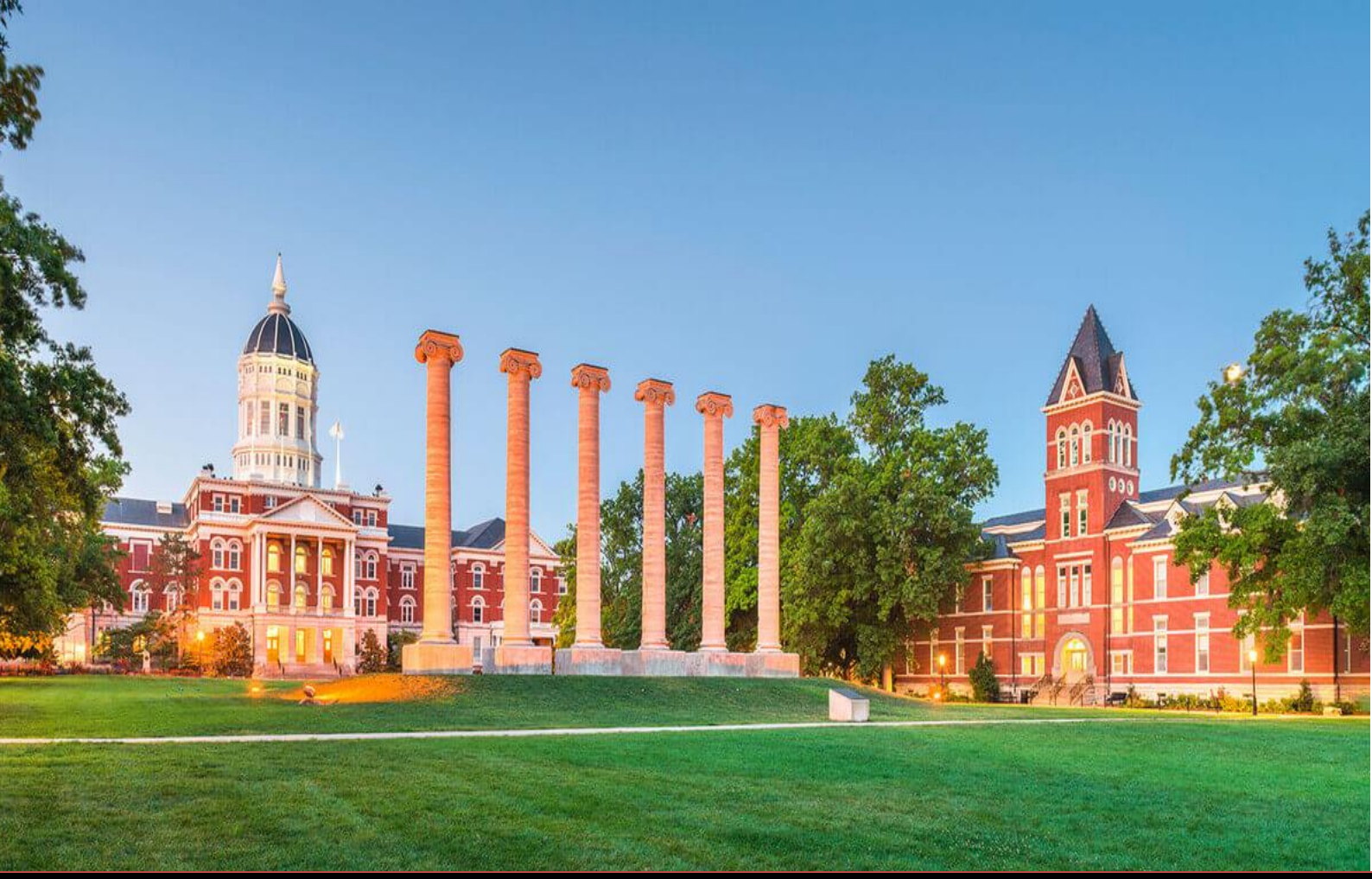

RCAF, Fall 2025

42nd Research and Creative Activities Forum

BOOK OF ABSTRACTS

OCTOBER 24th, 2025

ABOUT RCAF

RCAF stands for Research & Creative Activities Forum, an annual event that offers an invaluable opportunity for graduate and professional students to showcase their academic projects and research. The conference has been designed to provide a platform for students to display their work and discuss their findings with a larger audience. RCAF aims to stimulate intellectual growth and inspire the next generation of researchers and academics. It is an ideal opportunity for students to get feedback, improve their presentation skills, and network with fellow researchers and professionals.

Since its establishment, RCAF has become a highly anticipated event that attracts Mizzou students from various fields of study. It offers a diverse range of presentations providing attendees with a comprehensive overview of current research trends and practices here at Mizzou. This year, the 42nd RCAF conference features an array of research topics, from Social and Behavioral Sciences, Life Sciences, Physical Sciences and Mathematics, Engineering Science and Informatics, Artistic Expression and Humanities. This event promises to be stimulating and thought-provoking for all those involved.

RCAF, Fall 2025

42nd Research and Creative Activities forum

GPC President's Message

It is an honor to welcome you to the **Research and Creative Activities Forum (RCAF) Fall 2025**. This signature event reflects the University of Missouri's enduring commitment to academic excellence, interdisciplinary collaboration, and the advancement of graduate and professional scholarship.

Historically held in the spring, RCAF will now be hosted in the **fall semester** to broaden participation, prevent overlap with other major research conferences, and provide students an earlier opportunity to present their work. This makes 2025 a truly unique year, as we proudly host **two RCAF events**, one in the spring and one in the fall.

RCAF serves as a vibrant platform for students to share innovative ideas, engage in scholarly dialogue, and connect across disciplines. The projects showcased today represent the creativity and intellectual rigor that define Mizzou's graduate community. Whether your work advances scientific discovery, explores social systems, or celebrates artistic expression, your contribution enriches our shared pursuit of knowledge and impact.

I extend sincere appreciation to the organizing committee, faculty judges, and mentors for their dedication, and to each presenter for the courage and passion behind your research. Together, we exemplify the collaborative spirit that drives innovation at Mizzou and beyond.

Warm Regards,
Felix Michael Oguche
President, Graduate Professional Council

RCAF, Fall 2025

42nd Research and Creative Activities forum

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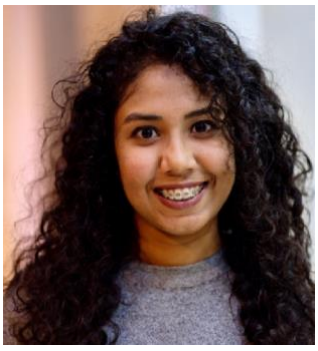

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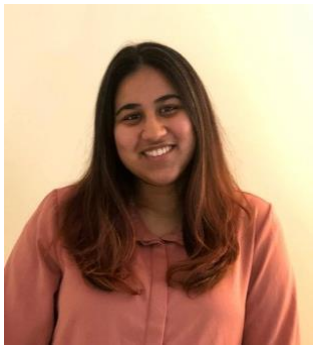

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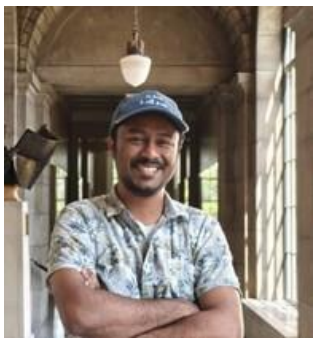

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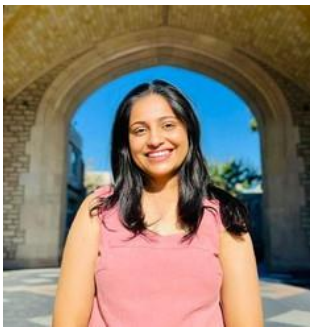

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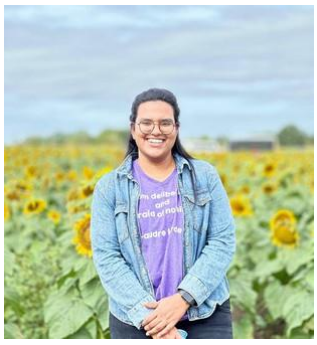

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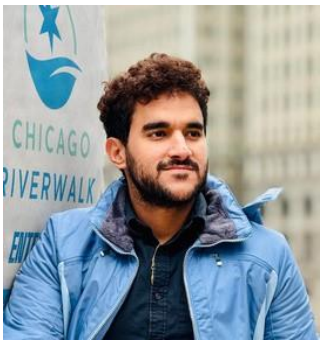

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RCAF, Fall 2025

42nd Research and Creative Activities forum

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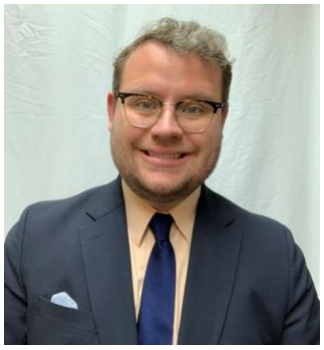

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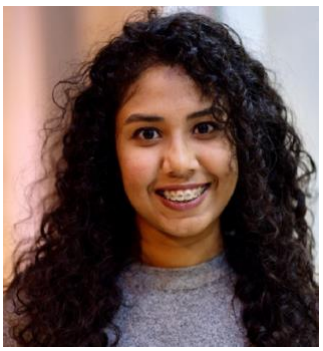

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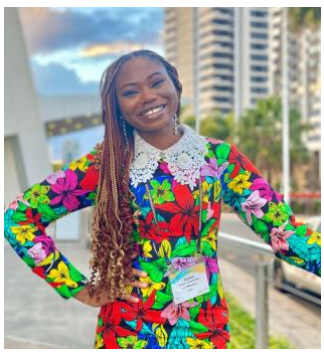

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ACKNOWLEDGEMENTS

The Graduate Professional Council is grateful to the following faculty, staff, and students for their invaluable support towards making this event a success.

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October 24, 2025

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HUMANITIES

A Geospatial Data Science Approach to Hannibal's Route through the Alps

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In May of 218 BC the Carthaginian general Hannibal Barca set out from Cartagena, New Carthage, in Iberia, modern day Spain, with an estimated estimated 50,000 infantry and 9,000 cavalry, and 37 war elephants on a quest to invade Roman Italy. Hannibal's crossing of the French Alps into Italy stunned the Roman Republic and his march has gone down in history for its audacity.

Two Greek historians accompanied Hannibal on his historic march, Silenus, probably from Caleacte in Sicily, and Sosylus of Sparta. Both wrote firsthand accounts of the march but neither history is extant and only exist in fragments from later writers, notably Polybius, Coelius Antipater, and Livy. Consequently, the two major secondary sources for Hannibal's march are the Greek historian Polybius' *Histories*, written closest in time to Hannibal's march, and the Roman historian Livy's history of Rome, *ab urbe condita*. Hannibal's route as described in these texts is never specified with certainty and the descriptions of key landmarks are often vague and ambiguous. Since the actual route is unknown it has been debated by historians for centuries.

Historian Patrick Hunt, who spent a decade in the Alps directing the *Stanford University Alpine Archaeology Project*, prefers a route through the Col de Clapier, as does John Hoyte, who lead the 1959 *British Hannibal Expedition*, a group of Cambridge University students who took an Indian elephant named Jumbo over the alps in an attempt to determine Hannibal's route. Recently, Mahaney et al. have suggested they found evidence that indicates the Col de la Traversette was Hannibal's route. Other contenders are a route through the Col du Petit-Saint Bernard, and the Col de Montgenèvre route.

This research takes a geospatial data science approach to this historical question by using data collected for Jumbo's walking speed during the *British Hannibal Expedition,* geospatial elevation data, maps of the candidate routes, and data derived from the US Army's field manual for Mountain Warfare and Cold Weather Operations to model soldier marching rates in mountainous terrain for each potential route. These quantitative models are then compared to descriptions in Polybius and Livy to determine how well they correspond to the ancient histories.

The Stripes of Glory We Wear: Reflections of the Legal Role and Intricacies of Citizenship in the History and Foundation of the Malaysian State

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The meaning of citizenship in Malaysia is a tale as old as the country itself—a thorny relationship between the state; the Bumiputera majority of Malay and native ethnicities indigenous to the land; and the non-Bumiputeras minority of Chinese and Indians who primarily migrated when the region was under British colonial rule and influence. In the present, Bumiputeras enjoy a constitutionally stipulated special status—a distinction that bestows many privileges and preferential treatment in all facets of life, from commerce to education, homeownership to government employment, that is off-limits to non-Bumiputeras. Supporters of the system argue it remains necessary—a form of affirmative action to correct the economic disparity between the two groups that has largely persisted since Malaya gained its independence. Detractors contend it effectively creates two classes of citizenship while also breeding corruption. Malay nationalistic rhetoric claims it is an inviolable Social Contract, concocted in a grand bargain between Malay and non-Malay independence leaders in exchange for non-Malays gaining citizenship rights.

Makandal, True Story

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Makandal, True Story, published in 1787 in the Mercure de France

The short story Makandal, True Story, published in 1787 in the Mercure de France, presents a representation of this historical figure and his acts of resistance against slavery (which took place thirty years before the outbreak of the Haitian Revolution). Here we will analyze the construction of the character of Makandal in this narrative schema and question the ideological issues of this representation in the context of colonialism and slavery in Saint-Domingue. We will analyze what this fictional representation reveals about the anxieties of French colonial society following the "real" revolt led by Makandal and his followers, the poisonings that spread terror throughout the colony of Saint-Domingue. We will see how the anonymous author portrays Makandal, what physical, psychological, and social traits he highlights and how the author uses the character of Makandal to promote certain conceptions about the nature of the slave and the acceptable limits of resistance. We discover what his choices reveal about the colonial perspective on slave resistance.

In the short story Makandal, True Story, published in 1787 in the Mercure de France, the mention of "true story" in the title contrasts with the oral tradition and legend that circulates — which, like all myths, may be based partly on truth, but is by nature not factual. The character of Makandal is depicted from his birth ("born in Africa," p.102), to his youth ("only about twelve years old," p.103), and up to his death at the stake ("they erected Makandal's pyre," p.114). His story is told from his arrival on the island of Saint-Domingue ("transported to Saint-Domingue and sold to a colonist," p.103) to his execution ("a soldier proved to him with a saber blow that he was more powerful than him and threw him back into the pyre," p.114), as to suggest that if his entire life story is recounted and, since it is complete, it must therefore be the whole truth. Implicitly, this suggests that it is the only truth — that this completeness makes it more plausible, leaving no room for doubt, and making it the only acceptable version.

The "Cordon à noeuds" in *Rosalie l'Infâme*: Memory of the Resistance of Enslaved Women and a Support for Lisette's Liberating Imagination

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The story of *Rosalie l'Infâme* takes place in the 1750s in Saint-Domingue, at a time when fear of poisoning was growing among white colonists. This novel brings readers into the heart of the resistance against slavery. It especially highlights the hardships faced by enslaved women and their struggle to maintain control over their bodies within a harsh and oppressive system. In this narrative, the knotted cord becomes a dual symbol. It recalls the painful past and the resistance of enslaved women, while it also points to the future, serving as a source of inspiration and a space of liberating imagination for Lisette, the protagonist. In this poster, I aim to explain the function of the knotted cord as a symbol of enslaved women's resistance and to analyze its broader meaning in relation to memory, the body, and freedom.

Preserving Indigenous Identity in the Early Modern Americas: A Royal Charter and Grant of Arms for the indigenous town of Santa Isabel Cholula, 1535.

Mariana J. Guzman, School of Visual Studies, University of Missouri-Columbia.
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In the present research I recatalogued the information on a document currently on loan from a private collection at MU's Ellis Library. Previously thought by its owner to be a *Carta Ejecutoria*, it is instead a Royal Charter to grant a coat of arms to the town of Santa Isabel Cholula (also called Santa Izabel Yztaczoatlan), issued for Don Pedro Acatótl, Don Miguel Cosca Teutli, Don Antonio Chitotl, and Don Juan Cholula Cahuátl. It was signed in 1535, addressing the authority of the first viceroy of the New Spain, Don Antonio de Mendoza, as well as the Royal Notary Juan de Cuevas. It includes the original design of the coat of arms, painted by an indigenous artist, along with a notarial transcription of the document from 1761. The coat of arms included here represents an extremely rare survival and invaluable example of an early image created by the indigenous people of Mesoamerica in adaptation of a European visual language. It is one of the earliest ever granted to indigenous peoples in the New Spain (now Mexico). According to Castañeda de la Paz and Luque Talaván, the first arms given to Spanish conquistadors are dated between 1527 and 1531, and indigenous peoples did not begin to ask for arms until the second half on the sixteenth century, with a few exceptions.This 1 is one of those exceptions. In the sixteenth century, and in the context of the clash and encounter of cultures in the American continent, coats of arms became bridges of understanding between indigenous peoples and Iberian conquistadors. The alliances established between the Spanish Empire and the indigenous *altépetls*, were sealed and visually performed by coats of arms granted to both individuals and cities. Images of indigenous heraldry were created to preserve the memory of the courage and power of indigenous warriors. They represent a strategy of self-preservation and resilience in the face of a threat of cultural extermination. Many indigenous peoples across the American continent faced genocide and erasure, while the people of Santa Isabel Cholula found a way to remain autonomous and preserve their traditions and identity in the sixteenth century, and up to the present day. This document represents their first step in that long quest for survival and self-determination. María Castañeda de la Paz, Miguel Luque Talaván. *Para que de ellos e de vos quede memoria. La* 1 *heráldica Indígena novohispana en el centro de México.* Universidad Nacional Autónoma de México, Ciudad de México, 2021. p. 42.

Vampires will never hurt you: A Horror Memior

Kofi Opam
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As a multiply marginalized artist and scholar, I use horror as both a creative outlet and analytical framework. For RCAF, I intend to present portions from my manuscript, *Vampires Will Never Hurt You*, a hybrid horror travel memoir that combines scholarly research with creative nonfiction to consider race, place, gender, and fear in post-COVID America. Its title, taken from a My Chemical Romance song, references one of the central questions my manuscript examines: are we scared of the right monsters?

The manuscript is a combination of essays, short fiction, and digressionary asides, exploring my experiences with the Gothic in towns and cities across an increasingly-divided America. I write through experiences such as visiting Miami in the weeks following the Pulse Massacre; teaching rhetoric in Missouri during the rise of "alternative facts"; and shooting my first gun at a firearm class in rural Illinois. Other locations include Long Island haunted houses, Iowa City emergency rooms, and the country's largest collection of Jim Crow memorabilia (located, interestingly, in Western Michigan).

This project is grounded in several theoretical frameworks. My questions about fear are rooted in affect theory, and my understanding of my lived experiences are filtered through queer of color critique and autotheory. The writing is in conversation with artists and scholars such as Audre Lorde and Saidiya Hartman, whose biomythography and critical fabulation blur the lines between theory, experience, and expression. It moves between the ethos of Afropessimists like Frank Wilderson and Afrofuturists like Reynaldo Anderson.

My poster will discuss my writing, critical frameworks, and selections from my creative research (including photographs and visual media). Because it resists easy answers when it comes to fear and favors catharsis over synthesis, audience members will come away with a more expansive understanding of art, along with strategies for thinking about their own academic research and creative writing.

LIFE SCIENCES

Environmental Exposures Accelerate Proteomic Aging in *Nothobranchius rachovii*

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Biological aging (BA), the progressive decline in physiological function, is influenced by both intrinsic and environmental factors. African killifishes (*Nothobranchius* spp.) provide a powerful model for investigating environmental modulation of biological aging due to their short lifespan and unique biology of stress response strategies. Here, we compared proteomic aging trajectories of laboratory and mesocosm-reared fish to determine how environmental exposures shape biological aging at the proteomic level. We hypothesized that mesocosm-reared fish would exhibit environmentally responsive proteomic aging signatures, particularly in pathways related to stress resilience, metabolism, and damage repair. Killifish *N. rachovii* from both environments (n = 8–10 per group at 8 and 18 weeks were analyzed using LC-MS–based proteomics, alongside a collection of mesocosm water temperature. LC-MS data (Bruker.d files) were used to perform a global search of proteins using the Data-Independent Acquisition Neural Network (DIA-NN) against the UniProtKB-*Nothobranchius* proteome (261,318 entries). R software was used to analyze the reports that were generated in DIA-NN. A large number of proteins were differentially expressed between environments and across age groups. We observed pronounced sex-specific differences, with males and females following distinct trajectories of proteomic aging. We also noted environment specific differences. Compared to laboratory raised fish, mesocosm-reared fish showed upregulation of proteins involved in energy metabolism (NDUFA2, NDUFB4, SDHA), oxidative phosphorylation related proteins (COX5B, COX6B1, COX6A1, COX6A2), stress response (HSPA8, AHNAK), fatty acid metabolism (ACADS, ACADSB, ACADM, ACADVL), lipid metabolism (APOA2), and structural remodeling (ACTN4, TPM4, MYLZ, KRT5). The findings demonstrate that the rate of proteome aging is faster under semi-natural conditions relative to the laboratory, highlighting the importance of environmental exposures in shaping biological aging.

Optogenetic Stimulation of The Basal Forebrain after Traumatic Memory Extinction Underscores the Necessity Of Sleep for the Consolidation Of Extinction Learning

Meet Parikh[1*], Rishi Sharma[2], Mahesh M. Thakkar[3]
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Background: Post-traumatic stress disorder (PTSD) is marked by persistent traumatic memories and profound disruption of sleep–wake regulation. Predator odor trauma (POT) in rodents serves as a robust model for PTSD-like symptoms, including anxiety, hyperarousal, and fragmented sleep. The basal forebrain (BF) has been implicated in both extinction learning and sleep control. Optimal consolidation of memory requires 8 hours of sleep. However, the role of sleep following the extinction process has not been extensively explored.

Methods and Materials:

Surgery

Adult male C57BL/6J mice (n = 8 per group; ~8 weeks old, 22–25 g) underwent stereotaxic surgery for bilateral optic fibers implanted targeting the basal forebrain (BF). In addition, 3 cortical EEG electrodes and 3 nuchal EMG electrodes were implanted for polysomnographic recordings.

Experimental Paradigm

Mice were randomly assigned to either a no odor control (NOC) group or a predator odor trauma (POT) group. On Day 1, traumatic memory acquisition (TMA) was induced in POT mice by a 5-min contextual exposure (conditioned stimulus) immediately followed by 15-min exposure to predator odor (unconditioned stimulus: soiled cat litter). NOC mice were exposed to the context with unused Cat Litter. On Day 3, traumatic memory extinction (TME) was carried out by re-exposing both groups to the same context for 30 min in the absence of odor, serving as extinction learning. Immediately following TME, channelrhodopsin-2 (ChR2)-expressing neurons in the BF were optogenetically stimulated using continuous 532 nm laser light at 10 Hz frequency with 5 ms pulse width for 30 min/session. Day-4 Traumatic memory recall was performed by re exposing them to the context for 10 min. A separate groups of mice were euthanized; brains were collected and processed for c-Fos immunohistochemistry to validate neuronal activation within the BF.

Results: Optogenetic stimulation of BF neurons following TME significantly increases POT-induced hyperarousal and anxiety-like behavior. Furthermore, extinction recall was demonstrated by increased theta–gamma activity during context re-exposure, indicating the significance of sleep.

Conclusion: Optogenetic stimulation of the basal forebrain after traumatic memory extinction underscores the necessity of sleep for the consolidation of extinction learning. These results emphasize the pivotal role of BF circuits in trauma-related sleep and memory regulation.

Effect of Bovine *In Vitro* Embryo Production on Fetal IGF System Signaling

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In vitro production (IVP) of embryos is used to promote rapid genetic improvement in cattle. IVP embryos exhibit epigenetic alterations that affect expression of imprinted and non-imprinted genes resulting in altered fetal and placental growth. Genomic imprinting is an epigenetic mechanism controlling parental allele-specific expression of genes that regulate growth and development of the fetus and the placenta. Results from our and other laboratories have identified insulin like growth factor receptor 2 (IGF2R), a maternally-expressed gene, to be downregulated in overgrowth. IGF2R targets IGF2 (a paternally-expressed fetal growth factor) for degradation. IGF2 signals via the IGF1R and insulin receptor A to stimulate the PI3K-AKT pathway. Here we aimed to establish if IVP affects the IGF signaling system in day 105 conceptuses. We used AI (n=8) and IVP (n=8) fetuses to start characterizing the IGF signaling pathways in muscle and liver. For this, the abundance of IGF2, IGF1R, IGF2R and of proteins in the PI3K/AKT pathway (PI3K subunit p110 total and phosphorylated, AKT total and phosphorylated and mTOR total and phosphorylated) were detected with Western blot and protein-specific results were normalized using total protein normalization method and quantified using ImageJ (NIH). Initial results show that liver of fetuses derived from IVP had an increase of 477% in the abundance of IGF2 ($p=0.03$) and this was accompanied with a reduction of 18% in the abundance of IGF2R ($p=0.07$), while no differences were observed in the abundance of IGF1R. In muscle, and contrary to liver, IVP fetuses had a reduction of 53.12% of IGF2 ($p<0.0001$) and an increase of 54.28% in the abundance of IGF1R ($p=0.0021$), while no differences were observed for IGF2R. Next, we examined abundance of kinases of the PI3K/AKT pathway in fetal muscle and found that that IVP fetuses had 47.8% less p110 total than controls ($p=0.001$) but an 81.3% increase in the ratio of phosphorylated p110 ($p=0.001$), indicating an increased rate of activation of this kinase. No differences were observed in the abundance of AKT total and phosphorylated between groups. The total levels of mTOR were increased by 58.45% ($p=0.08$) and phosphorylated mTOR was decreased by 45.37% ($p=0.01$) in IVP derived fetuses. The ratio of phosphorylated mTOR was reduced 68.44% in muscle of IVP fetuses ($p=0.01$). In summary, these preliminary results suggest that epigenetic alterations occur in IVP embryos prior to transfer which affect regulation of the IGF signaling system during fetal development in cattle.

Spermine Catalyzes Isomerization of The Sugar-Phosphate Backbone to A Non-Canonical DNA Backbone at an Apurinic/Apyrimidinic Site in Duplex DNA

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The loss of nucleobases from the DNA backbone to produce apurinic/apyrimidinic (AP) sites is a common, unavoidable reaction in cellular DNA. Due to the acidic nature of the α-proton in the ring-opened aldehyde form of AP site, these sites can easily undergo strand cleavage through β-elimination. This can occur spontaneously under physiological conditions or be catalyzed by heat, biological amines, NaOH, or repair enzymes such as AP endonucleases. Our group has shown that the biological polyamine spermine catalyzes AP site cleavage to yield a reactive α,β-unsaturated iminium ion (3′ddR-Sp$^+$), which can form a dG-ddR interstrand crosslink (ICL) with the N^2-amino group of guanine on the opposing strand. Here, we report a novel reaction in which the ddR-Sp+ sugar remnant on the 3'-terminus of the strand break reacts with the exocyclic N^2-amino group of a guanine residue at the 5'-terminus of the strand break. Our results indicates that the guanine residue on the 5'-terminus of the strand break adds back to the 3'ddR-Sp+ sugar remnant on the 3'-end of the strand break via 1,4-conjugate addition. This spermine-catalyzed strand breakage-religation sequence results in isomerization of the native sugar-phosphate backbone to a non-canonical DNA backbone at an AP site in duplex DNA.

Identifying PRDM Family Members Potentially Involved in Epigenetic Reprogramming after Fertilization in Porcine Embryos

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At fertilization, a wave of epigenetic reprogramming initiates transformation of germ cell specific epigenetic marks to embryo specific marks. This epigenetic remodeling is critical for pluripotency and zygotic genome activation (ZGA). A rapid decrease in DNA methylome is observed in multiple species, which is mediated by the TET (1-3) enzyme family. The TET3 protein is detected in oocytes and zygotes while TET1 is enriched later, in the inner cell mass (ICM) of blastocysts. The PRDM (1-19) family are transcription factors known to possess epigenetic reprogramming capacity. The member, PRDM14, will cofunction with TET1 to promote lineage differentiation in blastocyst. The structure of the PRDM family is highly conserved, suggesting multiple PRDM family members may be involved in epigenetic reprogramming during early development. We hypothesize that PRDM family members interact with the TET enzymes, fine-tune DNA methylation, and establish pluripotency in embryos. In this study, we characterized PRDM family expression and identify two candidates of the PRDM family that may cofunction with TET3 to initiate zygotic genome activation. In the first experiment, porcine ovaries were obtained from a local abattoir. Oocytes were matured, fertilized *in vitro*, and cultured for up to 7 days. Oocytes and embryos were randomly collected throughout *in vitro* production. RNA was extracted, and qRT-PCR was used to quantify expression. Exogenous GFP transcripts were used to normalize CT values, and five biological replications were performed. The expression patterns of *PRDM1*, *PRDM2*, *PRDM4*, *PRDM5*, and *PRDM6* indicated that they were maternal transcripts and not activated after ZGA (P=0.01). Six other *PRDM* members were identified, but their expression varied throughout development (P=0.02). We identified that *PRDM5* and *PRDM6* have the greatest expression in oocytes. We performed joint knockdown of the transcripts to characterize their function. Metaphase II oocytes were injected with a *PRDM5*/*PRDM6* siRNA mixture (50μM) or H2O (SHAM control). After *in vitro* fertilization, zygotes were cultured for 16 hours. Transcript knockdowns were verified with a 7.2-fold reduction in *PRDM5* and a 3.2 fold reduction in *PRDM6*. Embryos underwent immunocytochemistry staining for 5-hydroxymethylcytosine (5hmC), the byproduct of the TET enzyme reaction. The pronuclei were counterstained with DAPI. Three biological replications were performed (n=11). Following the *PRDM5*/*PRDM6* siRNA knockdown, there was ablation of the 5hmC mark. These results implicate PRDM5 and/or PRDM6 in regulation of TET3 during embryonic reprogramming. Future studies will elucidate the interaction between the PRDM and TET families. This work is supported in part by USDA-NIFA 2022-67015-36299.

Overcoming Early-Life Lethal Phenotypes to Develop a Distinct Mouse Model for Baker-Gordon Syndrome Using CRISPR-Cas9 Gene Editing Approaches

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Baker-Gordon syndrome is a rare neurodevelopmental disorder diagnosed in children with severe developmental delays and characterized by mutations in the synaptotagmin-1 (*SYT1*) gene. The *SYT1* gene codes for the protein synaptotagmin-1 (SYT1), which is a neuronal synaptic vesicle protein required to facilitate proper neurotransmitter release. Improperly functioning mutant SYT1 results in a dominant-negative phenotype by interfering with wildtype protein function, and homozygosity of mutant SYT1 is not viable with life. Currently, no treatment for Baker-Gordon syndrome exists, and little is known about the factors driving variable symptoms in patients. To better understand how these mutations cause disease, we developed a distinct mouse model to emulate the disease for characterization. This model used CRISPR-Cas9 gene editing to incorporate a D365E missense mutation into the endogenous mouse *Syt1* gene. To limit lethal homozygous gene editing, we forced heterozygosity by inserting an *Syt1* Y364Y silent mutation directly upstream of the desired mutation. We hypothesized that a CRISPR-Cas9 complex specific for the Y364Y mutation would selectively target and incorporate the desired D365E mutation into the Y364Y allele while leaving the *Syt1* wildtype allele unedited. This technique did successfully allow for the selective insertion and expression of the D365E *Syt1* mutant allele as confirmed by both DNA and RNA sequencing analysis demonstrating this approach worked to create heterozygous animals. Additionally, the model also exhibits a strong failure to thrive phenotype similar to the clinical signs seen in many affected human patients. In conclusion, this model and the strong phenotype it displays will be beneficial for the investigation of the specific mechanisms of pathogenicity and for the evaluation of potential therapeutics for Baker-Gordon syndrome.

Methionine Sulfoxide Reductases Play a Central Role in *Arabidopsis* Seed Proteome and Metabolic Homeostasis

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Seed storage protein (SSP) knockouts in Arabidopsis and other species trigger a robust reprogramming of the seed proteome, leading to rebalancing of amino acid profiles and carbon and nitrogen and sulfur. Recent findings from our lab suggest that reactive oxygen species (ROS) play a pivotal role in orchestrating this response. Notably, we observed strong upregulation of genes involved in ROS detoxification, particularly *Methionine Sulfoxide Reductases* (*MSRB1* and *MSRB6*), which are central to protein repair by reducing oxidized methionine residues and mitigating oxidative damage.

To investigate the functional role of these enzymes in seed proteome and metabolic homeostasis, we characterized *msrb1* and *msrb6* T-DNA insertion mutants and miRNA-mediated knockdown lines. Our preliminary results indicate significant changes in ROS levels, seed weight, C/N balance, and sulfur content—supporting the hypothesis that MSRBs are integral to maintaining redox balance and metabolic homeostasis in seeds.

As a next step, we are developing overexpression lines for *MSRB1* and *MSRB6* and conducting proteomic analyses of the mutant and overexpression seeds. These efforts aim to determine whether altering MSRB activity disrupts or modulates the proteome rebalancing mechanism and seed proteome homeostasis. Our findings will provide new insight into how redox homeostasis intersects with translational and metabolic regulation during seed development.

Uncovering *Arabidopsis* Root Defense: Transcriptomics and Mutant Screening Against Broomrape, *Phelipanche aegyptiaca*

Supral Adhikari

Broomrape, *Phelipanche aegyptiaca,* is an obligatory root parasitic plant that attacks a broad range of economically important crops, significantly affecting global agriculture. This parasitic weed attaches to the roots, penetrates with haustoria, and makes a vascular connection with the host plant through which it uptakes water, minerals, and nutrients for the growth and completing its life cycle. The vascular connection establishment with the host roots and uptake of the essential resources from the host cause severe yield losses. So, it is of utmost necessity to understand the host-parasite interaction, mainly host-defense responses. To understand more about the defense response of the host against this parasite, we performed transcriptomic analysis using RNA sequencing of *Arabidopsis thaliana* and *Lycopersicum esculentum* (tomato) roots infested by *P. aegyptiaca* on different time points after infection (1,2,3,5,7, and 10 days after infection). These multiple time points after infection led to the identification and analysis of the gene expression during the early stages of parasitization. From the RNA-seq data analysis, strongly upregulated and downregulated genes in response to the infection were sorted out, and potential candidate genes involved in host defense pathways were selected. These potential candidate genes were then screened to characterize their gene functions. The *Arabidopsis* knockout (KO) lines of these potential candidate genes in *Arabidopsis* were grown on an artificial bag system and infected with *P. aegyptiaca.* The number of *P. aegyptiaca* tubercles was counted, and the diameter of *P. aegyptiaca* was measured after two weeks of infection to compare the development between control and KOs. From the screening results of 40 *Arabidopsis* KO lines, it was found that four lines of *Arabidopsis* showed a significant difference in the number of tubercles compared to the control, indicating that these genes play important roles in the host resistance against *P. aegyptiaca*. The future direction for this research project is to conduct the screening in tomatoes using hairy root transformation, considering the potential candidate genes from the tomato RNA-seq results. These findings provide valuable insights into the host-defense response against the parasitic plant *P. aegyptiaca* and provide the baseline to develop crop varieties with enhanced resistance against this root parasite.

Investigation of The Interaction Mechanism Between Purple Corn Anthocyanins and Protein and Its Impact On Anthocyanin Stability

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Anthocyanins (ACNs) are water-soluble flavonoid pigments that are widely found in fruits and vegetables and have attracted much attention due to their antioxidant, anti-inflammatory and anti-tumor biological activities. However, the easy fading of ACNs in foods and beverages limits their shelf life and product quality. Although co-pigments can enhance the stability of ACNs, studies on the interaction of ACNs with proteins or amino acids are still limited. The protective effect of protein or amino acids on the stability of ACNs and its mechanism were studied in a beverage model containing L-ascorbic acid (AC) at pH 3.0. Ultraviolet-visible spectrum (UV-Vis) results showed that whey protein isolate (WPI) could inhibit the fading of ACNs in beverage models. Molecular dynamics (MD) simulations showed that the binding of cyanidin-3-O-glucoside (C3G) to beta-lactoglobulin (β-LG, the main component of WPI) was influenced by the location of glycoside oxygen atoms, which were more likely to bind to polar or charged residues (e.g. Gln, Asp, Glu) than to hydrophobic residues (e.g. Trp, Phe). Based on these findings, the study selected eight amino acids from MD simulation, covering all types of side chains (i.e., R groups), and identified their effects on ACNs stability. These included negatively charged amino acids (Asp, Glu), positively charged amino acids (His), polar-uncharged amino acids (Gln), and hydrophobic amino acids (Ala, Val, Phe, Trp). Stability studies had shown that hydrophobic amino acids, especially Trp, provided the best protective effect. Fluorescence quenching analysis between Trp and ACNs indicated that Trp quenched the fluorescence of ACNs via a static quenching mechanism, primarily driven by electrostatic interactions and hydrophobic force. Additional hydrophobicity studies supported that the stabilization of ACNs by WPI was likewise dominated by hydrophobic force.

A New Model of Cardiovascular-Kidney-Metabolic (CKM) Syndrome in Naturally Aged Swine

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Background: Cardiovascular-Kidney-Metabolic (CKM) syndrome (a new disease coined by the AHA in 2023) consists of complex pathophysiological interactions between metabolic factors and the renal and cardiovascular systems, resulting in an often progressive multiorgan dysfunction. Recent studies reveal that up to 90% of US adults meet criteria for CKM syndrome stage 1 or greater, and that older adults have higher prevalence rates of CKM syndrome with more severe outcomes. Unfortunately, CKM syndrome has limited therapeutic options, in part due to the lack of large animal models that permit translational studies. Thus, we report the first large animal model of CKM syndrome in naturally aged swine.

Methods: CKM was induced in naturally aged domestic pigs (*sus scrofa domesticus*, 6-9 years of age) via bilateral renal artery stenosis combined with a high-cholesterol/high-carbohydrate diet. Animals were studied longitudinally and followed for 14 weeks, and additional pigs without CKM were used as controls (n= 6/group). Renal (multi-detector CT) and cardiac (echocardiography, pressure-volume relationships) hemodynamics were quantified *in vivo*. *Ex vivo* studies were performed for analysis of metabolic parameters, renal and cardiac microvascular (MV) architecture (3D-micro-CT), and morphometric analysis (trichrome). Statistical analysis completed using parametric student's t-test or non-parametric Kruskal-Wallis tests when appropriate.

Results: Pigs with CKM syndrome recapitulated many features of CKM syndrome stage 2-3. CKM syndrome pigs developed hypertension, left ventricular hypertrophy, and moderate cardiac fibrosis, accompanied by cardiac stiffness and impaired diastolic relaxation, prominent features of heart failure with preserved ejection fraction (a critical component that associates with adverse outcomes in CKM syndrome). In addition, CKM syndrome pigs developed chronic kidney disease, subcutaneous and visceral adiposity, hypercholesterolemia, hypertriglyceridemia, and insulin resistance. In addition, the cardiac and renal microvascular architecture was significantly disrupted, showing a marked microvascular rarefaction (subendocardial, cortical, and medullary, respectively) compared to normal controls.

Conclusions: The age-dependent increase in the prevalence of CKM syndrome demands translational preclinical platforms. This work reports the first large preclinical model of aging with CKM syndrome. This new translational platform will enhance our understanding of the pathophysiology of CKM syndrome and potentially aid in identifying new, druggable cardiac, renal, and metabolic targets to halt the progression of this disease.

Characterization of ATPase DotO in Dot/Icm T4SS of *Legionella pneumophila*

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Legionella pneumophila, a Gram-negative pathogen utilizes a Type IV Secretion System (T4SS) for the translocation of ~300 effector proteins to disrupt host cell functions during infection. This T4SS comprises ~33 protein components spanning both bacterial membranes, among which are three ATPases: DotO, DotB, and DotL. These ATPases are thought to power transport through the T4SS, but there is lack of understanding about how the effector proteins are translocated. The most poorly understood ATPase is DotO. Therefore, this research aims to elucidate the structure and function of DotO to understand its role, particularly in assembly and substrate translocation using structural biology, biochemical, and biophysical approaches. To investigate this, we have isolated and purified DotO using an *E. coli* expression system. The purified protein was used for structure determination via cryo-EM and functional studies were employed to characterize its ATP binding, hydrolysis and its substrate engagement. This study will provide new insights into the structural role of DotO and its contribution to *Legionella's* ability to secrete effector proteins during infection.

Developing Super-resolution Imaging Techniques to Elucidate AAV's Cell Entry Mechanism and Interactions with GPR108

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Adeno-associated viruses (AAVs) are leading gene therapy vectors owing to their low pathogenicity, broad tissue tropism, and capacity for sustained gene expression. Clinical use of AAV is limited by poor transduction efficiency, which necessitates high vector doses (10^{12}–10^{14} vg/kg) that increase the risk of dose-dependent toxicities. Adeno-Associated Virus Receptor (AAVR) has been identified as the main or the primary receptor for multiple AAV serotypes with various established molecular characterization of AAV-AAVR interactions. Nonetheless, recent Genome-wide CRISPR screens have implicated the host G protein–coupled receptor (GPR108) as a conserved entry factor required for efficient transduction by multiple AAV serotypes. However, the molecular details of AAV–GPR108 interactions and the intracellular trafficking pathway of AAV remain unknown, hindering rational vector improvement. We seek to address these challenges with two project aims. Aim1 will develop and optimize STED and MINFLUX super-resolution microscopy protocols to visualize and track the mechanism of entry of fluorescently labeled AAV particles in both live and fixed cells. We will track individual viral particles with <50 nm spatial and <50 ms temporal resolution to map their movement from the plasma membrane through endocytic compartments and identify colocalization with known trafficking markers (e.g., endosomal and Golgi proteins). Aim 2 will define the molecular interactions between AAV and GPR108 and locations of such interactions in both live and fixed using dual color super resolution imaging techniques. Completion of these aims will (1) elucidate the dynamic entry and trafficking pathway of AAV at nanometer resolution, (2) define the physical interactions that mediate GPR108-dependent AAV entry, (3) provide foundational insights to guide engineering of next-generation AAV vectors with enhanced transduction efficiency and reduced dosing requirements, and (4) establish advanced imaging workflows broadly applicable to the study of virus–receptor interactions.

Investigating the Role of AAV2 VP1u in Cellular Trafficking

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Adeno-associated virus (AAV) vectors are widely used in gene therapy due to their ability to transduce diverse tissues with sustained gene expression and low pathogenicity. Despite clinical success, therapeutic applications often require high vector doses, increasing the risk of immune responses and toxicity. A critical bottleneck is inefficient endosomal escape a necessary step for successful gene delivery which depends on the phospholipase A2 (PLA2) domain in the VP1 unique (VP1u) capsid protein. Normally sequestered inside the capsid, VP1u must undergo conformational exposure to mediate membrane disruption. However, the physiological triggers and structural mechanisms governing VP1u extrusion remain poorly understood. The long-term objective of this project is to uncover the molecular basis of AAV uncoating and endosomal escape to guide the rational design of improved gene therapy vectors. The central hypothesis is that heat mimics key physiological cues that trigger capsid rearrangements and VP1u exposure. Understanding this process will inform strategies to enhance AAV intracellular trafficking and reduce vector dose requirements.

Unlocking Economic Potential for Soybean Grain Quality Through Segregated Harvesting

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Soybean is one of the world's premier oilseed crops, supplying vegetable oil for food and biodiesel, protein meal for animal feed, and specialty human foods. While yield drives volume, economic value hinges on grain quality, especially protein and oil concentrations. Although the influences of genotype, environment, and management on quality variation are well studied, farm-scale fields planted to a single variety still exhibit substantial within-field variation in these traits. This study emphasizes environmental drivers, which a GEM regional study found to account for ~70% of variation in grain quality. Mapping such variations is key to maximizing returns via segregated harvesting, directing high-protein zones to livestock feed and oil-rich areas to biofuel processors. Prior studies show that a 1% increase in soybean protein (from 44% to 48%) boosts the value of resulting meal by over $10/MT for swine feed and $12/MT for poultry, reducing reliance on synthetic supplements and cutting supply chain costs. This study develops predictive models for such spatial variation. The top performer, an XGBoost model, achieves RMSEs of 0.69% (R^2=0.36) for protein and 0.51% (R^2=0.15) for oil—enabling precise zoning at harvest. Future refinements will enhance generalization across wider variation windows, paving the way for scalable segregation that could add $0.50–$1.00/bushel in premiums while streamlining global food-energy flows.

Polyclonal Antibody Recognition and Immune Neutralization of AAV Gene Therapy Vectors

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Adeno-associated virus (AAV) is a promising gene therapy vector due to its safety and broad tissue tropism. However, a major challenge is that pre-existing neutralizing antibodies from the humoral immune response can swiftly intercept and block AAV vectors before they deliver their therapeutic payload. Previous studies have shed light on how monoclonal antibodies recognize and neutralize AAV vectors, but how these findings translate to the complex, polyclonal antibody environment remains poorly understood. In this study, we examined non-specific polyclonal IgGs for their binding potential to AAV-2 capsid, and early findings suggest limited detectable binding. This ongoing work aims to clarify mechanisms of polyclonal neutralization and ultimately inform the design of next-generation immune-evading vectors.

Schwann Cell Proliferation in The Adult PNS Challenges the Long-Term Durability of AAV Gene Therapies

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Myelin, a fatty substance formed by Schwann cells in the peripheral nervous system (PNS), insulates axons and allow rapid action potential propagation through saltatory conduction. Dysmyelination in the PNS is one of the pathological hallmarks of Charcot-Marie-Tooth disease type 1A (CMT1A) and Hereditary Neuropathy with Liability to Pressure Palsies (HNPP), debilitating inherited peripheral neuropathies driven by duplication or deletion of the *Peripheral Myelin Protein 22 (PMP22)* gene. While single-dose AAV-based gene therapies represent a promising therapeutic strategy, their long-term efficacy is uncertain. Myelinating Schwann cells, the primary therapeutic target, are not terminally post-mitotic and retain the ability to dedifferentiate and proliferate, raising concerns that transgene expression may be diluted over time due to natural myelin turnover. To investigate this phenomenon, we quantified Schwann cell proliferation in healthy adult mice and HNPP model mice using Bromodeoxyuridine (BrdU) labeling. We show myelin turnover in both healthy adult control and HNPP model mice. This ongoing proliferation indicates that as the Schwann cell population expands, therapeutic AAV transgene expression may progressively decline, potentially limiting the durability of single-dose treatments. These findings provide a crucial framework for developing next-generation AAV therapies, highlighting the need for strategies that ensure stable, long-term transgene expression in the dynamic cellular environment of the PNS.

Key Words: Charcot-Marie-Tooth Disease Type 1A (CMT1A), Hereditary Neuropathy with Liability to Pressure Palsies (HNPP), Peripheral Myelin Protein 22 (PMP22), Single dose AAV-based gene therapy, Schwann Cell, Bromodeoxyuridine (BrdU), Myelin, Microscopy

Sex-related Differences in Diabetes, Obesity, and Dyslipidemia as Cardiovascular Disease Risk Factors

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Cardiovascular disease (CVD) remains the leading cause of mortality worldwide, with diabetes, obesity, and dyslipidemia representing major modifiable risk factors. Historically, men have been viewed as having greater cardiovascular risk; however, emerging evidence demonstrates that women lose their cardioprotective advantage in the presence of metabolic disorders. This narrative review synthesizes current literature on sex-specific differences in the pathophysiology, clinical expression, and management of metabolic CVD risk factors, emphasizing biological and social determinants that contribute to observed disparities.

In diabetes, both type 1 and type 2, women experience a disproportionately higher relative risk of coronary heart disease, heart failure, and all-cause mortality compared with men. Mechanistically, the loss of estrogen-mediated vascular protection, greater visceral adiposity, and a more adverse inflammatory and lipoprotein profile contribute to this excess risk. Women also demonstrate greater insulin resistance and endothelial dysfunction at comparable glycemic levels. Compounding these biological factors, women remain less likely to receive cardioprotective therapies such as statins, ACE inhibitors, and SGLT2 inhibitors, which further amplifies cardiovascular morbidity. Sex-related differences in adipose tissue distribution and function also underlie divergent cardiovascular risk. Women generally possess higher total fat mass and preferential gluteofemoral deposition, whereas men accumulate more visceral fat. Following menopause, however, women undergo a shift toward central adiposity, which increases insulin resistance and systemic inflammation. Obesity-induced remodeling of adipose tissue—marked by macrophage infiltration, cytokine release, and endothelial dysfunction—appears more pronounced in women. Novel anti-obesity pharmacotherapies, including GLP-1 and dual GIP/GLP-1 receptor agonists, demonstrate efficacy across sexes, though representation of women in pivotal trials and equitable access remain limited.

Regarding dyslipidemia, men typically display higher triglyceride and LDL-cholesterol concentrations, yet the atherogenic consequences of these abnormalities are often more severe in women. Postmenopausal declines in estrogen, together with undertreatment of lipid disorders, further worsen cardiovascular outcomes. While statins, PCSK9 inhibitors, and bempedoic acid effectively reduce events in both sexes, women continue to be prescribed lipid-lowering therapy less frequently and at lower intensities. Future directions should include greater inclusion of women in mechanistic and therapeutic studies, elucidation of hormone and sex-chromosome effects on metabolism, and interventions that address healthcare inequities. Understanding and targeting sex-specific variations in metabolic risk is essential for precision cardiovascular prevention and achieving equitable outcomes in cardiometabolic health.

Interpreting Rabies Titer Testing and Pet Travel Regulations: A Mixed Methods Study of Public Health and Professional Understanding

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Rabies is one of the oldest known zoonotic diseases, with documented cases dating back to 2000 BCE. Despite global prevention efforts including mass vaccination, active surveillance, and isolation protocols, rabies remains a significant One Health and public health concern. Pet travel regulations, particularly those involving dogs, are an important part of the prevention of rabies. However, the rationale behind these policies is often poorly communicated to pet owners and the public. This lack of clarity can lead to confusion around preventive measures such as rabies titer testing. This preliminary mixed methods study used a Knowledge, Attitudes, and Practices (KAP) survey to explore how veterinary professionals, veterinary students, and pet owners understand rabies vaccination, titer testing, and pet travel regulations. Thirty-eight individuals responded to the survey, with 30 responses included in the final analysis. Most respondents were veterinary technicians (68 percent), followed by pet owners (21 percent), veterinary students (9 percent), and veterinarians (3 percent). The results showed that 63.3 percent of respondents completed at least five of the eight knowledge-based questions, while 23.3 percent completed all, suggesting possible survey fatigue or uncertainty. Among the 19 individuals who completed the attitude section, 74 percent reported confidence in distinguishing titers from vaccines, 84 percent supported using titers in place of automatic boosters, and 89 percent identified the lack of a national rabies tracking system as a challenge. Veterinary professionals expressed moderate support for formal titer acceptance, although 38 percent were hesitant due to inconsistent policies. Additionally, 60 percent of pet owners stated they would prefer titer testing over revaccination if it were legally accepted. Open-ended responses reflected common concerns related to financial burden, need for education, vaccine hesitancy, absence of a national database, and underuse of titer testing. Respondents consistently supported national tracking and improved educational materials across professions and the public. Future research should prioritize engaging early-career professionals and pet owners to strengthen prevention efforts. Expanding this work to high-incidence regions in the United States such as Texas, California, and New York would help address national gaps, while extending analyses to international contexts including Brazil, Russia, and Germany could offer valuable insights into global trends and disparities in rabies prevention.

PHYSICAL SCIENCES AND MATHEMATICS

Quantitative X-ray Diffraction Analysis of 2D-Oriented Powders with Area Detectors

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Two-dimensional van der Waals materials exhibit layered, anisotropic structures that produce unique X-ray diffraction signatures. Unlike 3D powders which exhibit diffraction rings, van der Waals materials often exhibit 2D-oriented powders which generate diffraction spots. Area detectors enable rapid and comprehensive collection of this information. We present a combined experimental and simulation framework for capturing and interpreting these hybrid ring-spot patterns, incorporating a ray-tracing approach for transmission, mosaic distributions for broadening, and stacking faults that produce diffuse scattering, yielding refined structure factors, mosaic parameters, and stacking-disorder probabilities. This approach provides a quantitative path for analyzing 2D-oriented powders and extracting structural information that traditional 3D powder or single-crystal methods cannot readily provide.

A Tale of Two Scalids: Priapulid Affinity with a Cambrian Cone

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Early Cambrian small shelly fauna (SSF), a diverse group of millimetric fossils originating approximately 538 million years ago, include numerous problematic taxa. These taxa possess distinctive morphologies, but their affinity is unknown, and many are speculated to represent skeletal components of more complex animals. Among these is the cone-shaped, spine-like microfossil *Stoibostrombus crenulatus* (Conway, Morris, & Bengtson 1990), whose taxonomic position remains uncertain. Previous interpretations of these endemic South Australian forms proposed an affinity with paleoscolecid worms, known from coeval assemblages. In this study, we re-examine the morphology and ultrastructure of *S. crenulatus* through multiple imaging approaches and comparative anatomy to test a hypothesized link to sclerite-bearing priapulid worms.

Priapulids span from the Cambrian to the present and are abundant in Cambrian deposits, yet their preservation is typically restricted to exceptional Lagerstätten, with no confirmed occurrences in lower Cambrian SSF-bearing limestones of South Australia.

Specimens of *S. crenulatus* from the Ajax Limestone and Mernmerna Formation (Cambrian Series 2, Stage 3) in the Flinders Ranges were analyzed using scanning electron microscopy (SEM) and X-ray microscopy (μCT). Additionally, a modern priapulid, *Priapulus caudatus*, was μCT scanned following staining, enabling detailed comparison of spine-like structures. These analyses reveal morphological parallels that suggest a potential relationship between *Stoibostrombus* sclerites and priapulid dermal spines. Such an interpretation would extend the known paleogeographic distribution of Cambrian priapulids into eastern Gondwana and underscores taphonomic biases influencing their recovery in SSF assemblages.

Hot on the Heels of Extinction: Tracing Post-Impact Warming of the Brazos River Region Through Oxygen Isotopes

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The Chicxulub impact event at the Cretaceous–Paleogene (K/Pg) boundary triggered a global mass extinction which ended the age of dinosaurs and set the stage for the subsequent age of mammals. Establishing the magnitude and rate of post-impact temperature change is critical for accurately characterizing climate dynamics in the aftermath of catastrophic events, thereby increasing the relevance of the study to modern contexts. This research applies a well-established method to estimate temperature from the ratio of 18O/16O in phosphatic microfossils from the Brazos River region (Falls County, Texas) compared to a modern reference standard. The aim of this research is to create a detailed timeline of temperature changes after the impact. A detailed sequence of post-impact temperature change in the Brazos River region, potentially at decadal-scale resolution, has been constructed by combining sedimentation rates inferred from iridium concentrations and microfossil assemblages to this isotope palaeothermometry

Specifically, our results indicate a ~1‰ decrease in δ18O equating to an approximate 4–6°C increase in temperature beginning ~130 cm above the K/Pg boundary. This level coincides with the level of the termination of the "impact winter" documented in a nearby section and could represent a time less than a decade from the Chicxulub event. The results provide new constraints on the timing and magnitude of post-impact warming, illustrating the rapid environmental response to an extreme event. Establishing this timeline enhances our understanding of temperature change following rapid global events and offers a valuable analog for assessing potential environmental responses to modern anthropogenic impacts on similar timescales.

Nitrogen Effects on Forage Utilization and Economic Returns in Grazing and Haying Systems

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Forage productivity and profitability are essential in both grazing and haying systems. This study evaluated haying and rotational grazing systems and nitrogen rates compared to overseeding birdsfoot trefoil (*Lotus corniculaatus*; BFT) on an Armstrong Loam (Aquertic Hapludalfs). Forage biomass was consistently higher under grazing, with its advantage widening as N increased. Both systems displayed diminishing marginal returns, but grazing achieved greater fertilizer efficiency, producing 13.3 lb forage for each lb of N applied compared to 10.1 lb under haying. Forage biomass was 21% higher when grazed rather than hayed for treatments where BFT was sown without additional N. The haying system produced 75% and 146% more utilized forage than the rotational grazing system at 60 and 180 lb N acre^{-1}, respectively. Forage utilization under rotational grazing peaked at 1,916 lb acre^{-1} at 60 lb N acre^{-1} and declined further with higher N rates. However, haying utilization increased steadily from 1,824 to 3,648 lb acre^{-1} at 0 and 180 lb N acre^{-1}, respectively. Grazing produced more net income and varied by N rate, with 0 lb N acre^{-1} producing the lowest income ($33 acre^{-1}) and 60 lb N acre^{-1} producing the greatest return ($232 acre^{-1}). Haying incurred losses at all rates ($-13 to $-34 acre^{-1}). Under the conditions evaluated, grazing is more economical and resource-efficient especially at moderate N levels.

Conformer Distribution of Normal Propyl Cyanide in Neat and Water-Rich Ices Probed by Broadband Rotational Spectroscopy

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Recent detection of linear and branched isomers of propyl cyanide (C_3H_7CN) in the interstellar medium (ISM) has prompted extensive experimental and theoretical investigations.[1-4] In this study, we examine the conformer distribution of **normal** propyl cyanide (*n*-PrCN) under astrophysically relevant conditions. *n*-PrCN exhibits two primary conformers – anti and gauche – with the gauche conformer being more stable by approximately 97±21 cm^{-1}. We compare the conformer distribution in neat *n*-PrCN ices, both amorphous and crystalline, as well as in mixed water ices. In this work, chirped-pulse mm-wave rotational spectroscopy coupled with buffer gas cooling was employed to measure the gas-phase distributions of species following temperature programmed desorption (TPD). In addition, *in situ* monitoring of the ice via Fourier Transform Infrared Reflection Adsorption spectroscopy (RAIRS) allowed us to compare the conformer distribution of *n*-PrCN within neat and water-rich ices as the ice was heated up. Our results indicate that while the amorphous neat n-PrCN ices consist of both conformers, the crystalline form is made up of only the gauche species. As water is added to the ice, the gauche to anti ratio increases, suggesting a conformer preference in ice dictated by the presence of water and corresponding hydrogen-bonded network. These experimental results provide insight into how the ice matrix influences conformational preferences relevant to astrochemical environments.

Anti-Parkinson's Therapeutic Discovery- A Computational Approach

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Next to Alzheimer's, Parkinson's ranks second among the most common neurodegenerative diseases, with over 25 million individuals projected to be living with this illness in 2050. Present treatments have been developed to mitigate the symptoms of Parkinson's, but none have been able to halt or slow down the disease progression. This study involves the collaboration of industry and academia, with the goal of discovering anti Parkinson's therapeutic [1].

Our approach uses winning hits from the scientific challenge CACHE (Critical Assessment of Computational Hit-Finding Experiments), with known binding free energy which was experimentally determined. Then, we aimed to identify molecules that can better bind to our target of interest, resulting in a potential therapeutic mechanism. Here, we explore the WD40 domain of LRRK2, a protein whose mutation is primarily associated with Parkinson's disease. An initial binding pose was obtained using hits from the winning submissions of the challenge, and in a bid to identify a more probable binding pose, pocket identification and redocking was done [2].

An ideal pose of the reference hit and protein complex's ABFE (Absolute Binding Free Energy) is calculated to achieve a more optimal binding affinity. Following this, analogs similar to the reference hits are retrieved by virtually screening the Enamine library, which contains commercially available compounds, and then template docking of these analogs to our reference pose is performed. An iterative approach known as Active Machine Learning is then deployed in computing the RBFE for these analogs. Compounds with stronger binding affinities relative to the reference hit are selected for purchase and experimental validation to determine their potency. The result of this study will lead to a therapeutics pathway for Parkinson's disease as well as bridge the gap between experimental and computational applications in drug discovery by combining computational machine learning algorithms with experimental validation.

This research lays yet another brick on developing more effective therapeutics targeting LRRK2 for Parkinson's and potentially other neurodegenerative diseases.

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SOCIAL AND BEHAVIORAL SCIENCES

Seed Sovereignty as an Ontological Approach to Food System Transformation

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The meaning of seeds and food can be expressed in terms of relationships instead of strictly as commodities. Such an ontological or onto-epistemological shift offers a non-exclusively Western approach towards food system transformation that has long been called for (Goodman, 2001; McMichael, 2012; Micarelli, 2018; Niewolny, 2022). The relational lens brought to this exploratory, interpretive research opens up other ways of knowing and being in the world cut off from modern industrialized societies. Three divergent voices – a dominant, marginalized, and hybrid – based on Bartlett's (2012) concept of voice, are used to combine methodologies from Critical Discourse Analysis and Positive Discourse Analysis to analyze the concurrent mixture of realities that make up the newly emergent seed sovereignty discourse domain. Meanings for seeds dispossessed but never forgotten are based on committed, trusting, human-like relationships that formed the basis of traditional societies. Together with relationships to their land, peoples were fed through the processes of mutual belonging. It is vital that relationships be properly represented in conceptualizations, mental models, and a common language of seeds and the food system, and to all other aspects of our collective lives. While numerous tensions persist among modern, traditional, and in-between populations, three general areas of commonality are evident: (a) forms of self-government that can ensure equal representation; (b) a free and fair means of exchange; and (c) a prolific, life-affirming natural environment. Seeds can become, once again, the means by which all three are achieved within societies.

The resulting common vision that could carry the seed and food sovereignty movement forward could easily be shared by those outside of the movement who are pursuing a sustainable food system. Such a pursuit would require us to move beyond our socially and politically constructed differences that serve as its unseen barriers. Western dualism has led us to devalue and anachronize kinship systems and communal social relationships in favor of scarcity, the social contract, exclusion, technological fixes, and market-as-solution. This has left humanity increasingly less able to rely on empathy, compassion, and solidarity as solutions. A transformation that extends well beyond the food system would need to place 'right relations' first and foremost - relations with one another, with Mother Earth, and especially with the seeds that are central to the perpetuation of life.

Parental Communication and Its Impact on Body Image Development in Female Adolescents

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Objective: Body appreciation reflects recognizing and valuing the body for its abilities, health, and cultural significance beyond appearance. Guided by the sociocultural model, this study examines the impact of parental body-related comments on young women's body appreciation in young adulthood, and whether sports participation during adolescence moderates these effects.

Method: Data came from a broader project on family relationships and young women's well-being. Participants were 65 female college students (Mage = 19.74; *SD* = 1.73), primarily White (76.1%). In-depth interviews explored parental body-related messages during adolescence, and surveys measured body appreciation with the Body Appreciation Scale (α = 0.94). Emotional impacts of parental messages were thematically coded (IRR > 0.80). Sports participation consistency was defined as involvement in both middle and high school. Chi-square tests and ANOVAs examined associations between parental comments, emotional impacts, body appreciation, and behavioral change.

Results: Positive emotional impacts from both mothers' and fathers' messages were significantly associated with higher body appreciation compared to messages that evoked negative emotions (Mother: $F(2, 54) = 4.44$, $p = 0.016$; Father: $\chi^2(2) = 7.33$, $p = 0.026$). Sports participation did not moderate these relationships. Negative parental messages were linked to behavioral change, with young women reporting body-related actions in response to negative maternal ($\chi^2(2, N = 57) = 14.53$, $p = 0.001$) and paternal comments ($\chi^2(2, N = 56) = 19.19$, $p < 0.001$).

Conclusion: Findings highlight the critical role of parental communication in shaping body appreciation and behaviors related to body image. While sports participation is often considered a protective factor for body satisfaction, it did not significantly moderate these effects, possibly due to the sample size.

Impact Statement: This study underscores the importance of positive family communication in fostering young women's healthy body image. Encouraging constructive, supportive conversations may enhance body appreciation, while negative remarks can increase vulnerability to body-related behavioral changes. Future research should expand with larger, more diverse samples to clarify the interplay of sports participation and parental influence on body image development.

Context of Eye Health: Social Determinants of Health Impact on Community Disease Burden Through Multiple Disease Models

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There is an acknowledged association between social determinants of health (SDOH) and prevalence rates of diabetic retinopathy (DR) and glaucoma (G) in the US. Often these studies are limited to individuals and their outcomes. This study seeks to elucidate the relationship on a regional level. This observational, cross-sectional study analyzed data from 3,142 U.S. counties. DR and G prevalence were calculated from Vision and Eye Health Surveillance System. SDOH measures included 14 county-level assessments from the 2019 American Healthcare Quality Research dataset. DR prevalence (mean: 2.76%) and G prevalence (mean: 1.39%) varied geographically. Low English literacy, segregation, unemployment, income inequality, and low education levels are significantly associated with higher county-level prevalence and severity of both DR and G. Lack of transportation and internet access are also linked to higher rates and severity of both conditions. Community-level SDOH, particularly healthcare access and economic factors, are strongly linked to DR and G prevalence and severity. Results underscore the need for community interventions. This study utilizes national datasets like the Vision and Eye Health Surveillance System and the Agency for Healthcare Research and Quality's annual data set and to examine the connection between differences a community's socioeconomic living conditions or demographics to determine the impact social determinants of health have on diabetic retinopathy and glaucoma outcomes. Data shows both diseases are drastically impacted by social determinants of health at the county level. This study shows that utilizing socioeconomic and demographic trends could be crucial in helping ophthalmology stay ahead of the ever-changing tide of community eye-health need.

Functional Connectivity and Volume of the Amygdala as Predictors of the Response to Propranolol for Anxiety in Autism: A Pilot Study

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Many autistic individuals experience higher rates of anxiety than both the general population and those with other neurodevelopmental disorders. Altered amygdala connectivity and atypical volume development in autism are linked to these anxiety symptoms which may be important biomarkers for precision medicine efforts. Propranolol, a non-selective beta-adrenergic antagonist primarily used to treat hypertension, has shown promise in alleviating anxiety symptoms in individuals with autism. However, the response to propranolol is variable across autistic individuals. Thus, objective biomarkers capable of predicting treatment response are critically needed to identify which autistic individuals are most likely to benefit from propranolol.

In this pilot study, we examined whether amygdala functional connectivity and volume are linked to anxiety improvement following propranolol treatment. Functional connectivity refers to the co-variation of brain signals between regions, measured via resting-state fMRI. Seventeen individuals with ASD (ages 15–21) were randomized to a 12-week double-blind trial of propranolol or placebo. Afterward, all participants received 12 weeks of open-label propranolol. Anxiety was assessed using the Clinical Global Impressions - Improvement (CGI-I) scale at baseline and after treatment. Resting-state fMRI scans were conducted at baseline. Participants who took propranolol for the blinded portion of the trial as well as those who took propranolol for the open-label portion were examined in this pilot study.

Responders were defined as those very much improved and much improved with propranolol, and non-responders were defined as those showing minimally improved, no change or worsening, based on CGI-I scores. There was no significant difference was observed in the right and left amygdala volume between the two groups. Furthermore, responders exhibited reduced functional connectivity between the left amygdala and right occipital pole and lateral occipital cortex, relative to non-responders.

Although preliminary, the results of this pilot study suggest that neuroimaging biomarkers, including functional connectivity and amygdalar volume, may provide valuable predictive information for which autistic people may receive the most benefit for anxiety from propranolol. However, the results should be interpreted with caution until further randomized clinical trials with larger sample sizes are conducted.

Early Childhood Material Hardship and Young Adult Mental Health

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Early childhood economic hardship has been linked to adversity later in life, such as poor mental health (Wickrama et al., 2016) and increased socioeconomic disadvantages in young adulthood (Ratcliff, 2025). Previous studies have demonstrated longitudinal associations between material hardship and subsequent mental health outcomes in both adolescence and adulthood (Najman et al., 2010). However, little is known about the underlying mechanisms through which childhood material hardship contributes to mental health difficulties and economic hardship in young adulthood. Given the significant influence of early adversity on overall health and well-being during the transition to adulthood (Brunette et al., 2023), the present study aimed to examine the longitudinal associations between childhood material hardship and young adults' mental health.

Using data from 2,970 mothers and their adult children who participated in the Future of Family and Child Well-Being Study (FFCWS), we used structural equation modeling (SEM) path analysis to test both direct and indirect pathways. Specifically, we examined whether the associations between early childhood economic hardship and young adults' mental health were mediated by parenting stress and parents' intimate partner violence (IPV) during middle childhood, as well as adolescents' mental health problems. Results indicated that early childhood economic hardship was associated with material hardship 22 years later. Moreover, the relationship between childhood economic hardship and young adults' mental health was mediated by parenting stress and adolescent mental health issues. These findings underscore the long-term impact of early material hardship on mental health in young adulthood and highlight the importance of addressing parenting stress and interparental conflict in families experiencing economic hardship to promote mental health across developmental stages.

Keywords: Material hardship, young adult, mental health.

Participatory Group Discussions of the 'Viviendo Bien' Study: Focus on Methods

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Purpose: Hispanic communities in the United States face a disproportionately high burden of type 2 diabetes mellitus (T2DM). Community-partnered approaches are critical for developing culturally grounded interventions. This project applies participatory discussion to engage Hispanic community members, focusing on strategies and lessons that advance equity-focused nursing research.

Theoretical Framework: The project is guided by the National Institute on Minority Health and Health Disparities Research (NIMHD) Framework, emphasizing multilevel drivers of health. Community engagement is conceptually defined as meaningful participation by individuals to shape health research priorities and operationally achieved through participatory discussions, co-created agendas, and participant feedback validation.

Method: An established community-health-academic partnership is conducting discussion groups across two Missouri counties. Groups are facilitated, in Spanish or English, by trusted promotoras/community health workers. Facilitators use icebreakers, real-time summarization, and member checking to enhance accuracy and engagement. Transcription and translation require iterative bilingual review to preserve nuance.

Results: Participants' engagement and enthusiasm are high. Key challenges include scheduling logistics and preserving meaning in translation. Bilingual facilitation and interactive validation have effectively sustained participation and trust and will contribute to data analysis within the NIMHD framework.

Conclusions: Despite some logistical and linguistic challenges, our participatory approach has proved viable and valuable for generating rich, context-specific insights. Our methods offer guidance for other studies seeking to foster meaningful engagement with communities across cultural and linguistic contexts. Findings will inform the development of culturally grounded, community-partnered interventions to address T2DM in high-burden populations.

Identifying Barriers in Healthcare facilities: Perceived Accessibility of Hospital Toilets

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Since the enactment of the Americans with Disabilities Act (ADA) in 1990, building facilities have been required to comply with accessibility standards. However, even after 35 years, many facilities still fall short of full compliance. This research aims to examine the physical accessibility of healthcare facilities through a multi-method approach, including on-site assessments of hospitals, an online mixed-methods survey of people with disabilities about their past hospital experiences, and focus groups with hospital stakeholders to identify the most significant challenges related to physical accessibility.

In this poster, partial findings will be presented from the online mixed-methods survey. The survey explored participants' perceptions of accessibility during their recent visits to healthcare facilities, covering aspects such as visit pre-planning, parking, exterior routes, building entrances, interior routes, toilets, other building features (e.g., ramps, elevators, interior doors), wayfinding, examination rooms, and communication. The survey was distributed through the Great Plains ADA Center, yielding a total of 236 responses collected over a two-week period. Descriptive statistical analysis indicates that toilets are among the most problematic areas in terms of accessibility. The results presented in this poster include both quantitative and qualitative data focusing on the physical accessibility conditions of hospital toilets, specifically participants' experience ratings for features such as ramps, sinks, toilets, and overall spatial layout, along with qualitative comments that provide deeper insight into these experiences.

Future work will include finalizing the remaining statistical analyses, both quantitative and qualitative, and conducting focus group interviews with people with disabilities to further explore the key issues identified in the survey.

The Morality–Creativity Paradox: When AI Turns Brand Innovation into Crisis

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In the retail industry, generative artificial intelligence (AI) offers significant creative efficiency in branding and design. Still, it simultaneously raises the risk of intellectual property (IP) violations, which may trigger brand crises and undermine brand image (Wei et al., 2025). For example, Shein faced a lawsuit for allegedly using AI to scrape online designs and mass-produce unauthorized copies (Hall, 2024). This case illustrates the growing challenges brands face as AI blurs boundaries of originality and ownership. We define an *AI-driven IP brand crisis* as a brand crisis that occurs when generative AI is used to infringe IP rights.

Against this backdrop, this study examines the paradoxical perceptions that arise from IP brand crises associated with AI use. These perceptions show that consumers view AI-driven brand creativity as both promising and threatening (Appel, 2023). Specifically, we examine the morality–creativity paradox, where consumers condemn AI-driven IP violations yet view the brand's AI use as innovative. These paradoxical perceptions reveal how consumers evaluate brand creativity in the context of AI use, perceiving the technologies as both promising and threatening (Shalvi et al., 2015). Furthermore, regarding this paradox, perceived threats—realistic (e.g., job loss) and symbolic (e.g., diminished identity)—have been identified as central to consumer responses (Oleksy et al., 2023). Therefore, the purpose of this study is twofold: (a) to examine how the source of an IP brand crisis (AI-caused vs. human-caused) and consumers' perceived threats (realistic, symbolic) shape evaluations of brand creativity, and (b) to examine how moral emotions and judgments mediate these responses.

We conducted two scenario-based, between-subjects experiments, manipulating the crisis source (AI-caused vs. human-caused) and measuring realistic and symbolic threat, moral emotion and judgment, and perceived brand creativity. In Study 1 (n = 161), PROCESS Model 2 showed strong model fit (R^2 = 0.6107, $F_{(5,155)}$ = 48.62, p < .001). AI-caused crises reduced perceived creativity (b = −1.07, p < .05), and this effect weakened as realistic threat increased (b = 0.52, p < .05). Joint moderation was significant (R^2 change = 0.02, $F_{(2,155)}$ = 3.88, p < .05): when realistic threat was low and symbolic threat was high, AI-caused crises lowered creativity (b = −0.93, p < .05). In Study 2 (n = 174), PROCESS Model 83 supported moderated serial mediation through moral emotion and moral judgment with realistic threat as moderator (b = 0.68, p < .001; index = 0.05, 95% CI [0.02, 0.09]). The indirect effect was negative at low realistic threat (effect = −0.05, 95% CI [−0.10, −0.01]) but positive at high realistic threat (effect = 0.05, 95% CI [0.01, 0.10]); symbolic threat was non-significant. These findings show that brands should emphasize human creativity and accountability when symbolic threat is high and realistic threat is low. When realistic threat is high, they should address ethical concerns while explaining AI use as strategic and responsibly managed.

Quantifying Narrative Characteristics and their Association with Individual and Relational Health: A Test of Communicated Narrative Sensemaking Theory

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Objective: This study tests proposition two of Communicated Narrative Sensemaking Theory, which posits a link between positively framed narrative content and individual and relational health. Through the examination of perceived lesson valence and utility, as opposed to ascribed tone, this study elaborates content's effect on resilience (individual health) and relational closeness (relational health), as well as intent to share the narrative.
Design: As part of a larger study, 42 emerging-adult-children of immigrants were given an online survey containing open-ended questions about their family's immigration narrative and lessons, as well as scales measuring their attributions of derived lessons.
Results: Analyses revealed a positive correlation between lesson valence and relational closeness, but no significant relationship between lesson valence and resilience. Lesson utility was found to be positively correlated with intent to share. Exploratory data analyses showed a positive relationship between lesson utility and resilience.
Conclusions: Findings expand upon Communicated narrative sensemaking's relationship between narrative sensemaking and health in a diverse population. Additionally, this study calls for the continued observation of narrative and lesson characteristics, as perceived by those involved in the narrative process.

What's in Your Ice Machine?

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Background: Ice is one of the most consumed items in retail food establishments (RFE) therefore, the cleanliness of an ice machine (IM) is essential for consumer safety. If an IM contains bacteria from cross contamination, biofilm, mold, dirt, and other debris there is the potential for health-related issues. Mold can cause allergic reactions and act as an irritant.
Objective: We sought to visit 118 RFEs identified in Pettis County and inspect floor model Ims for cleanliness to guide and assess food code for the county.
Methods: To conduct an IM audit, a survey form was developed containing 7general questions about the RFE IM, and 13 questions regarding the cleanliness of the IM and related utensils. All questions are yes/no questions.
Results: 85 total RFEs were visited, and 55 had floor model IMs that were inspected. 40% of IMs surveyed were leased, 54% of IMs have a cleaning contract, and 41% of IMs received an additional infraction report. 47% of the IMs that received an infraction report were leased.
Conclusion: To ensure the continued safety of RFE patrons, to comply with the county food code, regular cleaning, proper handling practices, systems, routine, and staff training are essential to maintain an unadulterated ice supply for consumers. Additionally, findings will be shared with all RFEs, an audit procedure will be provided so that RFEs can conduct self-audits of IMs (floor and overhead style) and ice bins, educational material will be provided on IM and ice bin safety, and encourage RFEs to review education, systems and routines with staff.

Re-membering as Decolonial Praxis: Nigerian Youth Navigate Language, Culture and Global Black Belonging

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Migration continues to transform the U.S. K–12 classrooms. This transformation has informed a demographic shift that calls for deeper attention to the racial, linguistic, and cultural identities immigrant students carry with them through their academic, cultural, and transnational trajectories. A critical gap remains in our understanding of a specific subgroup - the 1.5 generation immigrant youth. Unlike their first-generation parents, these young people are still developing core identities while negotiating multiple worldviews. It is therefore crucial to understand how this age group negotiates identity and makes sense of the multiple worldviews they encounter within schools and their new society.

This study is a narrative inquiry that seeks to make visible the languages, knowledges and identity negotiation processes of 1.5 generation Nigerian immigrant youth in the United States. Data were collected through three rounds of individual interviews and a three-hour focus group session with five participants. Theoretically, the study draws on Ngũgĩ wa Thiong'o (2009) concepts of dismemberment and re-membering. Dismemberment refers to how colonialism disconnected people from their land, languages and culture. Re-membering, in turn, is a process of putting back together that which has been fragmented and reclaiming one's humanity in a quest for wholeness. This study offers re-membering as a decolonial praxis and framework for understanding how Nigerian immigrant youth navigate identity within diasporic contexts.

The findings reveal four themes through which youth enact re-membering practices: through name choices, the recentering of Indigenous languages, the adoption of a global Black identity, and the development of a decolonial understanding of their homeland. These themes illustrate both re-membering and ongoing dismemberment, as participants express ambivalence, fluidity and tension in how they curate identity across spaces and interlocutors. For many, the longer they lived in the United States, the more attuned they became to the struggles of African-American peers and the broader global Black diaspora. This proximity cultivates a critical disposition that deepens their awareness of how colonialism continues to shape both Africa and the diaspora. The stories they share invite us to understand how diaspora provides a vantage point that prompts new ways of knowing oneself.

Ultimately, this study calls educators and teacher education programs to approach Black immigrant students with cultural attentiveness that moves beyond monolithic understandings of Blackness and affirms the complex, transnational selves they bring into the classroom.

Towards a Labor Hostility Index: An Expository into the Effects of State Labor Laws on Union Density & Public Opinion of Labor Unions in the United States

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This article explores data from the Bureau of Labor Statistics, Pew Research Center, and others, to isolate factors that affect union density (i.e. number of unionized workers taken from total population of workers) across the fifty states, in order to lay the groundwork for a Labor Hostility Index (LHI): a scale that compiles quantitative and qualitative data to predict the ease/difficulty of unionizing in a given state. The authors identify several independent variables which would form a basis for the LHI; Right-to-Work legislation, bans/restrictions on public-sector collective bargaining, etc. The study will use a regression model to explore several hypotheses about the relationship between state labor laws and rates of union membership among employees across the fifty states, in both the public and private sectors. We expect to find a dampening relationship between state Right to Work legislation and restrictions on collective bargaining, and the union density across workers in those states. We also expect to find a negative relationship between such restrictions and each state's minimum wage. We are also curious if there is a positive relationship between stronger Occupational Safety & Health (OSH) standards and union density in states. We expect to see lower union density in states with a dominant service-industry over states with dominant traditional industry. We expect to see a negative relationship between an increased number of strike actions, and public opinion of labor unions.

Keywords: Labor Unions, Right to Work, Strike Action, Public Opinion, Union Density, Minimum Wage

What Amplifies Health Information-Seeking Challenges Among International Students in Rural Midwest U.S.?

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Background: International students encounter significant barriers when seeking health information in the United States, including language, financial, and cultural challenges. These barriers are particularly amplified on rural campuses, where healthcare infrastructures are limited and co-national peer networks are smaller. While prior research has documented urban experiences, little is known about how rural contexts shape health information-seeking behaviors (HISB).

Objective: This study investigates how international students at the University of Missouri-Columbia, select, and evaluate health information sources. Specifically, it examines the barriers and facilitators that shape their HISB, how strategies evolve over time, and how rural infrastructures amplify existing challenges.

Methods: Two semi-structured focus groups (N=10) were conducted in Fall 2024, each with five international graduate students. Participants represented diverse genders, nationalities, and academic levels. Sessions were held via Zoom, recorded with consent, transcribed, and analyzed in ATLAS.ti using open, axial, and thematic coding. The analysis was guided by Wilson's model of information behavior, Chatman's theory of information poverty and avoidance, and Burnett and Jaeger's concept of information worlds.

Results: Peers and co-nationals emerged as the most trusted and frequently used health information sources. Institutional and insurer resources, including Sydney Health and Health Connect, were consistently underutilized due to low awareness, usability challenges, and opaque explanations of billing and coverage. Reported barriers included confusion about navigating the U.S. healthcare system, lack of transparency in costs, inconsistent orientation practices, and limited culturally competent care. Over time, students adapted by developing defensive and risk-minimizing strategies—such as delaying care, relying on peers, or limiting engagement with providers—rather than achieving confident use of the healthcare system. The rural context further intensified challenges by limiting provider choice, creating transportation difficulties, and reducing peer network density.

Conclusion: This study contributes conceptually by extending HISB theories to rural international student contexts, empirically by documenting how rural infrastructures magnify information barriers, and practically by identifying interventions for institutions. Recommendations include providing pre-arrival health information, recurring multilingual orientation sessions, transparent cost exemplars, and guided onboarding to health portals and insurer applications. Addressing these needs through student-centered and culturally responsive communication strategies can improve equitable access to health information and support the well-being of international students in rural settings.

Uncovering Metacognition Awareness in AR Learning Environment via Gaze Transition Entropy

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Metacognition refers to being conscious of one's thought processes and strategies, or "thinking about thinking" (Briñol et al., 2004; Petty et al., 2007). It helps students understand what they are doing, why, and how skills can be applied differently across contexts. Traditional research has relied on self-reports, which may not reflect actual behavior. Monitoring depends on tasks, context, and learning situations (Azevedo, 2015; Järvelä et al., 2019). To address these limitations, trace methods such as think-alouds (Azevedo et al., 2011), video (Rogat & Linnenbrink-Garcia, 2011), eye tracking (Taub et al., 2017), and physiological data (Haataja et al., 2018) provide real-time insights. Among these, eye tracking is especially valuable in problem-solving. Metrics like gaze transition entropy (GTE) measure unpredictability in gaze shifts between areas of interest (AOIs) and serve as indicators of metacognitive awareness. Higher entropy reflects a more exploratory approach (Krejtz et al., 2015; Straka et al., 2021; Ayala et al., 2022).

Background. GTE has been used to study cognition in diverse contexts. Yasue and Sawaragi (2024) found that experts show lower GTE in multitasking, indicating strategic resource allocation. Ayala et al. (2022) showed that efficient transitions support problem-solving, while high entropy reflects difficulties. Cui et al. (2024) found that GTE decreases when continuous monitoring is required, highlighting its role in attention allocation.

Approach. Twenty-one participants completed two AR-based lectures while wearing the HoloLens 2. Modules were triggered via the NFER system (Yu et al., 2023). Students completed the Metacognitive Awareness Inventory (MAI) (Schraw, 1994) and were split into High- and Low- Planning level groups. GTE was calculated for each module as:

$H(i) = -(p!" log\#(p!")\$"\%\&$ Here, H(i) is entropy for AOI i, with P_{ij} the probability of transitioning from i to j. Learning content was also categorized as conditional, declarative, or procedural knowledge.

Outcome. Regression results showed that GTE in Module 2 and 6 was negatively correlated with planning scores, while Modules 1 and 4 were positively correlated ($R^2 = 0.49$). High GTE without alignment to content indicated confusion, while aligned transitions reflected engagement and effective strategy use. High planners showed purposeful transitions (e.g., focusing on declarative panels when needed), whereas low planners made frequent, unfocused shifts.

Conclusion. GTE predicts metacognitive planning in AR learning. By measuring attention shifts with entropy, we observed clear differences between high- and low-planning students. Despite variability and movement challenges, GTE shows promise as a diagnostic tool for assessing strategies and informing AR instructional design.

Community Leadership Development for Social Change: A Socio-Demographic Comparative Analysis

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Background: Community-based leadership programs play a vital role in strengthening civic capacity and advancing community well-being. The Neighborhood Leadership Academy (NLA) and Neighborhood Leadership Fellows (NLF) were designed to cultivate inclusive leadership and foster community engagement.
Objective: This study examined how participants from NLA and NLF experienced leadership growth and community involvement across gender, age, race, and educational attainment.
Methods: Quantitative data were collected from 176 respondents who completed a structured online survey administered via Redcap survey as part of a mixed-methods evaluation. Participants included graduates from the individual program groups and were categorized into three cohorts based on their participation: NLA only, NLF only, or both NLA and NLF. Survey measures assessed leadership role attainment, community belonging and contribution, tolerance for diverse leadership, mentorship formation, fundraising ability, and perceived community improvement.
Results: Findings showed consistent engagement and leadership growth across groups, with some demographic variation. Female participants were more likely to assume new leadership roles (61.8%), while male participants reported stronger perceptions of belonging and contribution (100%). Participants aged 25–44 had the highest rate of new leadership roles (65.5%), those aged 45–59 achieved the most fundraising success (29.2%), and participants aged 60+ emphasized mentorship (71.4%) and community contribution (85.7%). Among racial groups, African American/Black participants were more likely to take on new leadership roles (65.5%) and showed high tolerance for diverse leadership (96.6%) and mentorship formation (72.4%). Participants with some college or less expressed the strongest belonging (88.9%), while graduate-level participants reported the highest tolerance (100%) and mentorship (75%) but moderate fundraising success (25%).
Conclusion: The NLA and NLF community development programs effectively foster inclusive and sustainable leadership across diverse groups. Participants reported greater confidence, belonging, and contribution to community change. However, persistent gaps in fundraising and institutional access highlight the need for targeted program components to strengthen financial and structural empowerment. Overall, these programs demonstrate the transformative potential of community leadership development as a vehicle for equitable civic engagement.
Keywords: Community leadership development; Civic engagement; Inclusive leadership; Social change; Community empowerment, NLA, NLF.

Health Gaps Across State Lines: Measuring Inequities Using Comparative Data

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This project highlights health inequities and identifies social justice concerns by examining racial differences in mortality between and within Missouri and Massachusetts. We gathered descriptive statistics from publicly available data sources such as HD Pulse, CDC Wonder, America's Health Rankings, SparkMap, and March of Dimes. For comparisons, we calculated ratios and differences between states and across racial categories. We found substantial differences between Missouri and Massachusetts in premature death, infant mortality, child mortality, teen births, firearm fatalities, and all-cause mortality. We also uncovered stark disparities between Black and White individuals in several mortality and maternal-child health indicators in both states. We explored how contributors such as public health funding and health insurance coverage likely influence these disparities. Analyzing and describing health disparities demands careful data mining from available sources, especially as access to reliable data becomes increasingly limited.

ENGINEERING AND INFORMATICS

Long-Term Electricity Demand Forecasting of University Campuses Based on Advanced Deep Learning Artificial Neural Network Algorithms

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The increasing global energy demand needs effective energy management strategies, especially in large environments with diverse infrastructure like university campuses that consume significant energy. This study focuses on electricity demand forecasting for university campuses based on various advanced Artificial Neural Network (ANN) models, aiming to find the best model for long-term demand forecasting. The research examines fourteen models, including Feedforward Neural Networks (FNNs), Recurrent Neural Networks (RNNs), Conventional Neural Networks (CNNs), and Hybrid Convolutional Neural Networks-Recurrent Neural Networks (CNN-RNN), using an hourly dataset collected over seven years (1/1/2017 – 12/31/2023) from the University of Missouri's Combined Colling and Heating Power Plant. In addition to the campus energy consumption the dataset includes various weather conditions to determine the dynamic relationships between weather and energy usage. The results show that while all models performed well, the hybrid CNN-RNN models, particularly CNN-BiLSTM and CNN-BiGRU models, showed higher performance, achieving 0.98 and 0.97 accuracy during training and 0.92 and 0.93 during testing, with a validation loss error of 0.073 and 0.062, respectively. Subsequently, the models were used to predict energy demand for the entire year 2024. The findings aligned closely with historical demand trends, showing strong reliability in handling long-term data. Finally, during the deployment phase, we compared the models' predictions with actual energy consumption in 2024 gathered from the power plant. This comparison confirmed that the hybrid models performed exceptionally well under real-world conditions. The results show the ability of hybrid models to optimize energy management strategies and supporting sustainability efforts for university campuses.

Keywords: Campus electricity demand, Combined heat and power plant, Long-term energy forecasting, Energy management, Artificial neural network.

Data Driven Decision: Reducing Simulation Runs in Early-Stage Building Design

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In the early stages of building design, data-driven parametric energy modeling is essential for making informed and sustainable decisions. This study evaluates the comparative effectiveness of two Design of Experiment (DoE) techniques, Plackett-Burman (PB) and Latin Hypercube Sampling (LHS), in screening factors that affect building energy efficiency. A Department of Energy (DOE) prototype small office located in Climate Zone 4A was selected as the case study, and seventeen design variables were considered. To conduct the analysis, a detailed Grasshopper–Rhino–Ladybug script was developed to enable parametric energy simulations. The workflow was connected with R statistical software to generate the design matrices. Using LHS, 510 simulations were performed to explore the influence of the seventeen variables, while PB required only 40 simulations for preliminary screening. The design matrices generated in R were saved as CSV files and connected directly to the Grasshopper script. Several Python codes were embedded inside the Grasshopper environment to automate tasks such as file management, simulation execution, and results storage. Simulation outputs were also exported to a separate CSV file for statistical analysis. Regression models and pareto analysis were applied to the results from both PB and LHS simulations to evaluate the relative influence of the design variables on building energy performance. The comparison showed that PB was able to identify statistically significant factors with only a fraction of the runs required by LHS. While the 510 LHS simulations allowed a more comprehensive assessment of the parameter space, the 40 PB simulations provided an efficient first step for factor screening. This efficiency demonstrates the potential of PB as a practical method to reduce computational demands in early-stage design studies. The findings highlight the advantages of combining advanced parametric modeling tools with statistical design methods for early decision-making. The Grasshopper–Rhino–Ladybug platform, enhanced by R-generated design matrices and embedded Python scripts, provided a flexible and automated framework for managing large sets of energy simulations. By identifying the most influential design parameters, the approach allows architects and researchers to focus on factors with the greatest impact on energy efficiency. This integrated methodology supports a more efficient, data-driven workflow that facilitates sustainable building design optimization from the earliest design stages.

Translational Optogenetics in ALS: Preserving Swallowing Function via Hypoglossal Neuromodulation in SOD1 Mice

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Dysphagia is a life-threatening symptom of Amyotrophic Lateral Sclerosis (ALS) that contributes significantly to malnutrition, dehydration, and aspiration pneumonia, increasing mortality rate by eightfold. Its onset in ALS coincides with tongue weakness and atrophy resulting from degeneration of hypoglossal lower motor units (XII MUs), which provide the sole motor innervation to the tongue. Despite its clinical impact, currently no therapies exist to directly target or preserve these critical motor units.

We hypothesize that optogenetics can serve as a targeted gene therapy approach to slow XII MU degeneration and tongue atrophy by promoting neuronal repair and nerve terminal proliferation. We utilized a translational mouse model of ALS (*SOD1-G93A*) showing clinicopathological symptoms of dysphagia to develop our experimental therapeutic approach. Our pilot study gave promising results, where we injected adeno associated virus (AAV) mediated excitatory opsin Channelrhodopsin2 (ChR2) into the hypoglossal nucleus (HGN) to directly stimulate and record neural activity via an implanted optrode. Here, we are adapting this approach into a minimally invasive method with greater feasibility for translation to ALS clinical trials. We injected AAV mediated ChR2 into the tongue (midline into the base and blade; 10-15 µL per site) of *SOD1* (n=6) and wild-type (n=8) mice to retrogradely transfect XII MUs. Approximately 3 weeks post-injections, optogenetic stimulation (opto-stim) of the tongue surface under anesthesia (either ketamine-xylazine or isoflurane) resulted in tongue contractions visible via strain gauge recordings. Cryosection histology of the brainstem and tongue showed opsin expression in the HGN and tracts as well as the tongue myofibers. Of note, tongue injections were administered after clinical disease onset, when *SOD1* mice presumably had axonal transport deficits, a hallmark feature of ALS.

We are currently refining strategies to improve opsin expression in XII MUs to enhance the efficacy and precision of opto-stim evoked tongue contractions. Post optimization, we will evaluate the therapeutic effects of targeted opto-stim in awake, freely behaving mice during voluntary licking from a light-emitting spout versus at rest via a light-emitting patch implanted subcutaneously under the tongue. This preclinical investigation is designed to assess whether selective activation of XII MUs can mitigate neurodegeneration, preserve bulbar motor function, and extend survival, thereby establishing the translational potential of this approach for dysphagia therapy in ALS.

Quantum Graph Neural Networks for Aerial Navigation

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This project explores hybrid quantum + classical graph neural networks (QGNNs) for subgraph matching in aerial navigation tasks. We convert satellite imagery into attributed graphs and apply a classical GNN backbone with a quantum projection layer to enhance robustness in approximate location retrieval. Two architectures are compared: a hardware-efficient global quantum projection over pooled graph embeddings, and a more expressive local quantum projection applied at the node level. Both are evaluated under controlled graph perturbations (node addition, deletion, and noise) using Recall@1/5 metrics. Results show that local quantum models consistently outperform classical baselines on heavily perturbed inputs, especially for smaller graphs. We also present a complete pipeline for embedding generation, quantum circuit integration, and large-scale subgraph retrieval. Our findings suggest practical routes for deploying quantum-enhanced graph models in aerial localization, with broader applications in domains like bioinformatics, materials science, and cybersecurity where approximate graph matching is key.

A Phase-Field Formulation for Fracture Modeling of Rate- and Temperature-Dependent Materials

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The phase-field method has become a powerful tool for modeling fracture across a wide range of materials. However, existing approaches often neglect the heterogeneous nature of materials like asphalt concrete, which consist of distinct phases such as mastic, aggregates, and air voids. Capturing this intrinsic heterogeneity is crucial for rate- and temperature-dependent materials, as fracture behavior can vary significantly with changes in loading rates and temperature conditions. To address these challenges, we extend our recently developed *regularized PPR* phase-field framework to account for thermo-viscoelasticity and explicitly represent material heterogeneity, enabling a more realistic representation of multiphase materials and their complex fracture mechanisms. In this work, we model asphalt concrete as a heterogeneous medium by incorporating its individual phases, where fracture predominantly propagates through the mastic phase under moderate and high temperatures but may also extend into aggregates at low temperatures. We introduce a weakly coupled thermo-viscoelastic formulation that employs a Dirichlet–Prony series representation for the material's shear and bulk moduli. Effective stresses in the displacement problem are solved incrementally, where stresses at the current time step are computed recursively based on those from the previous time step. Additionally, we use a history parameter for phase-field evolution that considers the contribution of the total elastic and viscous energies of the system. We present numerical simulations that demonstrate the capability of the model to capture complex and arbitrary crack paths, including the interplay between mastic and aggregate under varying temperature and loading conditions. The results highlight the importance of material heterogeneity in accurately predicting fracture propagation, offering valuable insights into the structural performance of asphalt concrete under thermomechanical scenarios.

Key words: Phase-field method, asphalt concrete, brittle fracture, quasi-brittle fracture, PPR cohesive zone model, thermoviscoelasticity, Dirichlet Prony series.

Impacts of Continuous Manure Application on Soil Health and Crop Performance

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Agricultural practices play a critical role in shaping soil health and crop productivity, yet their long-term impacts remain insufficiently understood. Since 2021, a split-split plot experiment has been conducted at Bradford farm in collaboration with the Missouri N340 Cover Crop Cost-Share program to evaluate the impacts of agricultural practices. As part of the fertilization treatments, poultry litter is surface applied at 3 tons per acre, providing partial substitution for inorganic fertilizers. Repeated measurements have shown revealed that manure application has promising effects on soil physicochemical properties. Notably, levels of organic and active carbon were significantly higher (p<0.001) under manure application compared to inorganic fertilization. However, no significant improvement was observed in aggregate stability, suggesting that longer-term manure application may be necessary to detect measurable changes in soil structure. Soil biological properties were also enhanced, as microbial communities responded significantly (p<0.001) to manure applications. These improvements in soil chemical and biological attributes are expected to improve crop performance, including yield and quality. In terms of yield, corn yield had slightly higher yield under inorganic fertilization, whereas soybean and wheat yields were increased with manure application, although these differences were not statistically significant. Manure application exhibited inconsistent effects on grain quality. Corn and soybean protein contents showed modest improvements, while wheat protein declined significantly (p<0.05). Mineral concentrations also varied across species, suggesting that the response of grain quality to fertilization is crop-specific and influenced by other factors such as differences in nutrient uptake. This ongoing study aims to generate long-term data to better understand the impacts of agricultural practices under real-world field conditions.

Temporal and Profession-Specific Trends in HIV Case Queries Within the Show-Me ECHO Program

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Introduction: Primary care clinicians lack adequate continuing education for HIV care, limiting their ability to manage patients and reducing access to specialty-informed treatment in community settings. ECHO programs link primary care providers with an expert hub for case-based HIV learning. From 2018 to 2025, primary care clinicians (PCC) submitted cases for learning, including questions for the hub team for tele-mentoring purposes. We produced a validated taxonomy of question categories and mapped temporal trends by profession, giving ECHO an evidence base view of what PCCs ask and when. This enables the design of tailored continuing education sessions for PCCs and provides a practical guide for curriculum prioritization in tele-mentoring for improved PCC competency and ultimately strengthening HIV care delivery in community settings.

Methods: 78 case presentations reviewed and entered into a dataset. Patient demographics were recorded, and all pre-session forms and session recordings were abstracted. Each question was labeled with one of seven themes: ART initiation/optimization, pregnancy/neonatal care, adherence/retention, regimen simplification, psychosocial/support barriers, prevention/transmission risk, or opportunistic infection/comorbidity to explore shifts in focus over time and by provider role.

Results: Engagement increased over time, driven primarily by physicians. Psychosocial and structural support subjects predominated in the early years, but in the mid-to-late years, there was a noticeable move towards clinical management, including opportunistic infections/comorbidity care and ART initiation/optimization. Early on, nurse practitioners' enquiries concerning adherence and psychosocial impediments increased, then increasingly focused on ART optimization in later years. Pharmacists participated at lower levels, and when involved their questions tended to concern regimen adjustments. Allied staff consistently raised psychosocial and care-navigation concerns throughout the period, while gradually engaging more.

Conclusion: Profession specific trends suggest tailoring ECHO curricula (physicians - medication regimens, nurses - prevention, pharmacists – pharmacologic management, allied staff – psycho-social supports) to maximize impact and strengthen HIV care.

MintOmics: Multi-omics Integration and Prediction of Oviductal Responses Using Machine Learning

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MintOmics is a machine learning-based multi-omics integration framework designed to predict protein abundance from transcriptomic data and to characterize molecular responses in complex biological systems. Using bulk RNA sequencing and LC-MS/MS proteomic data from mouse oviductal tissues, MintOmics integrates datasets across the infundibulum+ampulla (IA) and isthmus+uterotubal junction (IU) regions at 0.5, 1.5, 2.5, and 3.5 days post coitus (dpc). The framework employs random gene masking and stochastic sampling data augmentation techniques to address data scarcity, and utilizes a transformer-based architecture to model the nonlinear relationships between gene expression and protein abundance. MintOmics achieved 92% accuracy in predicting protein abundance levels, demonstrating high robustness and scalability. Downstream analyses, including interpretable attention analyses, differential gene and protein expression with Reactome and Gene Ontology enrichment, revealed key transcription factors and region-specific regulatory networks associated with reproductive processes. Notably, early sperm exposure (0.5 dpc) induced a distinct proinflammatory transcriptional signature in the IU region, consistent with known biological responses. These findings highlight the adaptability of the oviduct to fertilization cues and underscore the potential of machine learning-driven multi-omics integration for uncovering dynamic molecular interactions. Beyond reproductive biology, MintOmics provides a generalizable and extensible framework for predictive multi-omics modeling, offering a path toward improved biomarker discovery, mechanistic understanding, and precision medicine applications.

A Local Approach to Stress-Constrained Topology Optimization Of Multi-Material Structures

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Recent advances in multi-material topology optimization and additive manufacturing have enabled the design and fabrication of complex, high-performance structures. However, most existing approaches focus on stiffness maximization and overlook local material failure, which may render non-functional designs that fail under applied loading. Designing functional multi-material structures that can withstand mechanical loads requires accounting for the distinct failure behaviors of each candidate material. This study presents a framework for stress-constrained multi-material topology optimization that incorporates material-specific failure via a unified yield function capable of modeling pressure-independent and pressure-dependent materials, thus capturing the tension-compression strength asymmetry typical of polymers used in multi-material additive manufacturing (e.g., PolyJet 3D printing). Our method explicitly imposes local stress constraints for each material within every finite element, without relying on interpolated failure models. To ensure scalability and robustness, we solve the constrained optimization problem using the augmented Lagrangian method. We demonstrate the effectiveness of our approach through several numerical examples that highlight the benefits of combining materials with tension-compression strength asymmetries to reduce structural mass. Experimental validation of a fabricated design confirms the ability of our approach to predict structural performance and yield limits of multi-material, optimized components.

AI-Powered Automated Compliance Checking in BIM and Visualization to Enhance Accessibility in Healthcare Facility Design

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Healthcare facilities must comply with rigorous accessibility standards such as the Americans with Disabilities Act (ADA) to ensure equitable access for all users. However, the current process of checking compliance is predominantly manual, relying on time-intensive drawing reviews and subjective interpretations. This traditional approach often leads to inconsistencies, delays, and overlooked accessibility issues, ultimately affecting patient safety, user experience, and the overall quality of care environments. To address these limitations, this research introduces an AI-powered compliance checking and reporting system integrated within Building Information Modeling (BIM). The goal is to automate the detection, analysis, and visualization of accessibility-related design nonconformities, thereby supporting architects and healthcare planners in achieving early and accurate compliance. The proposed methodology combines rule-based algorithms and machine learning with the Revit API, Dynamo visual coding, and Python scripting to extract spatial and parametric data directly from BIM models. These data are evaluated against predefined accessibility standards, particularly ADA and healthcare-specific design guidelines. The prototype system is deployed as an interactive Streamlit web application that automatically generates compliance reports and visual dashboards. Noncompliant components are highlighted within the model, providing clear, data-driven feedback to designers. The tool's visualization layer enhances understanding and communication of compliance issues, facilitating faster design iteration and informed decision-making. The real-world contribution of this research is the system can significantly reduce manual workload and human error, allowing designers to focus on creative and functional problem-solving. In practice, such automation can accelerate healthcare project delivery, improve accessibility outcomes, and ensure regulatory confidence during design review and approval phases. By embedding intelligence directly into the design workflow, the project contributes toward more inclusive, efficient, and technology-driven healthcare environments.

Keywords: Healthcare-design, ADA-Accessibility, Automated-Compliance-Checking, BIM, AI

The Angle Effect: Single-Event Transients in β-Ga_2O_3 MOSFETs for Space-Power Applications

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β-Ga_2O_3, a wide bandgap semiconductor (~4.8 eV) with high breakdown strength and thermal stability, holds strong potential for next-generation high-power and radiation-hardened electronics. Yet, its response to radiation under non-normal ion trajectories remains insufficiently characterized. This work presents a comprehensive analysis of single-event transients (SETs) in β-Ga_2O_3 Metal-Oxide-Semiconductor Field-Effect Transistors (MOSFETs) under varying ion incidence angles using Technology Computer-Aided Design (TCAD) simulations. Heavy ion strikes with a linear energy transfer (LET) of 0.2 pC/µm were simulated at 0°, 63.43°, 75.96°, 80.53°, and 82.87° to investigate the influence of oblique incidence on transient behavior. Results indicate that as the ion angle increases, charge deposition paths elongate and overlap more with the active channel, resulting in larger transient current peaks and prolonged charge collection durations. At extreme oblique angles (≥75°), the lateral charge spreading becomes dominant, significantly distorting the local electric field near the drain and enhancing carrier transport asymmetry. These effects collectively highlight the angular dependence of SET severity, with oblique strikes posing a greater threat to device stability than normal incidence. The findings underscore the importance of incorporating angular radiation analysis into the reliability assessment of β-Ga_2O_3 power MOSFETs intended for space and high-power applications, where omnidirectional particle exposure is inevitable.

Adaptive Content Engine: Real-Time Personalization in VR Education using Reinforcement Learning

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Pedagogical agents (PAs) are increasingly recognized as powerful tools in digital learning environments due to their ability to deliver personalized, interactive, and socially responsive instruction. In Virtual Reality (VR), their potential is further amplified by immersive presence and embodied interaction, supporting cognitive and motivational goals. However, most existing VR learning systems rely on static or scripted pedagogical logic, offering limited responsiveness to learners' evolving knowledge or affective states. To address this challenge, we present the Adaptive Content Engine (ACE), a novel educational system that integrates VR, Reinforcement Learning (RL), and Large Language Models (LLMs) to personalize instruction in real time. ACE uses LLMs to generate adaptive, context-aware feedback, and reinforcement learning, specifically Proximal Policy Optimization (PPO) and Inverse Reinforcement Learning (IRL) to model expert behavior and optimize system adaptation based on learner performance. This hybrid approach supports personalized pacing, difficulty modulation, and emotionally intelligent guidance in dynamic learning scenarios. ACE is evaluated in an immersive escape room style cybersecurity training simulation designed to foster real-world decision making and response skills. Individual evaluation shows high performance in each module. System level experimental results that ACE outperforms non-adaptive baselines in learner success rate, engagement, and usability.

EmpathAI: A Trustworthy and Secure Conversational Agent for Mental Healthcare

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With advancements in AI, conversational agents are increasingly being used in healthcare and could be employed aptly in counseling psychology and mental health support. However, ensuring the reliability and trustworthiness of these agents is crucial for safe, effective patient interactions. In this paper, we present methods for enhancing the reliability of conversational agents through source tagging, which enables users to assess information transparently and preemptive user metadata enrichment for providing emotion-sensitive responses. Additionally, we address security challenges such as prompt injection attacks, by proposing prompt engineering strategies to mitigate these vulnerabilities. By systematically integrating confidence metrics and fortified prompts, our approach ensures conversational agents provide secure and trustworthy responses in sensitive healthcare environments.

Index Terms: Trustworthy AI, Secure Chatbot, Healthcare Security, Prompt Injection, LLMs, Digital Therapy, eHealth

Integrating Economic and Sustainability Factors in Building Design through Data-Driven Surrogate Modeling

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Our neighborhoods and buildings are outcomes of design, which involves balancing complex considerations and constraints. Designers rely on historical data, estimation, calculation, and simulation to guide decisions, yet integrating these sources into a coherent strategy remains challenging. This research streamlines data-driven analysis and multi-criteria simulation to support informed and efficient design decisions, focusing on the interplay among three critical dimensions of sustainable building design: economic performance, energy efficiency, and aesthetic quality.

A surrogate model is a structured, simplified model that emulates a high-fidelity simulation to reduce computational cost while maintaining accuracy. This research integrates surrogate modeling for data-driven analysis and computational simulation for precise calculation, investigating three phases: a surrogate model for historical data analysis, multi-criteria performance simulation, and integration of analytical results into a data-informed design decision framework. The prototyping process aimed to translate analytical and simulation outcomes into a practical design-support framework. A surrogate model was developed using historical housing data to capture relationships among design, cost, and performance. These relationships were integrated into a simulation environment to assess trade-offs among economic, energy, and aesthetic criteria. The resulting prototype served as an experimental platform demonstrating how data-driven insights could guide sustainability-oriented architectural decisions.

The King County Housing Dataset was used as a case study for the suggested framework. It included key characteristics such as building area, lot size, grade, condition, year built, renovation status, location, and market value across more than 21,000 residential properties. These factors represented financial, ecological, and architectural quality of home design and were used to analyze trade-offs and train a surrogate model predicting sustainability outcomes.

Based on the findings, the suggested method showed that data-driven surrogate modeling can improve both the speed and accuracy of design assessments, allowing designers to make more informed decisions at early stages. By converting empirical housing data into design-relevant insights, the framework allows designers to identify sustainable design strategies grounded in real-world evidence.

The next phase of this research will expand the surrogate modeling approach using simulated datasets to further lower computational costs and speed up multi-objective design optimization, building on this integration between computational modeling and architectural design thinking. By strengthening the link between performance simulation and empirical data, this extension seeks to enable a more thorough assessment that considers both economic and environmental factors.

3D-Printed Scaffolds Reinforced with Natural Mineral (*Asphaltum Punjabianum)* for Skin Tissue Engineering

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Additive manufacturing via direct ink writing (DIW) allows price control over scaffold architecture and bifunctionality. We fabricated carboxymethyl cellulose (CMC)/polyvinyl alcohol (PVA) scaffold reinforced with purified shilajit (*Asphaltum punjabianum),* a natural mineral complexes containing fulvic acid, humic acid, and trace elements. The 3D-printed scaffolds exhibited interconnected porosity and excellent layer fidelity. Rheological analysis confirmed shear-thing behaviour and thixotropic recovery. Fourier Transform Infrared (FTIR) analysis of the 3D-printed scaffolds revealed distinct profiles with limited sharp bands, confirming the successful binding of shilajit and polymer. Antibacterial tests showed strong inhibition of *Escherichia coli* (*E. coli*) and *Staphylococcus aureus* (*S. aureus).* The cycocompatibity assays indicated acceptable cell viability for skin tissue engineering. Swelling and degradation studies revealed high hydrophilicity and controlled biodegradability, enabling sustained shilajit release around 60 % over 7 days. This blending of bioactive mineral content with precise 3D printing provides a multifunctional platform for advanced wound healing therapies.

Keywords — 3D printing, scaffold, shilajit, antibacterial activity, skin regeneration

Content Analysis of Alcohol and Breast Cancer Risk Information from Generative AI Chatbots

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Introduction: Alcohol is a group 1 carcinogen, the same as tobacco, and contributes to breast cancer risk for women. Awareness of this status and relationship remains low, even as the health harms of alcohol are discussed nationally in the US. Thus, it is imperative to know what information about alcohol and breast cancer is available to the public, especially information provided by Generative Artificial Intelligence (GenAI) chatbots.
Methods: To document and assess GenAI information about alcohol and breast cancer risk, we extracted 66 responses (output) from 22 configurations of 11 GenAI chatbots in June 2025. We used three prompts from the WHO, CDC, and National Breast Cancer Foundation websites regarding alcohol consumption and breast cancer risk. Content analysis to label output sections by clinical content and information presentation was conducted in Dedoose.
Results: Similarities and variations in clinical content and information presentation were identified. Nearly all output included information about causal mechanisms (n=64, 97%), and the majority included information about dose dependency (n=56, 84.8%). About half (n=35, 53%) listed content using a numbered list. In total, 34 (51.5%) did not provide citations/references, while 31 (62%) included statistics or data about breast cancer and alcohol consumption alongside citations. Three (5%) outputs included phrasing about alcohol's group 1 carcinogen status.
Conclusion: Findings represent the variability present in GenAI output regarding alcohol and breast cancer risk. Inconsistent information from GenAI chatbots is a public health concern. We call for greater standardization of GenAI output and the need for GenAI prompt and output literacy.

Explainable AI for Segmentation and Classification of Liver Cirrhosis on T2-Weighted MRI

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Liver cirrhosis requires accurate and interpretable Magnetic Resonance Imaging (MRI) analysis to support timely diagnosis and assessment of disease severity. However, many existing methods separate segmentation from classification and lack the explainability needed for clinical use. This research contributes to the development of 3UResNet, an advance ensemble deep learning model designed for multiclass segmentation of cirrhosis on 2D T2-weighted MRI scans. In addition, a deep learning–based feature fusion classifier was developed to classify liver cirrhosis cases into different severity levels. To improve transparency and strengthen clinical trust of the proposed model, the study incorporated Local Interpretable Model-Agnostic Explanations (LIME) and Gradient-weighted Class Activation Mapping (Grad-CAM), which highlight clinically meaningful liver regions and show how the model makes its decisions. On the test data, the segmentation model achieved a Dice score of 0.9516 and a mean Intersection over Union (mIoU) of 0.9077, outperforming existing approaches in literature. Overall, this study presents a practical end-to-end framework that combines accurate segmentation, severity classification, and explainable outputs, paving the way for clinical adoption. The code and dataset associated with this research are publicly available on GitHub.

A 1 MHz GaN-Based Transformerless Resonant Superimposed Quadratic Converter for 48 V-to-PoL High-Current AI Power Delivery

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A surge in artificial intelligence (AI) and high-performance computing (HPC) is set to triple electricity demand from U.S. data centers, which is expected to surpass 300 TWh by 2028. It creates unprecedented demands for highly efficient power delivery networks. While the industry has standardized on a 48 V distribution bus to minimize resistive losses, this architecture presents a major challenge for point-of-load (PoL) conversion. Modern processors operate at ultra-low voltages (~1 V) and high currents. Contemporary ASICs and FPGAs, such as Intel® Agilex™ 7 and AMD Versal™ AI Core devices used in AI acceleration and networking require multiple supply rails delivering tens of amperes. Previous works addressing high-current PoL conversion have primarily utilized LLC converters or linearly extendable group-operated architectures. They operate in the low-frequency domain and suffer from reduced power density. This work presents a high-frequency, high-current synchronous buck converter designed for 48 V-to-PoL applications by eliminating bulky magnetic transformers and using twelve switches. The proposed Resonant Superimposed Quadratic (RSQ) topology combines a resonant switched-tank stage with a superimposed quadratic buck structure fully implemented with Gallium Nitride (GaN) devices to maximize power density. Operating at a switching frequency of 1 MHz, the converter achieves high power density and fast transient response. It is simulated in a SPICE environment using vendor-provided GaN transistor, capacitor, and inductor models. Simulation results demonstrate continuous operation from 30A to 60A with a step of 5A output currents. It achieves peak efficiency 90.15% at 50A, which validates its capability for an extreme 48:1 step-down ratio.

GIS-Based Settlement Vulnerability Assessment in Rohingya camp, Cox's Bazar, Bangladesh

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Landslides and flood-related slope failures are major hazards in the hilly terrain of southeastern Bangladesh, especially in the Rohingya camps, where communities live on steep and densely populated slopes. This increases and threatens communities and shelters located on those steep, occupied areas. Communities that are settled close to riversides and slopy areas are at a higher risk of suffering from those natural disasters. The research presented in this paper aims to identify potential threated areas in Rohingya camps that are susceptible to such natural disasters. This study applies open-source geospatial data and basic GIS techniques to identify and map landslide susceptibility zones. Elevation data from the Copernicus DEM are used to derive slope, curvature, and flow accumulation layers, while Sentinel-2 imagery provides vegetation and surface stability information through NDVI. Additional factors, including land cover, proximity to drainage channels and roads, and soil type, are combined using a weighted overlay analysis to produce a composite susceptibility map. Building footprints from open data sources are then overlaid to assess exposure levels. The resulting map highlights areas where settlements are concentrated in high-risk zones, offering insights for targeted hazard mitigation and community planning. The approach demonstrates how open GIS tools can be used for practical, site-scale risk assessment in data-scarce environments. These findings can inform the development of urban planning guidelines that identify the disaster-prone areas, contribute to building more resilient communities.

Keywords: GIS, Landslide, Flood, Rohingya Camps, Bangladesh

Adaptive Structure-Aware Connectivity-Preserving Loss for Improved Road Segmentation in Remote Sensing Images

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Accurate extraction of road networks from high-resolution remote sensing imagery is a critical step for applications such as navigation, disaster management, urban planning, and environmental monitoring. However, roads appear as thin, curvilinear structures that are highly prone to fragmentation due to low-contrast surfaces, shadows, vegetation occlusion, and visually similar non-road structures. While deep learning segmentation models have achieved advanced pixel-level accuracy, pixel-level loss functions such as binary cross-entropy and Dice remain insufficient for preserving connectivity and topology of thin curvilinear structures such as roads; small local errors can disrupt the extraction of accurate road graphs, complicating subsequent characterizations and analysis tasks. We present **SAC-Loss**, an **Adaptive Structure-Aware Connectivity-Preserving Loss** designed to address these limitations. SAC-Loss combines local gap detection with global structure awareness by dynamically adjusting penalties for false negatives and false positives based on road geometry. First, the predicted road mask is skeletonized to locate endpoints and potential breaks. A proximity map derived from distance transforms highlights pixels near road structures. These cues generate a spatially varying weight map that amplifies penalties in gap-prone regions while suppressing spurious detections elsewhere. The weight map is integrated into a Focal Tversky formulation, producing an efficient, topology-aware objective that preserves connectivity without increasing model complexity or training cost. We validate SAC-Loss on three widely used remote sensing benchmarks—Massachusetts Roads, DeepGlobe, and SpaceNet—by integrating it into two different CNN-based architectures (U-Net and SemSeg). Evaluation uses both pixel-based measures and topology-sensitive metrics, including relaxed F1, Quality (relaxed IoU), and graph-level Average Path Length Similarity (APLS). Across six experimental settings, SAC-Loss consistently outperforms or matches state-of-the-art alternatives, achieving the highest scores in 14 of 18 comparisons and up to 0.17 APLS improvement over standard losses. Qualitative results further show cleaner, more continuous road predictions with fewer false positives and reduced fragmentation compared to BCE, Focal Tversky, and GapLoss baselines. By requiring no architectural changes and adding negligible computational overhead, SAC-Loss offers a simple yet effective way to make existing segmentation networks topology-aware. Beyond roads, its adaptive weighting strategy is readily transferable to other curvilinear extraction tasks such as rivers, blood vessels, or fiber networks where preserving connectivity is essential.

Automated Diagnostic Analysis of Low-Concordance Dermatology Cases Using a Multimodal AI Model

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Introduction: Diagnostic accuracy of dermatologic diseases by non-dermatology clinicians is lower compared to dermatologists. These "zero-accuracy" cases, where provider diagnoses do not align with final dermatologist recommendations, represent a critical opportunity for decision-support interventions. This study evaluated the performance of MedGemma, a large multimodal AI model, on a curated dataset of these diagnostically challenging cases.
Methods: From 594 tele-ECHO dermatology sessions (2016–2021), a cohort of 99 cases with 0% diagnostic accuracy was isolated. To ensure patient privacy, images containing identifiable faces were removed using a machine vision script (deepface library), reducing the final dataset to 77 cases with 360 clinical images. De-identified images were processed in Python and analyzed with the MedGemma-4B-IT model via the Hugging Face Transformers library on a GPU platform. The AI was prompted to generate likely diagnoses and differentials, with prompt engineering strategies applied to enhance performance. Outputs were compared to expert diagnoses using a custom multi-level string similarity algorithm that categorized matches into "Yes," "Similar," "Contains Diagnosis," "No," and "Not possible."
Results: The analysis of the 77 challenging cases revealed that while no AI-generated diagnosis was classified as exact ("Yes") or highly similar ("Similar"), the model still demonstrated relevant outputs. In 35 of 77 cases (45.5%), the AI output text included the correct diagnosis ("Contains Diagnosis"). In the remaining 42 cases (54.5%), outputs did not align with the final diagnosis ("No").
Conclusion: This study demonstrates the feasibility of evaluating multimodal AI against the most diagnostically difficult dermatology cases. Results suggest that MedGemma can generate clinically relevant diagnostic cues where provider concordance is 0%, however more research is needed to improve accuracy for responsible clinical applications. These findings highlight the potential role of multimodal AI as a decision-support tool in tele-dermatology, with implications for improving diagnostic confidence and outcomes in complex cases.

Comparative study on the formulation and characterization of protein-based active packaging films with multifunctional properties

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This study aimed to develop and characterize protein-based biodegradable and active packaging films fortified with colored corn-derived phytochemicals under varying pH conditions (pH 3 and 9). Biodegradable films were formulated using soy, zein, and casein proteins, with and without phytochemical extracts, under acidic and basic pH conditions. Ultrasonication and heat-induced stirring ensured uniform protein denaturation, followed by casting at 35 °C for 24 hours. Corresponding mechanical, antioxidant, antimicrobial, UV barrier, thermal properties and water vapor permeability were evaluated. Soy and zein protein-based films incorporating phytochemicals (SAE and ZOE) exhibited complete inhibition of *Bacillus subtilis* and *Escherichia coli*. Casein-based film (CAE) containing phytochemicals demonstrated a fivefold increase in antioxidant activity (119.39 mg TE/g film) compared to control (19.38 mg TE/g film). All films displayed near-zero UV transmittance, confirming effective UV barrier properties. The tensile strength of casein-based films (CA and CB) was 2.72 and 3.19 MPa with higher elongation at break percentages of 95.65 and 102.67%, respectively. Zein-based film (ZOE) had the highest tensile strength of 4.08 MPa but the least elongation at break percentage of 13.72%. Most films were thermally stable, with casein-based films showing endothermic peaks at 255.98 °C. Zein-based films with phytochemicals demonstrated the lowest water vapor permeability (0.59×10^{-10} g/Pa·m·h), indicating excellent moisture barrier properties. All films were compatible with laser engraving. Notably, the films developed under acidic conditions consistently demonstrated enhanced antimicrobial efficacy compared to those produced under basic conditions. Protein-based and colored corn phytochemical fortified biodegradable films, especially those formulated under acidic conditions exhibited superior antimicrobial, antioxidant, and barrier properties.

High-Performance Simulations of Raw Sediment Behavior in 3D Printing.

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Predicting the feasibility of introducing raw sediment to binder jetting technology (BJT) requires an accurate analysis of its spreadability, particularly when using traditional spreading mechanisms such as a counter-roller. Spreadability is assessed through powder bed density (PBD) and layer uniformity, necessitating both physical and numerical studies for validation. Unlike conventional discrete element method (DEM) studies that rely on simplified multi-sphere particle reconstructions or focus on small-scale spreading, this study integrates high-resolution sediment grain geometries—captured via industrial X-ray Computed Tomography (CT) scanning—into Altair EDEM for large-scale powder spreading simulations. The simulation leverages high-performance computing (HPC) with GPU clusters to realistically model 500,000 grains using detailed 3D STL files for accurate shape representation. A set of 30 CT-scanned sediemnt grains was selected at random and used to represent the grain geometry in the simulation, striking a balance between shape realism and computational efficiency.

Keywords: Binder jetting technology (BJT), powder bed density (PBD), Computed Tomography (CT), discrete element method (DEM), high-performance computing (HPC), additive manufacturing (AM).

ABOUT GPC

The Graduate Professional Council (GPC) is the official student government for all graduate, professional, and post-baccalaureate students at the University of Missouri (MU) in Columbia, Missouri. Since 1982, it has represented all the departments of the Graduate School and the schools of Business, Public Affairs (previously Public Administration), Law, Medicine and Veterinary Medicine. GPC is the voice of graduate and professional students to many of the decision-making bodies at MU, including the Board of Curators and numerous faculty committees. Another function is the development of events such as the Research and Creative Activities Forum to showcase the innovations and talents of graduate and professional students. GPC also brings you captivating social events to give you an opportunity to meet fellow graduate and professional students.

The Graduate Professional Council is the representative umbrella organization for all graduate and professional students to the administration of the University and UM Board of Curators. Although the school councils have influence on the decisions of the individual schools, only GPC has influence in general policy decisions by the University or UM System affecting all graduate and professional students (issues such as fees, tuition, and health insurance).