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Co-Editors-In-Chief of JYEM

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Adaptive Haptic Feedback Device for Observing the Delivery of Information in Time-Critical Human-Machine Interfaces

Adithya Patnam and Noah Kay

ABSTRACT

This study introduces an adaptive haptic feedback belt designed to improve situational awareness and information delivery in time-critical human-machine interfaces (HMIs), with a specific focus on aiding visually impaired individuals. By providing tactile feedback through four vibration motors corresponding to angular sectors around the user's body, the belt shifts spatial information into intuitive, real-time haptic cues. The system dynamically adjusts vibration intensity based on the proximity of objects, allowing users to detect and locate obstacles in their environment effectively. Initial tests show the device's ability to communicate crucial spatial information non-visually, offering a promising assistive technology for navigation and obstacle avoidance. The belt's design combines an Arduino-based control system with custom-printed circuit boards (PCBs) and eccentric rotating mass motors (ERMs), optimized for comfort and durability. A 3D-printed mount system secures the motors while providing even vibration distribution. To validate its effectiveness, the prototype was tested in controlled experimental setups, achieving high accuracy in object detection and user satisfaction with comfort and usability. Future applications include integrating the belt into a virtual reality (VR) simulation to train the system for real-world object prioritization using machine learning. By improving situational awareness, the device aims to assist visually impaired users in navigating environments and avoiding obstacles. Subsequent real-world testing hopes to refine this device further, advancing the development of wearable assistive technologies.

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HYPOXIC BURDEN AND VENTILATORY BURDEN PREDICT SLEEPINESS IN PATIENTS WITH OBSTRUCTIVE SLEEP APNEA

Ann Karottu

ABSTRACT

Obstructive Sleep Apnea (OSA) is a widespread sleep disorder with significant health implications, including cardiovascular disease, neurocognitive dysfunction, and increased daytime sleepiness. The current diagnosis method for OSA is the apnea-hypoxia index (AHI). This method fails to fully capture the clinical consequences of OSA, especially its comorbidities. This study looks at two novel measures of OSA, ventilatory burden (VB) and hypoxic burden (HB), and analyzes whether VB and HB predict improvements in sleepiness with treatment of OSA. HB and VB from the Sleep Health Heart Study (SHHS) and the Apnea Positive Pressure Long-term Efficacy Study (APPLES) were analyzed, with participants categorized by gender and race. Results indicated that both HB and VB were higher in males compared to females, consistent with previous findings in OSA literature. However, there was not a consistent pattern for race across these datasets. Regressions were done with HB and VB as the independent variable and ESS and PVT as the dependent variable. These analyses revealed significant correlations between HB and daytime sleepiness, measured using the Epworth Sleepiness Scale (ESS) and the Psychomotor Vigilance Test (PVT). They also showed a significant correlation between VB and ESS however, HB proved to be a stronger predictor of sleepiness than VB. These results suggest that HB and VB may be used to predict the effects of CPAP treatment on OSA patients. However, further longitudinal studies are needed to confirm HB and VB as a diagnosis method for OSA.

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Molecular Editing and Quantum Chemical Evaluation of Nanoparticle-Based Photosensitizers for Hypoxia-Targeted Photodynamic Therapy in MDA-MB-231

Ethan Kim

ABSTRACT

Hypoxia is a major barrier to cancer treatment that decreases the efficiency of PDT by reducing the production of ROS by photosensitizers and promoting immunosuppression and cancer treatment resistance. The focus of this study is to develop a computational tool to design nanoparticle-assisted photosensitizers for the treatment of hypoxic cancer cells. In this study, molecular structures of porphyrin-based photosensitizers were modified by molecular editing, and their optimized molecular structures were studied using quantum chemical methods to examine their frontier molecular orbitals, HOMO–LUMO energy gap (ΔE), dipole moment, molecular electrostatic potentials (MEP), and total charge on the molecule. Of these properties, the Type I photochemistry via electron transfer that can lead to the production of ROS by the excited photosensitizer and possibly kill cancer cells by apoptosis or necrosis is of special interest. Since the production of ROS by Type II photochemistry, which involves the reaction of photosensitizer-excited state oxygen, is decreased under hypoxic conditions, much of the anticancer activity of PDT can be via Type I photochemistry. In addition, various nanocarriers have been reviewed for their potential uses in increasing the stability of photosensitizers, cancer cell uptake, and controlled release of photosensitizers. Importantly, ROS produced by PDT can induce immunogenic cell death (ICD) that leads to the release of tumor antigens from cancer cells and maturation of dendritic cells in the tumor microenvironment to activate tumor-specific cytotoxic T cells. Therefore, this study integrates the study of hypoxia-related traits of MDA-MB-231 human triple-negative breast cancer cells with molecular editing, quantum chemistry, nanotechnology, PDT, and cancer immunotherapy to assess the properties of photosensitizers for the treatment of hypoxic triple-negative breast cancer.

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The Effect of Varying Concentrations of Salicylic Acid on the Rate of Infection of Tobacco

Daniel Zheng

ABSTRACT

Tobacco Mosaic Virus (TMV) reduces crop yields by up to 50% in tobacco and 25-40% in tomatoes. TMV remains a significant challenge in agriculture due to its stability, ease of transmission, and lack of definitive cures. Modern treatments focus primarily on management rather than curing TMV. Salicylic acid (SA) is a critical plant hormone that regulates plant growth, development, and defense mechanisms. This study investigates the effect of varying concentrations of SA on Solanum lycopersicum (tomato plants) to determine its role in mitigating TMV infection. A qualitative and quantitative experimental design was used to assess leaf length, chlorophyll content, and the severity of TMV infection across different SA treatment groups. Experimental data was collected over the span of seven days. Results indicate a concentration-dependent response, with higher SA levels correlating with increased chlorophyll content, reduced TMV severity, and improved average leaf growth, suggesting an enhanced antiviral defense. These findings support SA's potential as a plant defense enhancer, which may contribute to improved crop resilience.

Keywords: Salicylic Acid, Tobacco Mosaic Virus, Plant, Mitigation, Severity



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Targeting CDK7: Comparing the Effects of Inhibition, Degradation, and Phosphorylation Mutants

Ivan Zou and the Fisher Lab

ABSTRACT

Cyclin dependent kinases (CDKs) are regulators of cell division and transcription. Among them, CDK7 is an important player in both these two pathways. This study investigates the effects of analog-sensitive inhibition and degradation of CDK7 on gene expression and protein levels. Using mutant cells expressing the analog-sensitive mutation F91G, we show 3-MB-PP1 effectively inhibits CDK7 activity, resulting in notable downregulation of genes DCAF16, MYC, and HEXIM1. In contrast, the effects from degrader 3- MB-C7 were less potent, likely due to differences in treatment duration, concentration, or incomplete CDK7 degradation. Additionally, off-target effects or compensatory pathways may contribute to the reduced efficacy of the degrader. To better understand the mechanisms behind CDK7 and the role of phosphorylation and its regulation, we introduced mutations S164A and T170A. We measured their effects on the phosphorylation of downstream targets RBP1 and CDK2 in combination with 3-MB-PP1 and 3-MB-C7 treatment. Both mutants showed lower levels of phosphorylation, but neither was able to replicate the effects observed in the wild-type reintroduced CDK7-F91G cells. This suggests that phosphorylation is not the only regulatory mechanism of CDK7 activity. My experiments measuring effects on mRNA expression highlighted the different responses of genes to different drugs. HEXIM1 in particular, gave varied expression levels depending on the drug and the conditions in which it was used. Together, my findings reveal some of the complexities of targeting CDK7 and suggest that while inhibitors currently provide very precise control over kinase activity, degraders may require further optimization to be effective in future studies. Keywords: Cyclin-dependent kinase 7 (CDK7), Small molecule inhibition, Targeted protein degradation, analog-sensitive kinase system, transcriptional regulation,

Keywords: Obstructive Sleep Apnea, Hypoxic Burden, Ventilatory Burden, Daytime Sleepiness, CPAP, Epworth Sleepiness Scale, Psychomotor Vigilance Test, AHI, Sleep Diagnostics

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IDENTIFICATION OF HUB GENES IN PANCREATIC DUCTAL ADENOCARCINOMA TISSUES USING WEIGHTED GENE CO-EXPRESSION NETWORK ANALYSIS (WGCNA).

Jacob Shuster

ABSTRACT

Pancreatic ductal adenocarcinoma (PDAC) is among the most lethal malignancies in the United States, with a 5-year survival rate below 15%. Early detection remains a critical challenge due to the absence of reliable biomarkers. Weighted Gene Co-expression Network Analysis (WGCNA) provides a powerful framework for uncovering biologically relevant gene modules and hub genes associated with PDAC progression, offering an advantage over traditional approaches such as differential expression analysis, protein–protein interaction (PPI) networks, or enrichment analysis, which lack gene co-regulatory context and often fail to identify central regulatory nodes.This study applies WGCNA to gene expression data sourced from the GSE132956 dataset in the Gene Expression Omnibus (GEO), comprising 10 PDAC tissue samples (2 early, 3 middle, and 5 late stage) and 5 normal tissue samples. After preprocessing via 95th percentile quantile normalization, filtering low-variance genes (FDR < 0.05), and confirming the absence of batch effects using principal component analysis, a soft-threshold power of 12 was selected based on optimal scale-free topology (R^2 > 0.8). Hierarchical clustering of the topological overlap matrix revealed seven co-expression modules. STRING analysis identified nine hub genes—FYN, MAPK3, CDK2, SNRPG, GNAQ, PAK1, LPCAT4, MAP1LC3B, and FBN1—as key regulators within these modules (p = 1.07e-05), eight of which are novel in the context of PDAC.These findings affirm WGCNA's utility in detecting functionally relevant gene modules and biomarkers across PDAC stages, with implications for improving diagnostic precision and guiding personalized therapies.

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Exploring Neuroarchitecture: How Architecture and Interior Design Shape Human Cognition and Emotion

Minjun Sean Choi

ABSTRACT

Neuroarchitecture is a newly emerging discipline that is based on an integration of neuroscience, psychology, architecture, and interior design. In this paper, we review the current state of knowledge about architectural features and their psychological and physiological effects on humans. We explore the effects of spatial organization, lighting, color, texture, acoustics, furniture, and natural elements on humans' state of relaxation vs. stress, concentration vs. distraction, creativity vs. boredom, and emotional stability vs. instability. We are particularly interested in the way that urban environments affect humans' mental health and well-being, and how green spaces and social contact can be integrated into architecture and urban design in order to support human-centered design. In addition, there are an increasing number of new technologies that can be used in order to monitor and assess humans' neurological and physiological states in various environments, including EEG, wearable biosensors, and even smartphone-based measurement tools. Neuroarchitecture can be applied to a number of settings, including hospitals, educational institutions, workplaces, residential environments, and even cities as a whole. The potential applications of neuroarchitecture for designing more comfortable environments that support human cognition and mental health, as well as overall well-being, are great. By studying these interactions, neuroarchitecture has the potential to revolutionize current design practices that are generally based on form and function, and create more humane, sustainable, and responsive environments for a wide range of humans in various settings and stages of life.



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Hierarchical Self-Assembly of Frenkel Excitonic Nanotubes: Unraveling the Role of pH-Induced Effects

Nazifa Meher

ABSTRACT

As the climate crisis demands cleaner and more efficient energy systems, hierarchically self- assembled nanostructures are emerging as promising tools for sustainable technologies. Hierarchical supramolecular self-assembly is a crucial natural design principle that enables the formation of robust complex materials with structural order across multiple length scales. Understanding this process is essential to appreciate the mechanisms that govern molecular interactions and organization, which ultimately guide the development of novel technologies for applied science, such as solar energy conversion. Though the forces behind self-assembly (e.g. hydrophobicity) are known, the specific mechanism of how monomers form supramolecular structures remains unsolved. To address this gap, I investigated how basic pH environments affect the hierarchical self-assembly of light-harvesting nanotubes. I utilized a well-defined artificial model system: supramolecular double-walled light- harvesting nanotubes (NTs). NTs self-assemble in aqueous solution from cyanine dye molecules, which further hierarchically self-assemble into bundled single-walled NTs (b-NTs). I gradually adjusted the pH of assembly solutions to increasingly basic values (10.30, 11.10, 11.80) to elucidate its role in the self-assembly of NTs to b-NTs. My findings exhibit that a basic environment greatly accelerates this bundling process. B-NT formation normally takes weeks to months, but in a basic environment this process took only 24 hours. By revealing how small pH shifts can drastically affect nanoscale organization, my results demonstrate the immense potential of environmental parameters in developing strategies that utilize this controllable molecular self-assembly process to produce well-designed nanostructures.

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ENHANCING DYE-SENSITIZED SOLAR CELL PERFORMANCE: THE ROLE OF GELLED ELECTROLYTES

Samantha Stoneking and Kristina Theodosopoulos

ABSTRACT

According to the Environmental Protection Agency, 25% of greenhouse gas emissions are created from electricity and heat production. Dye-sensitized solar cells (DSSCs) offer a promising renewable energy solution due to their affordability, ease of fabrication, and environmental benefits. However, their efficiency and long-term stability remain challenges that must be addressed to enable widespread adoption. This study investigates strategies to enhance DSSC performance by incorporating gelled electrolytes, optimizing natural dye combinations, and comparing carbon-based counter electrodes. Natural dyes were extracted from anthocyanins, chlorophyll, and betalains, with mixtures co-sensitized to broaden light absorption across the visible spectrum. Gelled electrolytes, fabricated using agarose, were introduced to address the drawbacks of liquid electrolytes, such as leakage and evaporation, while improving ionic conductivity and stability. Counter electrodes were prepared using candle soot and graphene, with a cost-benefit analysis revealing the economic feasibility of soot-based electrodes compared to graphene, which offers higher efficiency but at a greater expense. The DSSCs were fabricated using standardized methods to ensure consistency and tested under controlled illumination. Cyclic voltammetry was employed to analyze the redox properties and degradation rates of the dyes. Results showed that the co-sensitized dye mixtures improved absorption across broader wavelengths. Candle soot electrodes provided a cost-effective alternative with moderate efficiency, supporting the viability of low-cost DSSC production.

Keywords: co-sensitization, cyclic voltammetry, electrolyte

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Regulatory Role of IL-17Ra Signaling in Stromal Cells of the Intestine: Impact on Intestinal Epithelium Differentiation and Crypt-Villus Morphogenesis

Samaya Syalis

ABSTRACT

Crohn's disease and ulcerative colitis, collectively referred to as the inflammatory bowel diseases (IBD), are chronic inflammatory conditions of the gastrointestinal tract that are characterized by a dysregulated intestinal environment. The cytokine IL-17A plays opposite roles in host defense and inflammation, and is also implicated in maintaining the intestinal epithelial barrier. In this study, we investigate whether IL-17RA signaling in intestinal stromal cells, specifically those that are PDGFRα+, influences epithelial cell differentiation and architecture. To this end, we generated a conditional IL-17RA knockout mouse using Pdgfra-Cre-positive mice and compared them to Pdgfra-Cre-negative controls. We examined terminal ileum from both groups of mice by hematoxylin and eosin staining, Alcian blue staining to assess goblet cells, and quantitative polymerase chain reaction (qPCR) to assess expression of several markers that are associated with epithelial cell differentiation. Our results indicate that stromal IL-17RA signaling affects intestinal epithelial cell differentiation, as well as the cellular composition and architecture of the intestinal epithelium. The increased number of goblet cells and the elongated crypts in the IL-17RA knockout mice suggest that these changes may be compensatory in nature, and further studies are required to elucidate the roles of stromal growth factors, the intestinal microbiota, and the intestinal epithelial barrier in IBD. These studies will highlight the importance of stromal-epithelial interactions in maintaining intestinal homeostasis.

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A NOVEL AIR QUALITY ASSESSMENT METHOD WITH LOW-COST SENSORS AND PREDICTIVE ANALYTICS USING AUTONOMOUS DRONES

Sathvik Dasari

ABSTRACT

This project presents a novel method for real-time air quality monitoring using a low-cost, modular sensor system designed for future drone integration. Traditional monitoring stations are expensive, stationary, and lack spatial resolution, while most portable systems offer limited accuracy or predictive capability. This work bridges that gap by combining affordability, mobility, and intelligent analytics into a single, scalable solution. The prototype uses a Raspberry Pi platform integrated with MQ-series gas sensors (CO, NO□, NH□) and a BME680 environmental sensor. Data is collected at 15-second intervals, timestamped using NTP synchronization to minimize drift, and processed through machine learning models. A Random Forest Regressor was trained on the AirQualityUCI dataset to predict pollutant levels, while DBSCAN was used to identify pollution anomalies. All models were optimized for on-device inference using TensorFlow Lite with quantization. The system was tested in three distinct environments urban intersections, residential neighborhoods, and construction zones over six 30-minute sessions. Performance metrics showed strong predictive accuracy with R^2 scores of 0.85 for CO, 0.81 for NO□, and 0.91 for NO_x. Mean Absolute Errors ranged from 0.071 to 0.156 ppm, with real-time prediction latency of ~1 second and average uptime of 5.5 hours per battery cycle. Compared to consumer-grade and government-grade monitoring systems, the proposed model offers a competitive balance of cost, accuracy, and real-time capability. This approach lays the foundation for future drone-based deployments, enabling rapid, distributed air quality surveillance in both urban and underserved regions.

Keywords: Air Quality Monitoring, Low-Cost Sensors, Autonomous Drones, Predictive Analytics, Machine Learning



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The Effect of Omega-3 Fatty Acids in Chia Seeds on the Phototaxis Response of Alzheimer's Disease (AD) Modeled in *Drosophila melanogaster*

Soraye Takahashi and Katerina Katehis

ABSTRACT

Alzheimer's Disease (AD) is the fifth leading cause of death for Americans 65 and older. It is a neurodegenerative condition that leads to memory loss and cognitive decline. With no cure currently available, further research into alternative treatments is vital. Chia seeds, a rich plant-based source of omega−3 fatty acids, may help the immune system clear amyloid-β 42 (Aβ42), a peptide that disrupts neural communication and plays a key role in AD. This study tested the effects of chia seeds on neurodegeneration using Drosophila melanogaster. Flies were exposed to chia seed concentrations of 0 µL (control), 1 µL, 3 µL, and 5 µL and assessed through longevity and aversive phototactic assays. In the longevity test, higher concentrations reduced survival, likely due to levels above the flies' LD50. However, the 1 µL group showed a higher mean survival rate compared to control (M = 41.8, SD ± 84.6), though results were not statistically significant (p > .05). In contrast, the aversive phototactic assay showed a significant improvement, with the 5 µL group having the highest percent passing the second phase (M = 2.54, SD ± .319) compared to control (p < .001). These findings suggest that moderate chia seed consumption may support both longevity and cognitive function. While chia seeds may not provide enough omega−3s alone, they remain a beneficial dietary addition. Future research should explore diets containing optimal levels of omega−3 fatty acids to further examine their potential role in reducing AD risk.

Keywords: Alzheimer's Disease, omega-3 fatty acids, amyloid-β 42, Drosophila melanogaster, chia seeds, aversive phototaxic assay

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Visualizing the Behavior and Characterization of the Förster Resonance Energy Transfer (FRET) RhoG GTPase Biosensor

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ABSTRACT

Fluorescent biosensors are novel pharmacological tools that allow real-time visualization of protein activations in cancerous cells, allowing biologists to visualize the dynamic pathways of proteins. The biosensor measures protein activity through genetically encoded Förster resonance energy transfer (FRET). RhoG GTPase is a signaling G protein that plays a crucial role in cellular processes and when disrupted can contribute to cancer progression. However, a fully optimized and characterized RhoG FRET biosensor currently does not exist. Therefore, the objective of this study was to validate the behavior of this biosensor through the co-expression with protein inhibitors, mutant biosensor expression, and cell stimulation. Increasing concentrations of Rho guanine nucleotide dissociation inhibitor (RhoGDI), and RabGDI were co-transfected with the RhoG biosensor, and the FRET emission from was then determined. Results displayed a significant decrease of the FRET/donor protein ratio as RhoGDI concentration increased (p<0.005). Additionally, active and inactive mutant RhoG biosensors were examined in live-cell imaging to determine the total dynamic range of the signal modulation. The results showed a 40% decrease (p<0.0004) in FRET/donor ratio between the mutants. Lastly, cellular growth factor stimulation was used to examine the biosensor's response to cell stimulation, however additional research is required to further validate results. Future research can examine how pharmaceutical drugs affect RhoG proteins using this biosensor, establishing a foundation for cancer therapies.

Keywords: Biosensors, Ras Protein, FRET

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AN INNOVATIVE APPLICATION OF METALLIC POWDERS AND FERROFLUIDS IN THE DIRECT REMOVAL OF NANO/MICROPLASTICS IN FRESHWATER ECOSYSTEMS

Aditi Senthil Prasad

ABSTRACT

Nano/microplastics are heavy polluters of our aquatic ecosystems and freshwater resources. While many filtration systems exist and are being tested, they do not entirely extract the plastic, and this occurs after the water is taken to a treatment plant, meaning that the plastics in the water harm the organisms while the organisms inhabit the ecosystem. This project tests and adds further research using ferrofluid adhesion to plastics and extraction through magnetic force. The aim is to be able to apply this in the future to directly extract this from the primary water source without a mediating treatment plant to improve the quality of our freshwater and save multiple species from harm. By testing magnetite, aluminum, and stainless steel powder (all chosen due to their nontoxic properties), magnetite was the most effective and efficient in removing plastic from the water, leaving the least residue and extracting plastic the easiest. When testing the different amounts of magnetite (10g, 15g, and 20g), the 15g of magnetite per 300 ml of water (water amount was kept constant) worked best because this amount was able to extract the plastic most effectively while also not having too much metal to clean up after the extraction. When used in future applications of direct filtration, this method could benefit water quality, our quality of life, and aquatic ecosystems.

Keywords: Nano/Microplastics, pollution, ferrofluids, primary source, direct filtration



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INVESTIGATING ARTISTIC EXPRESSION AS A CATALYST FOR SPEECH DEVELOPMENT IN MINIMALLY-VERBAL AUTISTIC CHILDREN

Medha Pulluru

ABSTRACT

This study investigates whether artistic expression can support spoken language development in non- verbal/minimally verbal autistic children. Current speech therapy practices have a limited focus a child's unique, individual expression, and prioritize basic needs to ensure safety and functionality among other groups of children. These practices have mixed-effectiveness in regards to verbal speech development across the population, especially in older age groups. This study hypothesizes that artistic expression can encourage verbal communication by engaging distinct, but integrating parts of the brain. The dual-method experimental design involves allowing a group of nonverbal/minimally verbal autistic children to engage in artistic expression over a time period, and measuring their changes in verbal expression. This will be supplemented by an EEG study that will measure ERP potentials to analyze changes over this period of time. Finally, to contextualize the results, a literature-based meta-analysis will be conducted to compare the results of artistic-expression to other commonly used speech therapies. In conclusion, this study aims to identify whether incorporating creative, child-centered expression can contribute meaningfully to speech development in autistic children with limited verbal communication.

Keywords: Autism, Speech Delays, Medical Humanities



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The Impact of Primary Challengers on Congressional Language: A Logit Regression Analysis

Vinay Murugan

ABSTRACT

This study investigates intra-party linguistic polarization among Democratic incumbents in the 116th U.S. Congress in response to viable progressive primary challengers. Utilizing over 600,000 tweets from congressional accounts, the author applies a dictionary-based natural language processing approach alongside random effects logit regression to quantify changes in progressive language use. Contrary to the initial hypothesis, results reveal a statistically significant moderation of language following progressive challenger endorsements, suggesting strategic linguistic distancing by incumbents. Interaction models further indicate that this moderation intensifies over time and varies by district partisanship, though not by electoral outcome. These findings offer nuanced insight into how internal electoral pressures reshape rhetorical positioning, contributing to the broader understanding of polarization dynamics in American politics.Keywords: Autism, Speech Delays, Medical Humanities



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VARIANT HISTONE MACROH2A LINKER AND MACRO DOMAINS MODULATE CHROMATIN CONDENSATION AS DE FACTO LINKER HISTONE H1 SUBSTITUTES

Banghua Pan

ABSTRACT

Nucleosomes, the fundamental units of eukaryotic chromatin, consist of DNA coiled around an octameric histone core. MacroH2A (mH2A) is a histone variant enriched at inactivated genome sites, signaling its role in chromatin condensation and transcription suppression. Its tripartite structure consists of a conserved N-terminal histone fold region and a 30 kDa globular C-terminal macro domain connected by an unstructured linker domain. We aimed to assess the involvement of the macro domain and the less-studied linker region in inhibiting DNA accessibility through a nucleosome digestion assay with restriction enzymes HinfI and BtscI. Hypothesizing the mH2A linker domain to have an uncharacterized role in higher-order chromatin condensation, we compared the accessibility of nucleosomes containing canonical H2A to different mH2A constructs: the mH2A histone fold (1-127), the mH2A histone fold and linker domain (1-161), and the full-length mH2A (1-369). We found that both the truncated mH2A variants with linker (1-161) and full-length mH2A (1-369) significantly reduced nucleosome digestion, indicating increased DNA protection. Furthermore, we uncovered similarities between the mH2A linker domain and linker histone H1, a known condenser of nucleosomes into compact 30 nm chromatin fibers. Transmission Electron Microscopy (TEM) images revealed a compaction of nucleosomes containing only the mH2A histone fold and linker domains (1-161) similar to that of nucleosomes containing canonical H2A and H1, suggesting the linker domain functions analogously to linker histone H1 in stabilizing chromatin. This holds implications in cancer therapeutics, as mH2A attenuates uncontrolled cell proliferation through chromatin compaction and the resulting suppression of oncogene transcription.

Keywords: MacroH2A; Linker Domain; Chromatin condensation; Linker Histone H1

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Manganese-Iron Combined Exposure Reduces Oxidative Stress in C8-D1A Astrocytes Through the Upregulation of Hmox1 and NQO1

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ABSTRACT

Parkinson's disease (PD) is a global health burden characterized by the loss of dopaminergic neurons. Oxidative stress (OS) plays a critical role in the pathogenesis of PD, contributing to the death of dopaminergic neurons. While overaccumulation of manganese (Mn) and iron (Fe) has shown to generate OS and neurotoxicity, there is little data on their combined effect. Thus, the objective of my study was to explore the effects of combined Mn-Fe exposure on C8-D1A astrocytes and the mechanisms underlying how it affects OS. I hypothesized that combined Mn-Fe exposure would increase reactive oxygen species (ROS) levels compared to Mn-Fe exposure alone. I performed a H 2 CDF-DA assay to measure ROS, LDH/MTT assays to measure cell viability, Western Blot analysis to measure antioxidant protein expression, RT-qPCR to measure antioxidant gene expression, and total glutathione (GSH) assays to measure GSH and oxidized glutathione (GSSG) concentrations. My results show that combined Mn-Fe exposure significantly reduced ROS compared to Mn and Fe alone, significantly reduced cytotoxicity compared to Fe alone, and significantly increased Hmox1 and NQO1 expression compared to Fe alone. My results suggest that combined Mn-Fe exposure significantly reduces cytotoxicity and ROS levels compared to Mn and Fe exposures alone through the upregulation of Hmox1 and NQO1. My results may provide valuable insights into the complex interplay between Mn, Fe, and oxidative stress.

Keywords: Parkinson's Disease, Manganese, Iron, Oxidative Stress, Antioxidants



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