Software, Math and Physics knowledge and skills learned in respective courses are used to combine discarded hardware components into useful working devices that decrease waste and e-waste and improve our environment. Recycling older computer technology can create a wide variety of helpful computer devices. Coming to these terms will help with the excellent development of technology in terms of human's best interests, from health to cost-effectiveness. These processes will be documented and presented with the help of oral and written communication.

Antivirus systems: Functionality and User Awareness
India Barker
Prof. Ossama Elhadary

As digital threats continue to evolve, understanding how antivirus software functions is vital for enhancing cybersecurity. This research examines user awareness of antivirus products and the methods they employ to detect malware. With cybersecurity becoming an increasingly critical concern, assessing users' comprehension of these tools is essential for improving the prevention of cyberattacks. The primary research question is: *How aware are users of the different virus detection methods used by antivirus software, and how effectively are they utilizing these tools?* Our study reviewed popular antivirus products, analyzing their detection techniques and overall effectiveness. We found that while antivirus software commonly employs signature-based, heuristic, and behavior-based scanning methods, many users lack a full understanding of these approaches and the features offered by these tools. Furthermore, gaps in the protective capabilities of certain antivirus products were identified. These findings highlight the need for enhanced educational initiatives to improve user knowledge and engagement with cybersecurity tools. Future research should explore strategies to increase user understanding and promote more effective utilization of antivirus software, ultimately strengthening digital security.

Building an R Library of Financial Functions
Manahill Arshad
Prof. Ossama Elhadary

This research centers on developing a specialized R library to simplify and enhance financial modeling tasks. The project aims to provide a user-friendly toolset that can be easily customized to support key financial functions, ultimately aiming to improve decision-making, risk management, and collaboration within the financial industry. The initial phase of this project is focused on creating a financial function for calculating idiosyncratic volatility which is a key metric used to assess the risk associated with individual assets. This function serves as the first building block in the R library, which is designed to simplify complex financial calculations, allowing professionals to derive critical insights more quickly. To evaluate the effectiveness of the R library, I compared its results against traditional tools like Excel and well-known financial software programs. The comparisons were conducted on tasks such as portfolio optimization and forecasting, with a particular emphasis on advanced models like Monte Carlo simulations and time series forecasting. Feedback was gathered from financial professionals to assess both the functionality and user-friendliness of the tool. The research findings indicate that the R library significantly improved efficiency, reducing

the time required for complex tasks and delivering more consistent results. The idiosyncratic volatility function, for example, was able to generate more accurate estimates compared to Excel-based models, while also offering greater flexibility and customization options. The library's capacity to handle large datasets and integrate advanced financial models also proved valuable in supporting more informed financial decision-making. Moving forward, additional functions will be developed and integrated into the library, further expanding its capabilities. The ultimate aim is to create a comprehensive toolset that bridges the gap between theoretical financial models and real-world applications, empowering financial professionals to make faster, more accurate decisions in an increasingly data-driven environment.

Evaluate Leading CyberSecurity Solutions

Carl-Handy Abraham
Prof. Ossama Elhadary

This research looks at different cybersecurity solutions, focusing on three main areas: Cloud Security, Identity and Access Management (IAM), and Threat Detection and Response. Our goal is to find the top vendors and their solutions by evaluating them based on five important criteria: how well they integrate with existing systems, their ability to grow with an organization, their compliance and reporting features, user-friendliness, and how effectively they detect and respond to threats. Integrating with current tools is key, as it allows these solutions to work smoothly with services like cloud storage, security monitoring, and managing user access. We also assess how scalable each solution is, meaning its ability to expand as an organization grows while still performing well, which is essential for managing users and keeping data secure. In addition, having strong compliance and reporting features is vital for meeting regulations like GDPR and HIPAA, helping companies keep clear audit trails and transparency in their security practices. User experience matters too; a system that is easy to navigate reduces training time and improves accuracy in handling security tasks. Finally, we analyze how well each solution can detect and respond to threats, such as unauthorized access or unusual activities, in real-time. By combining hands-on testing and interviews with industry professionals, this study aims to offer practical insights to help organizations choose the cybersecurity solutions that best fit their needs and security challenges.

Exploring the Idiosyncratic Volatility Puzzle

ZiHan Cao, Hasib Mahmood, and Benny Wu
Prof. Ossama Elhadary

Idiosyncratic Volatility (IVOL) is the unique risk of an individual stock ignoring market movements, which is crucial for risk management within a portfolio. The Idiosyncratic Puzzle is a phenomenon where stocks with high IVOL on average earn low future average returns. We analyze this problem with the Fama-French three factor model to estimate IVOL, testing to see if we can find and explain this phenomenon. Stock data was merged with Fama-French factor data which we used to calculate daily returns, which we then used to calculate residuals. We applied rolling thirty-day windows to compute variance which finally is used to find IVOL. The Idiosyncratic Puzzle was then confirmed to exist.

Green Roof Feasibility Study for Pre-War Buildings in NYC

Yoselin Sarita Sandoval
Prof. Ivan L. Guzman Pena

Neighborhoods such as Sunset Park and Flushing can stand to benefit from green roofs by providing conditioning of atmospheric temperature and oxygen to reduce heat vulnerabilities, increase presence of beneficial insects, stormwater management, visual aesthetics, contribute to LEED accreditations, and increase in property values. The current distribution of green roofs across New York City has a significant amount of unused or under utilized building roof real estate inventory. This represents a significant opportunity to improve many aspects of the urban atmosphere, including social, financial, and environmental prospects, by retrofitting these roofs with green roof gardens. During the first part of this study the amount of existing roof square footage (or # buildings) in NYC was established, along with the amount that currently house a green roof, and the ones that have the potential of housing a green roof with minimal structural changes to the building. With over 1.6 billion square feet of roofing attributed by 1,0378,464 buildings, only 736 buildings are equipped with a green roof system. Of these, 610,133 buildings are pre-war buildings, built in excess structural capacity,and the potential to accommodate a new green roof system. Pre-war buildings are attractive to the green roof industry because of the extra structural capacity which eliminates the need of costly structural enhancements to support the additional 13 to 50 psfs of loading associated with green roofs. The conclusions of this part of the study can be used to lobby government and private sector shareholders to promote and fund green roof projects in NYC. Shareholders and decision makers can target environmentally and financially susceptible neighborhoods across NYC as points of interest. By strategically expanding green roof coverage in these neighborhoods, New York City can foster resilience while enhancing the quality of life for residents.

Pandemic to Present Ozone Analysis Comparison: LiDAR's Role in Urban Air Quality Monitoring

Julissa Mendez
Prof. Viviana Vladutescu

Ozone concentrations in the atmosphere have raised public awareness of their impact on both health and the environment. The Differential Absorption Lidar (DIAL) system is situated at 40.821° N latitude and 73.949° W longitude at The Grove School of Engineering on the City College of New York (CCNY) campus. This system measures ozone levels at various altitudes above the location of our DIAL system. Comparing the received LiDAR signals at the two wavelengths on-band (289 nm) and off-band (299 nm), the ozone concentration is settled to extrapolate the ozone mixing ratio by separating the lidar returns at the two wavelengths. Our analysis indicates that ozone during the COVID-19 pandemic was reduced, resulting in notable changes in atmospheric composition. Our LiDAR measurements reveal that ozone levels experienced a marked decrease during the pandemic's peak due to reduced emissions of ozone precursors. We observed a slight increase in ozone concentrations post-pandemic by examining the ozone density, which had more molecules per centimeter cubed between 1 and 1.5, compared to during COVID-19, which had fewer molecules/cm3 between 0.5 and 1. This study emphasizes the critical need for continuous ozone monitoring, validating findings with additional datasets, and conducting sensitivity analyses to comprehend the variables affecting ozone concentrations. Additionally, the research underscores the importance of integrated observational and modeling approaches in tracking ozone levels, thereby contributing to a better comprehensive learning of atmospheric dynamics and their implications.

Understanding of the Impact of Climate Change on Building Energy Consumption

Ferasuddin Siddiqui, Abdellah Gessra, Rashiek Barber, Christopher Sanchez and Takoda Nestor
Prof. Daeho Kang

Human activity and greenhouse gasses emissions have reached a record high causing global temperature to rise. Buildings are the primary contributors to climate change along with being primarily affected by climate change. To address these issues, significant efforts are needed to improve building energy efficiency, which in turn reduces climate change. This study focuses on the impact of climate change on buildings. By comparing the impact of climate change on buildings in different regions climate change can be better understood. Heat degree days and cooling degree days in different areas were measured to see how climate change impacts buildings' energy

demands. The findings reveal that the rise of global warming increases the demand of the HVAC systems. The growing demand leads to a decrease in efficiency and higher operating cost, worsening climate change and its effects. This research will help with the development of different strategies to reduce energy consumption. Future research is required where a bigger database can be used to improve accuracy.

Enhancing Middle School Computational Thinking through Mathematical Manipulatives: Exploring Unplugged Activities Aligned with K-12 Standards

Alyssa Johnson
Prof. Nadia Kennedy

The New York State Education Department's (NYSED) Computer Science and Digital Fluency Learning Standards (CSDF) for K-12 aim at introducing school students to computational thinking, empower them with computer science skills and ensure they are prepared for college, careers, and life in the 21st century. Computational thinking is an essential skill for today's workforce, as many employers seek candidates who can break down complex problems into smaller, manageable tasks, and create step-by-step solutions. The goal of this project is to explore and identify mathematical tools that can be used to introduce students to computational thinking, while enhancing their mathematical learning. The emphasis is on remixing and modifying existing tools or developing new ones. The project aligns with the NYS Education Department's Computer Science and Digital Literacy Standards for K-12, focusing on designing unplugged activities that introduce middle school students to computational thinking. These activities address key computational thinking dimensions, including modeling and simulation, data analysis and visualization, abstract and decomposition, and algorithms and programming. The activities are designed to help middle school students become familiar with computational thinking. Additionally, the activities will support teacher candidates in becoming familiar with the Computer Science and Digital Fluency standards while also learning unique ways to teach students computational thinking using non-digital tools.

Heat Monitoring in the New York City Subway System
Isatu Jalloh and Shaquan Larose
Prof. Abdou Bah

New York City (NYC) faces great challenges due to the rapidly changing climate. Many facilities including underground transportation infrastructure will be severely impacted from climate change effects, particularly from more frequent heat waves. The increased temperature in the New York City subway system during periods of heat waves could impact the health and safety not only of commuters, but also of the subway system's personnel and infrastructure. However, the severity of the temperature impacts is not well known. For this reason, this study thoroughly investigates temperature impacts and implications within the subway system. Temperature and relative humidity data were collected using sensors and thermal infrared cameras in several underground stations across NYC in the Bronx, Brooklyn, Manhattan and Queens. The findings will highlight critical areas where heat management is most needed, suggesting targeted interventions to mitigate heat buildup.

Illuminating the Connection Between Galaxy Morphology and Evolution with the Legacy Survey Of Space and Time
Samiya Shamsur
Prof. Charlotte Olsen

Galaxy morphology is the study of the structure and form of galaxies, including their shapes, sizes, and features like spiral arms, central bulges, or discs. Galaxies can be classified into various types such as spiral, elliptical, and irregular. The impressive diversity of morphological types in galaxies has long been an area of investigation, and while we have an improved understanding of what factors contribute to a galaxy's appearance, our understanding is far from complete This research aims to highlight the connection between galaxy morphology and evolution, with a focus on how environmental factors have influenced the structural characteristics of galaxies. Utilizing data from the Vera C. Rubin Observatory's Legacy Survey of Space and Time (LSST), this work involves analyzing state of the art stimulated image data that accurately represents what we expect to see when the telescope begins taking observations in 2025. With an initial galaxy sample we start by classifying galaxies by eye. We then use positions and calculated distances to look for trends between galaxy location and morphology. This methodology allows us to uncover the correlations between the galaxy morphologies and their surrounding environments (i.e. groups, clusters, filaments, and voids,etc). We anticipate our findings will provide deeper

insights into the important question of what external environmental processes drive galaxy evolution.

Parameters for Entanglement between various Qubits for Quantum Computers

Alyssa Burtsev, Melissa Demollari, Elizabeth Frias, Houke Gao, Stefanie Rivera
Prof. Oleg Berman

To make a quantum computer system, one must understand the core components of qubits, their variations, and how the entanglement of certain qubits can lead to the fast processing of complex problems. Quantum bits can occupy multiple states, 0 and 1, simultaneously. This superposition is too complicated for classic computers, which are only capable of using bits either 0 or 1, at a given time. The ability for quantum computers to do this will accelerate processing times, revolutionize technology, and bring advancements in fields such as logistics, finance and manufacturing. Since many security systems rely on factoring numbers, quantum computers could potentially breach security systems. On the contrary, it will have the ability to create its own quantum encryption becoming virtually unbreakable, using qubits, the fundamental unit of quantum information. Through researching the different types of qubits from past research, we determined what advantages and disadvantages these qubits have. Our findings were that although superconducting qubits were easy to make using already existing circuit technology, they were only able to interact with qubits around them, four maximum, and only at the very low temperature of 0.1K. Trapped atomic and ion qubits create a high quantum entanglement to work with all qubits in the system at temperatures up to 4K but very slowly. Photonic qubits work at room temperature with a high quantum entanglement, but they require matter-based components like beam-splitters and detectors to blend light with matter, which technology is currently unable to produce. To continue our research, we can research more qubits to better understand their uses.

A Deep Dive of the Standard Model of Particle Physics

Christopher Osorio
Prof. Andrea Ferroglia

The Standard Model of particle physics serves as the foundational theory describing the fundamental forces and particles that constitute the universe. This framework explains how particles interact through the electromagnetic, weak, and strong forces, excluding gravity. The purpose of this project is to provide an educational overview of the Standard Model, examining the core particles such as: quarks, leptons, and gauge bosons and their interactions as controlled by symmetries and conservation laws. By studying this model, I aim to present its predictions and limitations, particularly highlighting elementary particles and the mediators of forces within the model while also acknowledging the limitations of the extent of our model (ie. Gravitons, Dark Matter, Dark Energy). This research includes an analysis of the Standard Model's theoretical structure and a visual presentation to make its complex components accessible. My findings emphasize the Standard Model's success in predicting particle interactions while acknowledging its gaps, thus highlighting the need for future developments in particle physics.

Redistribution and Localization of Biometals in Apples Using X-Ray and MRI

Jasper Cheung, Achlyn Genao, Somdat Kissoon, and Natalya Tomskikh
Profs. Subhendra Sarkar, Evans Lespinasse, Zoya Vinokur, Eric Lobel, Mary Alice Browne

This project tested the bulk dynamics of endogenous biometals including potassium, calcium, and iron due to localized mechanical trauma in fruits. The hypothesis was to test the role of bulk porous structures and redistribution of such minerals to maintain homeostasis. We also used computed tomography (CT) and magnetic resonance imaging (MRI) to better visualize the interior anatomy and endogenous mineral movement prior to and after applying deep cuts from cortex to core in various apple varieties representing fresh or old carbohydrate tissue models. The soft x-ray imaging was done using a Hologic mammography system at 20-38 kVp after suitable filtration. For CT, multislice Siemens scanner and for MRI, Siemens 3T magnets were used. The apples were mechanically damaged with a shearing cut at locations identified as being iron-poor. That created a local injury to the apple causing a global response. As apples lack blood vessels, it is expected that there is a mineral flow in the form of macromolecule redistribution carrying the metals within. The mammographic images (soft x-rays) taken 3 minutes and 5 days post mechanical cuts showed biometals immediately moving towards the site of the mechanical cuts. MR images most likely indicate, 2 kinds of iron in apples: the first one loses signal more quickly suggestive of metal particulates or deposits, while the edges near the cuts retained brighter signal

presumably due to dissolved iron in the native fluid within the pores near the mechanical cuts. To avoid volume averaging but using the basic x-ray absorption, computed tomography (CT) scans of mechanical cuts in apples were done that supported acute accumulation of minerals and perhaps reorganization of pores near mechanical cuts confirming the results from MRI and Mammography.

Secondary X-ray Generation by Composite Filters
Somdat Kissoon, Jasper Cheung, Daler Djuraev, Achlyn Genao
Profs. Subhendra Sarkar, Evans Lespinasse, Eric Lobel

Scatter radiation is generated when incoming photons interact with loosely bound electrons in a sample. Many of the interactions with matter produce a large number of these secondary electrons with no known utility. Scatter is generally thought to be detrimental to the generated image by creating unnecessary noise and generating unwanted additional radiation in the patient. Our experiments explore ways to benefit from these harmful Compton scattering. We generate weak photon streams from higher energy incident photons by thin cellulose or organic filters and a second composite layer of crystalline salts or salt solutions embedded in porous matrix that provide surface charges at grain boundaries and pore surfaces mainly from surface seeking electron-rich halide ions. Alkali halides in porous matrix offer many nanomaterial advantages including generation of secondary or Auger electrons and phonon assisted various photon harmonic generation within the salt lattice structures depending on composite crystallinity. These new photon streams with their weak harmonic x-rays exit the composite filters with variable flux density in select directions similar to the laser beam amplification as standing waves in laser cavities and may be useful for low-dose photon therapy of superficial tumors.

Traumatic Brain injury Modeling by Chemical Mass Transfer
Vanessa Robinson, Xionhui Wu, Jakiya Akter, and Kyuhyung Chae
Profs. Mary Alice Browne, Subhendra Sarkar, and Faisal Khosa

Traumatic brain injury (TBI) is a structural and physiological disruption of brain function caused by a forceful blow or an impactful external force. TBI is sustained in two phases, with a primary injury resulting in the stretching of white and gray matter axons and a secondary injury responsible for endoplasmic reticular stress, mitochondrial dysfunction, and the buildup of reactive oxygen species. The secondary injury not only causes the neurological dysfunction of the brain but also alters the flow of cerebrospinal fluid (CSF), breakdown of the blood-brain barrier (BBB), and temporarily affects the sleep, wake, and circadian circuit of the brain. The rapid

stretching of the axons causes irregulation of sodium (Na+) and potassium (K+) ion concentration outside and within the axons, which in turn causes the increased concentration of calcium (Ca2+) within the axons. The combination of the destruction of the brain tissue, the collapse of the blood-brain barrier, and the regional neuroinflammation leads to an increase of iron (Fe2+) from the blood into the brain parenchyma. Iron overload and ferroptosis, which is a form of regulatory cell growth is highly involved in the pathophysiological process of secondary brain injury. Both the increase of calcium and iron can lead to cell death within the brain.

Foveal Fixations on a Vanitas Image

Tamara Tugulashvilli
Profs. Daniel Capruso & Howard Sisco

When viewing a complex scene, the brain guides the eye to make a series of foveal fixations on scene elements at a rate of 3-5x/second, with each fixation ending with a saccadic eye movement to the next area of interest. This experiment sought to determine which elements of a complex scene were of greatest visual interest. Subjects (n = 41) received a 10s exposure to a Flemish Vanitas image containing reminders of mortality such as a skull, flowers, burning candle, hourglass, sundial, and an open book written in Dutch. Foveal fixations were recorded with a Tobii T-60 eye tracker with a temporal resolution of 60 Hz and a typical gaze position accuracy of 0.5° of visual angle. A repeated measures ANOVA indicated that there were significant differences in the visual attention allocated to the objects in the image, $F(1, 40) = 7.88$, $p < .01$. Contrary to prediction, the longest gaze durations were for the Dutch writing in an open book (M = 1.23s, SD = 0.86s) and in an inscription (M = 1.23s, SD = 1.25s), whereas more salient objects such as a skull (M = 0.69s, SD = 0.76s) and flowers (M = 0.74s, SD = 0.44s) had shorter gaze durations. The findings indicate that when presented with a complex image, substantial visual attention will be allocated to foreign language script contained therein. In contrast, visual object recognition is a more rapid process and requires substantially shorter gaze duration.