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So, as you embark on your research journey, hold on to your passion, question everything, and never stop exploring. The world awaits your discoveries, and your work has the power to make a difference.

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"Featured Article of the Current Volume"

Seeing Through the Scan: The Impact of fMRI Evidence on Juror Satisfaction and Verdicts

Isabella Souza
Columbia University

ABSTRACT

The areas of the brain that become active when formulating a lie, or "deceit patterns", are denoted on fMRI scans, yielding results that are more accurate than the polygraph. Using publicly available court records and fMRI results obtained from previous literature, the extent to which fMRI scan evidence influences juror confidence, perceived strength of argument, and verdict counts between participants serving as mock jurors in a mock trial exposed to fMRI scan evidence and those not exposed to it were compared. Analysis of these metrics revealed that a mock juror's exposure to fMRI evidence increases their perceived strength of the argument for the side consistent with their verdict and drastically changes the distribution of guilty versus not guilty verdicts. The difference in confidence levels between mock jurors in the control and experimental groups was not found to be statistically significant, however future research using a larger sample size may verify the current trend that viewing fMRI evidence increases juror confidence in their verdict. Although fMRI evidence possesses the potential to revolutionize the way juries lend weight to pieces of evidence, because it was found to cause such significant shifts in juror decision making, court judges should caution its admission into evidence or further scrutinize its credibility during evidentiary suppression hearings until it is deemed generally acceptable by the scientific community.

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Computational Biology & Bioinformatics/ Evaluation of Brain Structure and Function in Currently Depressed Adults with a History of Early Life Stress

Joshua Jones
University of Rochester

ABSTRACT

Early life stress (ELS) is often a precedent of major depressive disorder (MDD). Critical regions in this connection include the dorsolateral prefrontal cortex (DLPFC), anterior cingulate cortex (ACC), hippocampus (HIP), and amygdala (AMY). Previous studies demonstrate structural differences exist in these regions exposed to ELS. These regions are also implicated in MDD pathophysiology, however, most biological findings in MDD do not account for ELS. Structural findings demonstrate that ELS can reduce volumes in certain regions when MDD is present, however, the functional aspect has yet to be considered. To address this question, in this study, 86 currently depressed participants were subjected to a Childhood Trauma Questionnaire (CTQ) and completed a multimodal neuroimaging study. From these images, structure (volume or cortical thickness) and function (metabolism) were calculated. I hypothesized that MDD patients with history of ELS, compared to those without ELS, will exhibit a reduced volume/thickness and metabolism in the DPLFC, ACC, HIP, and AMY. The results demonstrate that metabolism and cortical thickness of the DLPFC were significantly different across childhood trauma levels, as was metabolism of the ACC. Volume of HIP and AMY were significantly inversely correlated with total CTQ score. Additionally, a significant correlation between DLPFC thickness and metabolism (p=.006) was found. This study successfully provided a comprehensive examination of the relationship between neurobiology and ELS within MDD.

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Investigating uveal melanoma using a Seurat scRNA-seq analysis of SEAM organoid gene clusters

Ethan Chiu
Yale University

ABSTRACT

Uveal Melanoma (UM) is the most common eye cancer with a mortality rate of 80%. However, only 1% of patients have detectable UM at metastasis and UM exhibits punctuated early growth. The origin and proliferation of UM was investigated using single-cell RNA sequencing analysis as it is currently the best method to define cell states and phenotypes. The Seurat R toolkit was used to separate the cells of a self-formed ectodermal autonomous multi-zone (SEAM) organoid and UM cells into gene clusters. These gene clusters were then identified using canonical gene markers and compared in samples with and without UM. In this way, the origin of UM was attributed to certain genetic clusters and targeted for future treatments. Distinct cell clusters with unique gene expression patterns were found in the UM datasets, which provided insight into the mechanisms underlying UM progression and facilitated comparisons between the control SEAM organoid and the experimental UM gene datasets. Moreover, the potential of the SEAM organoid model in modeling UM metastasis was verified. In the future, both in vitro and in vivo experiments will be performed to confirm the results of the scRNA-seq analysis. Additionally, RNA interference with lentivirus therapy will be tested using the SEAM organoid model to determine whether it effectively minimizes the UM phenotype.

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The Effect of Cetirizine and Loratadine on the Photosynthetic Process of Chlorophyta

Melissa Louis, Chloë Allen-Jackson and Zoe Henderson

ABSTRACT

Pharmaceuticals are very important due to their role in helping humans in many ways. People tend to flush these pharmaceuticals once they expire. Once flushed, it ends up in water ecosystems, which affects both the water and the different organisms that inhabit those environments. One organism that pharmaceuticals can affect is Chlorophyta, or better known as Green algae. Cetirizine and Loratadine, or more commonly referred to as Zyrtec and Claritin, are medicines used for allergy purposes that will be used for this study. In this research study, numerous items were used. These items consisted of the Chlorophyta plant, the two pharmaceuticals (in serum form), a hood fume, pipettes, graduated cylinders, a beaker, test tubes, 1 1000mL wheaton bottle, 5 125mL wheaton bottles, water, and 5 250mL erlenmeyer flasks. Concentrations (10%, 1%, .1%, .01%, 0%) of the pharmaceuticals were made by measuring 90mL of water and 10mL of each pharmaceutical. The Zyrtec concentrations were poured into 125mL wheaton bottles, while the Claritin concentrations were poured into 250 ml erlenmeyer flasks. 5mL of Chlorophyta was then pipetted into 45 test tubes to later have the concentration percents pipetted into them. Data was collected by using a spectrophotometer daily. As a result, it is unclear whether the hypothesis was supported or not. For future research, it is recommended to use different pharmaceuticals, try a different type of algae, see what specific ingredients cause the medicine to affect the algae, etc.

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Emergence of Savvy Elite Roman Women from the Second Punic War into the Early Roman Empire

Kelly (Yeonwoo) Sung

ABSTRACT

This historical study analyzes the evolution of influential roles played by elite Roman women from the Second Punic War to the Early Roman Empire. The paper begins with a comprehensive examination of the societal expectations imposed on these women, emphasizing virtues such as chastity and the importance of upholding their respective family's reputation. Aside from the exceptional circumstances of Vestal Virgins who were held to special standards and privileges, most women were subject to strict control by their paterfamilias and guardians while also abiding by the limited succession rights imposed on them during the early years of the Republic. Under this backdrop, the focus of the paper centers around the impact of the Second Punic War on women's influence, noting how economic empowerment and increased autonomy for some elite women stemmed from their accumulated wealth acquired through inheritances from deceased fathers and husbands. This section highlights legislative measures, such as lex Oppia and lex Voconia, which aimed to restrict women's wealth and influence. While the scope of the paper may seem narrow by analyzing a specific period within the broad history of ancient Rome, the nuanced importance of the dynamic and evolving roles of elite Roman women during the transition from the Second Punic War to the Early Roman Empire is most evident.

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Detecting Meteorites from Outside the Ecliptic Plane with Multi-Messenger Astronomy

Katie Sie

ABSTRACT

Treatment refraction is a hallmark of small cell lung cancer (SCLC), occurring in almost 80% of patients after initial response to current treatment modalities. The aggressive nature of this cancer and 5-year survival rate of less than 5% in patients necessitates further research to understand resistive mechanisms, identify biomarkers, and mitigate poor prognosis. Single cell RNA sequencing datasets of untreated and DNA damage repair inhibitor (DDRi) treated samples were obtained through the Gene Expression Omnibus. Gene set enrichment analysis (GSEA) was performed to identify upregulated pathways, elucidating resistive mechanisms present in treated, relapsed samples. Prominent genes in the leading edge subset of GSEA were visualized in RStudio and analyzed in GEPIA2 for their impact on survival. Reactive oxygen species (ROS) pathway and TGF Beta Signaling pathway were two upregulated gene sets shared by both treatment types. Shared leading edge subset genes of the ROS pathway included TXN, TXNRD1, NDUFB4, and LAMTOR5, which allow cancerous cells to evade apoptosis and promote cell proliferation. Shared leading edge subset genes of the TGF Beta Signaling pathway included HDAC1, CTNNB1, and SLC20A1, which promote epithelial mesenchymal transitions, suppressed immune response, and increased tumor growth. This study identifies novel genes that play a role in the development of treatment refraction in SCLC, and further experimentation may validate their potential as therapeutic targets to resensitize tumors.

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“Virginia Slims” Redux: Revisiting the Construct of Subjective Value Placed On Feminine-Advertised Products

Julia Revill

ABSTRACT

Gender-based price discrimination, or “The Pink Tax,” is an economic bias that sees one gender charged a different price for the same goods or services. This “tax” is commonly levied on feminine-marketed products. Thus, “female” goods targeting are comparatively more expensive than those marketed to males. Previous research has confirmed the presence of gender-based price discrimination; this study expands this work by examining whether girls’ knowledge of these price disparities differs by high school type (single-sex or coeducational). Additionally, it evaluates the extent to which internalized sexism and/or relative masculinity vs. femininity contribute to adolescent girls’ knowledge. 147 participants chose between a series of binary product choices (masculine-advertised or feminine-advertised). They also completed 1) The Traditional Masculinity-Femininity (TMF) scale and 2) a self-designed Internalized Sexism Scale. These instruments evaluated subjects’ attitudes towards masculinity/femininity and gender roles. Additionally, participants were asked to define gender-based price discrimination in a free-response question. Both quantitative and qualitative coding and statistical analyses were undertaken.

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The Effects of Sublethal Doses of Hexavalent Chromium on the Health Eisenia fetida

Kamar Birthwright

ABSTRACT

In this experiment working with Chromium and Eisenia fetida studying the health and behaviors of Eisenia fetida and how Chromium will affect their behaviors when exposed to Chromium. Other researchers that have done similar research showed that their Eisenia fetida have died because of being exposed to too much Chromium or in other experiments they did not have an outcome because the Eisenia fetida was not exposed to enough Chromium. The Eisenia fetida will be exposed to Chromium for about 2 weeks. The worms will be monitored. The habitat of the Eisenia fetida is moist soil, although some Eisenia fetida actually prefer mud, such as the mud that is found along the shores of lakes or swamps. Eisenia fetida can be found in the soil of backyards as well as near bodies of fresh and saltwater. When the Eisenia Fetida arrive there will be an enclosure for them to be in. Earthworms eat soil. Their nutrition comes from things in soil, such as decaying roots and leaves. The entire surface of a worm's body absorbs oxygen and releases carbon dioxide. Moisture Eisenia Fetida moves by squeezing muscles around their water- filled bodies. The Earthworms will lose weight when being exposed to Chromium. They will also shrink and the regeneration process for the earthworms will slow down. This shows how Chromium does have an effect on Eisenia fetida and can cause the worms to have different effects.

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A Eugenius Way of Anesthesia: The Effects of Different Clove Oi lAnesthesia Administration Methods on Earthworm Physiology and Behaviorology

Alana Wolfson, Rhia Kumar, Nicole Ma

ABSTRACT

Clove oil, Eugenia caryophyllata, is portrayed as an alternative form of local anesthesia through immersion. The active ingredient eugenol allows for clove oil to inhibit voltage gated sodium channels. Nevertheless, anesthesia administration through immersion is comparable to topical application on humans, which is suggested toreduce pain moderately. Moreover, local anesthesia administration through intravenous injection is significantly more potent; however, injecting oil into an individual's blood stream can create pulmonary embolisms. Nevertheless, epicutaneous microneedling provides an administration method for analgesics by delivering into the epidermis layer. Epicutaneous application is an application that is utilized for immunotherapy and allergy testing in humans. Earthworms Lumbricus terrestris were the specimens tested due to their complex neurological functionalities. Mobility, convulsions, stimuli response, regeneration, and mortality were evaluated with concentrations of 0%, 0.5%, 1% with epicutaneous or immersion administration. It was demonstrated that the 1% epicutaneous administration was the most effective in sedating directly after application. Moreover, neither the 0.5% or 1.0% concentration of clove oil caused any notable change in regeneration, over an average of 5 convulsions throughout 60 minutes, and no mortalities were recorded. The limitation of this experiment consists of an error in sealing the petri dishes during the mobility assay. Future implications consist of more trials for validation and evaluating vaporization as another potential application. Epicutaneous administration of 1% concentration of clove oil was examined as safe and effective in analgesic sedation.

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A Study on Consensus Dynamics in Multiagent Systems Using Mathematical and Computational Simulations

Sungjoon Park

ABSTRACT

Consensus dynamics in network theory, also known as graph theory, plays a significant role in various aspects of our lives. Through network theory and its applications, this project studied various frameworks for understanding and solving real-world problems related to connectivity, optimization, and the analysis of complex systems by simplifying the complex procedures and concepts occurring in our real lives. The geometrical properties of various designed networks were assessed to perform the consensus dynamics in multiagent systems using mathematical and computational simulations. After calculating the Adjacency matrix, Diagonal matrix, and Laplacian matrix of each network, the eigenvalues of each system were found to present a model for opinion formation(consensus) among individuals of society within a social domain.The results showed that active communication and contact between nodes (entities, individuals, or groups within the network) play a crucial role in the dissemination of information, opinions, or behaviors. The outcome of consensus dynamics or influence propagation showed that it is not solely dependent on active communication but also on the network's structural properties and geometrical dependencies. For example, in a network with strong clustering (nodes tend to be connected to other nearby nodes), consensus within clusters was formed more quickly. MATLAB and Python programming were used to perform the computer simulation and calculations.

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