

Inspiring Diversity in STEM Conference 2022



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Abstract

Inspiring Diversity in STEM is a grassroots initiative based in London, Ontario, Canada promoting diversity and inclusion in science, technology, engineering, and mathematics (STEM). Our mission is to help break down barriers that underrepresented groups face by connecting them with inspiring and representative role models, cultivating early research skills, and providing a supportive community. Together, we are building an inclusive community dedicated to helping future leaders achieve their goals. We hope to be a more inclusive community for people from various backgrounds, including race, ethnicity, gender and gender identity, age, socioeconomic status, national origin, sexual orientation, ability, and religion. Inspiring Diversity in STEM has run three successful biennial conferences thus far, in 2016, 2018, and 2022 and will be hosting its next conference in March 2024. Our conferences include keynote speakers, workshops, panel discussions, industry and graduate program expos, and an undergraduate poster competition. During each conference iteration, we award several students with poster presentations awards. We also provide travel awards to students travelling from outside of London, Ontario. Our conferences have brought in hundreds of attendees, ranging from the undergraduate to the faculty level, and several local industry partners. To learn more about us, please visit our organization's page.

Keywords: undergraduate research; science; technology; engineering; math; diversity; inclusion; equity; conference; STEM

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Conference Abstracts

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Poster Presentations in Neuroscience

Informing the neurobiological treatment of addiction: The role of abnormal default mode network functional connectivity in craving, withdrawal, and relapse

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The bio-psycho-social-spiritual model of addiction proposes the etiology of substance use disorder (SUD) is multi-faceted and comprised of several interrelated components, including biological, psychological, social, and spiritual influences. With respect to biological influences, different neuroimaging techniques such as functional magnetic resonance imaging (fMRI) are increasingly being used to identify regions of interest in the brain that are implicated in the development and maintenance of SUD. As such, a growing body of research using fMRI technology would indicate that the functional organization of an individual's neuropsychological systems may significantly influence their propensity to partake in risky behaviour, including the recreational use of psychoactive substances. Particularly, there is evidence to suggest that abnormal default mode network (DMN) functional connectivity may be associated with craving, withdrawal, and relapse among individuals with SUD, making this region of the brain an essential target for the development and implementation of neurobiological treatment approaches. Accordingly, different evidence-based neurobiological treatment approaches increasingly are being used to address the role of abnormal DMN functional connectivity in SUD, including cognitive interventions (e.g., cognitive control, mindfulness meditation, positive emotion regulation, cognitive bias modification training), behavioural interventions (e.g., cue-exposure therapy, cognitive-behavioural therapy), motivational interventions (e.g., motivational interviewing, personally-tailored messaging), and neuromodulatory interventions (e.g., neurofeedback, transcranial magnetic current stimulation).

The effects of resistance training to improve brain health in older adults with obesity

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Obesity and old age are associated with decline in structural connectivity (SC) and decreased cognitive functioning. SC is defined as the existence of white matter tracts physically interconnecting different brain regions, allowing for various mental operations to co-occur. The disruption of SC by diseases associated with obesity and aging, often results in significant interference to normal cognitive function. Resistance training (RT) has shown to be a promising exercise intervention capable of inducing changes in SC and cognition. Liu Ambrose et al. (2012) had older adults undergo a 52-week RT intervention and found that participants in the RT group performed better in tasks involving executive functions (i.e., Stroop test) and improvements of brain pathologies (i.e., removal of amyloid plaque, etc.). However, investigating changes in SC in white matter tracts is complex, hence previous evidence regarding the neurobiological processes underlying structural changes remain inconclusive. To combat its complexity, researchers have adopted a tool known as diffusion tensor imaging (DTI). DTI serves as a highly sensitive tool that enables visualization and characterization of white matter tracts and the potential to combat the complexity of volumetric white matter changes often seen in studies. The degree to which SC can improve with RT in obese older adults using DTI remains poorly understood. Thus, by utilizing DTI, the present study may provide a comprehensive understanding of the neurobiological processes underlying the effects of RT on SC in obese older adults.

Inhibition of astrocytes in the dentate Gyrus impairs pattern separation

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Pattern separation is a cognitive process that is essential for successful memory retrieval. It helps us to keep similar memories distinct from one another by transforming similar neuronal inputs into distinct, non-confusable outputs. This process depends on adult-born neurons in the dentate gyrus region of the hippocampus. These adult-born neurons functionally interact with cells called astrocytes. Recent research has suggested that astrocytes have a role in integrating adult-born neurons into hippocampal circuitry. The exact mechanisms underlying how adult-born neurons contribute to pattern separation remain unknown. Although our laboratory has previously studied the activation of Gq (excitatory) signaling of astrocytes in the

dentate gyrus, it has not yet been investigated how the activation of Gi (inhibitory) signaling of astrocytes affects pattern separation in this region. We hypothesized that inhibiting astrocytes in the dentate gyrus would impair pattern separation ability. To test this hypothesis, we employed two mouse lines to express hM4Gi designer receptors exclusively activated by designer drugs (DREADDs) on astrocytes by using two astrocyte-specific promoters (glutamate aspartate transporter (GLAST) and aldehyde dehydrogenase 111 (ALDH). We infused clozapine-N-oxide (CNO) or saline into the dentate gyrus prior to behavioural task performance. Both spontaneous location recognition (SLR) and location discrimination (LD) tasks were used to assess spatial pattern separation. We found that inhibition of astrocytes impaired pattern separation in SLR compared to controls. Data collection for the LD task is currently in progress. The findings will help to further our understanding the role of astrocytes in pattern separation. This research also introduces astrocytes as a new target for therapeutics when assessing pattern separation deficits in disease models.

Poster Presentations in Psychology

The effects of implicit reactivity due to increased daily social exposure on compulsions in young adults diagnosed with obsessive-compulsive disorder

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Exposure and response prevention therapy (ERP) is a frontline treatment for obsessive-compulsive disorder (OCD), however low adherence rates to between-sessions homework practices are diminishing the effects of the therapy. Low adherence rates can be attributable to many factors, including the stress from patients having to reluctantly induce compulsions onto themselves. More viable homework practices are necessary to increase adherence rates and improve prognosis. Thus, this proposal aims to examine how typical and inevitable daily social exposure can act as a less intrusive homework practice. It is hypothesized that increased social exposure over time will decrease compulsions because there are various factors within social exposure (e.g. subtle cues, being watched, connections with others) that act as positive punishment to trigger the public self-awareness that is already heightened in individuals with OCD, and thus motivate change. This hypothesis is based on the current literature pointing to three crucial and relevant phenomena: ERP is based on positive punishment, group ERP sustains lower treatment dropout rates compared to individual ERP sessions, and generally the presence of others influences behaviour. This pre-test post-test self-report study will look at whether those various factors within social exposure, measured by frequency and intensity, affect participants' need to perform a compulsion, as defined by their level of internal distress. The data will be analyzed using multiple regression. If the hypothesis is supported, practical implications lie in increasing adherence rates and improving the effectiveness of ERP.

Examining the role of age in McGurk illusion perception differences between cochlear implant users and normal hearing controls

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Multiple studies have explored the effect of hearing impairments, including cochlear implant (CI) use, on audiovisual (AV) integration by measuring rates of syllable fusion in McGurk illusion experiments. Generally, CI users experience less syllable fusion than typical hearing controls. However, a recent study by Stropahl et al. (2016) found that CI users reported a higher frequency of fusion compared to controls, which was interpreted to indicate greater AV integration in CI users. Importantly, these groups were not age-matched, with the control participants being younger on average than the CI users. Age is a confounding variable here as syllable fusion rates in McGurk experiments have been shown to increase with age. An online replication of Stropahl et al.'s study with age-matched CI users and controls yielded no significant group differences. In the current experiment, an additional sample of control participants with a younger average age (matching that of Stropahl et al.'s control group) is taking part in the online replication to determine how much of the difference in fusion reported by Stropahl et al. is due to age and how much is due to CI use. Our results revealed a close replication of Stropahl and colleagues' findings, with the younger control group reporting less fusion than both the older control group and the CI users. This result would suggest that age contributed more than hearing type to the overall difference between groups in McGurk perception, and therefore AV integration, reported by Stropahl et al.

Chunking in backward recall of digits: A theoretical model comparison

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Working memory is an important aspect of executive function that is impaired in several disorders. Studying its underlying mechanisms is indispensable as it helps to gain a better understanding of the impairments and their resulting deficits in these disorders. Items in working memory can be recalled in the same way they were presented (forward recall) or in the reverse order (backward recall). Backward recall has been extensively used in research and clinical settings as a test of working memory and intelligence. However, the mechanisms underlying backward recall are not yet clear. In this study we put forward two theoretical models for backward recall, considering the effect of a common mnemonic device, chunking, which involves grouping a sequence of digits together. The first model assumes retrieval of information in both directions with equal facility. The second model (peel-off model) assumes that recall is inherently forward, and backward recall occurs through a series of forward recalls, where each time the last item is recalled (peel-off). To test these models we tested 15 right-handed adults (n=15; 9 women, 6 men) using a 6-digit immediated recall task, where we manipulated the recall direction and chunking strategy (2 or 3-digits) and measured accuracy and response times. Based on the operation involved in the two models, we made predictions on response times and accuracy to compare with the collected data. The behavioral data most closely resembled the second model (peel-off) in both chunking conditions, providing evidence in support of the peel-off model.

Poster Presentations in Biology

Investigating the function of M. masseter pars coronioidea

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The human jaw's stability and masticatory functions are supported by the masseter muscle. This quadrilateral muscle is traditionally depicted as a two-layer muscle. However, some sources have suggested the presence of a third layer. Recently, strong evidence has been found of a physiologically distinct third deep layer (coronoid layer) which has an unclear function yet to be confirmed by empirical data. The proposed study investigates the movements of the jaw that are facilitated by the coronoid layer of the masseter muscle. It is expected that the coronoid layer demonstrates peak activation during stabilizing motions: elevation and retraction of the mandible. This study proposes the utilization of MRI paired with the Slicer program to build a 3D model of the subject to locate the precise masseter location. Using the model, intramuscular electromyography electrodes across the 3 divisions of the masseter muscle are inserted to monitor activation through elevation, depression, protraction, retraction, and lateral movements of the mandible. While this method is invasive and limited in sample size, it provides extremely precise motor unit activation data. A clear link to the function of this coronoid layer has important implications in maxillofacial surgery, precision of speech therapy and treatment plans, and injury rehabilitation of the face and jaw. To complement and extend the findings of this study, biopsy studies of the muscle are suggested. This will establish a clear link between histological structure and function, clarifying the controversial physiology of the masseter muscle.

Impact of climate change on human zoonoses, with an emphasis on COVID-19

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Over the last few decades, the world has experienced several pandemic outbreaks of various pathogens. Additionally, the frequency of the emergence of novel strains of infectious organisms has recently increased. Many studies have found associations between climatic conditions and zoonoses transmission. However, there is debate about the future impacts of climate change on zoonoses transmission, especially with the rise of SARS-CoV-2 (COVID-19). In the context of the current COVID-19 pandemic, this study investigates the major causative climatic factors that influence the repeated emergence of pandemics, by examining the current impact of climate change on viral (West Nile and Dengue) and non-viral (Lyme and Malaria) zoonoses transmission. A literature search was conducted, using the electronic databases: PubMed, Scopus, ScienceDirect, Web of Science, GEOBASE, and CINAHL. The search focused on peer-reviewed primary research articles published in English from 2004 through 2020. 52 studies met the inclusion criteria and most of the studies showed that the

transmission of pathogens was highly sensitive to climatic conditions, especially temperature, rainfall, relative humidity, and wind. The findings indicated that temperature was the most significant climatic variable affecting zoonotic pathogen incidence, compared to wind, relative humidity, and precipitation. Higher relative temperatures tend to decrease pathogen incidence for COVID-19, but the opposite relationship was evident for West Nile, Lyme, Dengue, and Malaria. Extrapolating this towards the epidemiology of COVID-19 proposes a modest reduction in COVID-19 transmission during the summer. This information can be utilized for future research related to COVID-19 transmission and alleviation. Future research should also focus on improved pathogen surveillance and a better understanding of bioclimatic relationships from interdisciplinary perspectives.

A synthetic biology system to measure cell-cell communication in vivo using a blood test

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The field of cell-based immunotherapy has made major improvements to cancer treatment over recent years. Clinically, blood tests are often used to detect circulating immune cells, but these measurements do not reflect what happens within tumors to reflect treatment efficacy. Here we aim to build a new activatable system that secretes a unique blood biomarker when engineered therapeutic immune cells interact with target cancer cells within tumors. The synthetic notch (SynNotch) receptor is a versatile system that signals cell-cell contact via transcriptional modulation of desired genes-of-interest in response to SynNotch-target antigen binding. Our goal is to engineer immune cells with a SynNotch system that will activate the expression of a blood-based biomarker upon cancer binding. We engineered human Jurkat T cells via sequential lentiviral transduction of two components: (1) a SynNotch receptor directed against the B cell leukemia antigen CD19, and (2) a reporter response element encoding secreted embryonic alkaline phosphatase (SEAP), a safe and stable blood-based reporter protein. Engineered Jurkat T cells were co-cultured with CD19⁺/⁻ leukemia cells to assess reporter activation in vitro, resulting in significantly higher SEAP activity in CD19⁺ conditions than CD19⁻ conditions. We have established a synthetic biology reporter system that is activated upon cancer antigen binding, which we posit will allow for robust reflection of immunotherapy efficacy through simple blood tests. Current work involves assessing the system sensitivity in vivo. The development of this system would allow for a specific monitoring tool for many cell-based immunotherapies, which can ultimately reveal their treatment dynamics.

Overcoming milk intolerance through identification of elastase small molecules

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Milk intolerance affects an estimated 65% of the adult population worldwide. Bovine β -casomorphin-7 (BCM-7), the protein associated with this condition, can lead to serious health implications including excess mucus in the gastrointestinal (GI) tract, which hinders GI function, as well as cardiovascular disease. A1 β -casein protein digestion is associated with milk intolerance, as pancreatic elastase cleaves between residues Ile66 and His67 in A1 β -casein to produce BCM-7. Our study investigated the structure of porcine elastase (3EST), as well as the different amino acids that bind to one of its two allosteric sites. Using MCULE, inhibitors were designed to fit this allosteric site by selectively modifying five atomic locations on residues which made polar contacts with allosteric site 1 of 3EST based on toxicity and binding affinity: TYR'207/N, TYR'207/O, LEU'120/O, LEU'120/N, VAL'122/N. Lastly, our study verified the docking scores, binding affinity, and toxicity of these modified small molecules using MCULE, Prodigy, and PyMol. The results suggest Modified MCULE9238123340-0-2 has the greatest possibility of being an effective inhibitor due to its binding affinity (-8.1 kcal/mol), logP (4.54) and ligand efficiency (0.258). This inhibitor can be efficiently absorbed and bind to the allosteric site 1 of 3EST, thereby reducing the amount of BCM-7 produced and minimizing the physiological GI effects stemming from the consumption of A1 β -casein milk.

The role of PPAR delta in the regulation of synovial biology

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A condition impacting millions of Canadians yearly, osteoarthritis (OA) is a prevalent and serious disease with profound impacts on the aging population in society. The condition has been known to impact a variety of sectors ranging from economic and healthcare systems to indirect impacts on the wellbeing and quality of life of patients. In spite of this widespread impact, there are no prevailing treatments to reverse OA. However, previous research has indicated a primary target in nuclear receptor PPARdelta; it is a transcription factor with a known function to promote cartilage degeneration in post-traumatic osteoarthritis (PTOA) mouse models. From previous findings, it can be hypothesized that PPARdelta has protective abilities in a PTOA model. Thus, the investigation of the role of PPARdelta in synovial cells must be investigated to understand the transcription factor's relationship to synovial cells given that the role of PPARdelta in the synovium is unknown. Through collecting synovial cells from OA patients and rats with and without OA, and further categorization with control incubation (DMSO), PPARdelta activator GW501516, or PPARdelta inhibitor GSK3787, cell proliferation and apoptosis can be measured, and expression of inflammatory genes can be detected. It can be hypothesized that PPARdelta will result in inflammatory and catabolic alterations to the synovial cells, and the inhibition will suppress these changes. Through further research, one can anticipate the catabolic and inflammatory activities induced in the synovium in conjunction with heightened expression of protective factors including PRG4.

Evaluation of antioxidant effects of creatine in cancer

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Oxidative stress is recognized as a significant factor in the pathogenesis of various diseases. Multiple studies have implicated oxidative stress as the underlying mechanism for cancer initiation and progression by enhancing DNA mutations, DNA damage, and cell proliferation. Interestingly, there is an extensive and still growing body of literature debating the effects of creatine supplementation in cancer. Creatine supplementation has proven beneficial as a nutritional supplement, therapeutic agent, and antioxidant. The goal of this review is to assess previous literature focusing on the effects of creatine on oxidative stress in cancer. Currently, there is strong evidence supporting the antioxidant role of creatine in cancer cells as it is known to protect mitochondrial DNA from oxidative stress. Previous studies have suggested that this reduction in oxidative stress is associated with a reduction in tumour weight and mitigation of the disorders and harmful effects associated with cancer. However, these studies are mainly limited by their lack of a manipulatory intervention to isolate creatine supplementation as the direct cause of these antioxidative effects. Further studies should focus on repurposing creatine to be used in combination therapy with other antioxidants to examine whether both mitochondrial and nuclear DNA can be protected. Studies involving the long-term supplementation of creatine should be conducted to assess its therapeutic effect and whether it is safe to do so. Lastly, future studies should focus on the effects of creatine in methionine and folate cycles under conditions of induced oxidative stress, and whether creatine engages in a protective role to preserve these cycles from oxidative stress.

Differences in fetoplacental volumes in successful and unsuccessful guinea pig litters

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The in-utero development of the fetus is a critical stage of life. Therefore, researchers aim to determine whether certain factors affect fetoplacental development, such as maternal diet. The amount of unhealthy food in the food industry has been increasing significantly, contributing to today's high-fat and high-sugar Western Diet. A higher percentage of guinea pig pups previously had not survived to collection in the Western Diet group, compared to the Control Diet group. Differences in fetoplacental volumes between unsuccessful litters (USL, in which all pups did not survive) and successful litters (SL) had not been investigated. Thus, we compared the volumes of the fetuses and placentae in USL and SL. It was hypothesized that the volumes of fetoplacental units in USL would be smaller than those in SL, since pups in USL may not have grown as much. Pregnant guinea pigs were fed a Western diet. They were imaged at an average gestational age of 33 days using a 3T MRI. 3D Slicer 4.11 was used to segment the fetuses and placentae in the images of each guinea pig. The volume of each

fetus and placenta was computed and recorded. Linear mixed models of fetal volume and placental volume were generated using R and R Studio. Analysis of variance was performed on each model to assess for significant differences in volume between USL and SL. Results: The volumes of fetuses are not significantly different between SL and USL ($p = 0.6259$). The volumes of placentae are not significantly different between SL and USL ($p = 0.1298$). This study provides no evidence that the volumes of fetoplacental units are different in USL compared to SL. The linear mixed model accounted for confounding factors of pups from the same mother. Limitations included the comparison only being performed in guinea pigs fed a Western Diet, a small sample size, and subjectivity of the segmentation process. Future work includes performing this comparison with a greater sample size and multiple people segmenting. The comparison can also be done in the Control Diet group and eventually in human pregnancy as the main future goal.

Poster Presentations in Chemistry/Biochemistry/Health Science

Conformational changes of intrinsically disordered protein in explicit water solvent

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Intrinsically disordered protein (IDPs) is one of the most abundant types of protein existing in nature. They play a significant role in controlling the cell cycle as well as cell signalling. Mis-expressions or mutations in IDPs could lead to cancer, cardiovascular diseases and neurodegenerative diseases. A previous study by Mao et al. compared the conformational changes of the polypeptide model Ac-(Arg)₂₅-Nme in both explicit solvent and implicit solvent. The results revealed that as the concentration of salt increases in the implicit solvent, the radius of gyration of the polypeptide decreases, indicating that the polypeptide became more compact. In contrast, the study showed that as the salt concentration increases in the explicit solvent, the conformation of the polypeptide remains unchanged. The purpose of this project is to re-perform the experiment performed in the explicit solvent to assess the conformational changes of the same polypeptide. Molecular dynamics are used for the simulations. The results are obtained which revealed that as the concentration of salt increases, the radius of gyration of the polypeptide decreases in explicit solvent. Another order parameter called end-to-end distance is calculated and further analyzed. The results observed confirms that as the salt concentration increases, end-to-end distance of the polypeptide in the systems increases. Systematic analysis established a huge potential for in vivo and in vitro studies.

Diethylamine nonoate as an adjuvant immunotherapy agent to treat glioblastoma

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Glioblastoma is a malignant brain cancer that targets glial cells and invades nearby brain tissue. Temozolomide (TMZ) is a chemotherapeutic commonly used to treat glioblastoma. TMZ helps decrease the growth and progression of tumors by alkylating the O6 site on guanine during replication causing insertion of thymine residues instead of cysteine. This mutation results in double and single stranded breaks in the DNA, eventually leading to cell death. In a 2016 study, over 50% of glioblastoma patients being treated with TMZ experienced resistance due to their cells overexpressing methylguanine methyltransferase (MGMT), a DNA repair protein. MGMT works opposite to TMZ by repairing damaged guanine through transfer of a methyl group at the O6 site of guanine allowing the cell to avoid apoptosis. Nitric oxide has been shown to indirectly prevent transcription of the necessary MGMT DNA repair proteins. We are proposing to administer diethylamine nonoate as an adjuvant immunotherapy agent alongside TMZ via a lipophilic nanoparticle as potential treatment for glioblastoma. Diethylamine nonoate is a nitric oxide donor that can subdue MGMT activity. To ensure specificity, the outside of the nanoparticle would be decorated with folic acid molecules that are specific to the folate receptor on glioblastoma cells. This nanodrug would suppress the effects of MGMT, sensitizing the cells to TMZ and leading to an increased potential in combating glioblastoma. This opens the opportunity for adjuvant drugs to be used alongside other chemotherapeutics to improve patient outcome and help advance the future of brain cancer treatment.

Can exercise restore memory as much as caffeine?

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Caffeine is a widely consumed psychoactive substance which can increase alertness, energy and working memory performance. However, caffeine use can cause headaches, anxiety, muscle tremors, and withdrawal symptoms upon cessation. Acute exercise has been shown to improve working memory at a similar level to caffeine and does not have the negative effects of caffeine. Both caffeine and aerobic exercise have been effective in reducing the symptoms of caffeine withdrawal. Although both exercise and caffeine are known to improve working memory in non-withdrawal states, there is a lack of research comparing their abilities to restore working memory in acutely deprived caffeine users. Moderate intensity exercise will be as effective as caffeine in restoring working memory performance following a 24-hour period of caffeine deprivation in moderate to heavy caffeine consumers. To investigate this, participants are being recruited for two visits to the Exercise and Health Psychology Lab. The first visit involves a baseline n-back assessment (to measure working memory). The second visit and n-back assessment will occur after 24 hours of caffeine abstinence. After this assessment, participants will either perform 20 minutes of moderate intensity exercise or consume caffeine. They will then perform a final n-back assessment to measure the influence of these interventions on working memory performance. The exercise intervention is to complete 20 minutes of moderate intensity exercise (brisk walk) while the caffeine condition is to consume 1.2 mg/kg of caffeine. One-way repeated measure ANOVA will be used to determine whether n-back error rates differences will be seen between treatment groups (exercise vs caffeine) across time (pre-treatment and post-treatment).

Efficacy of secondary versus primary closure techniques for the prevention of postoperative complications after impacted mandibular third molar extractions: A systematic review update and meta-analysis

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This is an update of a 2012 systematic review comparing secondary and primary closure with respect to postoperative complications after impacted mandibular third molar (IMTM) extraction. We searched PubMed, EMBASE, and CENTRAL for randomized controlled trials (RCTs) through June 16, 2021. Additional databases such as SID.ir, ProQuest, Google Scholar, trials registries, and conference abstract databases were searched for grey literature. We conducted screening, data extraction, and risk of bias assessments using the Cochrane Risk of Bias tool independently and in duplicate. We pooled results across studies using a random-effects meta-analysis and assessed the certainty of the evidence using the Grading of Recommendation Assessment, Development, and Evaluation (GRADE) approach. We included 40 RCTs with a total of 3,349 participants. Moderate certainty evidence demonstrated a trivial difference between the closure techniques with respect to pain at day 7, trismus within 1 week, and the incidence of infection, alveolar osteitis, and bleeding within one month. However, secondary closure is probably associated with less swelling on day 1 (SMD = -0.98; 95% CI [-1.22, -0.73]; moderate certainty) and on day 3 (SMD = -0.87; 95% CI [-1.16, -0.59]; moderate certainty). There was low certainty evidence for swelling at day 7 and pain at days 1 and 3. This review found a trivial difference between secondary and primary closure with respect to most postoperative complications. There was moderate certainty evidence that secondary closure probably imparts a benefit for swelling on days 1 and 3.

Use of GRADE in dentistry systematic reviews: A methodological study

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Evaluate the use of the Grading of Recommendations, Assessment, Development and Evaluation (GRADE) approach in dentistry systematic reviews (SRs). We searched Ovid MEDLINE for dentistry SRs of randomized controlled trials published between January 1, 2016 and September 23, 2021. Pairs of reviewers independently screened titles and abstracts, as well as full-texts. Of all the titles and abstracts meeting the inclusion criteria, a random subset was screened at the full-text stage until 200 SRs were included. Data extraction was conducted independently and in duplicate. We determined the frequency of GRADE use and appropriate use of GRADE for the overall review and a specific outcome. We used the odds ratio and its 95% confidence interval to determine whether SRs using GRADE have better methodological quality. We screened 3307 titles and abstracts to include 200 SRs. Thirty-six percent of the SRs utilized GRADE and of those, 53% and 31% used GRADE appropriately at the review and outcome level, respectively. Additionally, SRs using GRADE were of higher methodological quality, as they were more likely to search for grey literature (OR = 3.03; 95% CI [1.66, 5.53]) and minimize errors in screening and data extraction (OR = 5.73; 95% CI [1.29, 25.45]). More authors of SRs in dentistry should complete certainty of evidence assessments and those currently completing them should improve the quality of their assessments by better adhering to the GRADE guidelines. SR authors and consumers should be aware of these limitations when interpreting SR conclusions.

Integrating residents and family care partners as research team members in long-term care research

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Patient engagement (PE) believes that individuals with lived experiences are aware of what must be done in order to meet their health care needs and improve their quality of life. Therefore, the aims of this project were to: 1) document lived experiences collected from the meaningful inclusion of older adults living in long-term care (LTC) homes and their family care partners (FCPs); and 2) identify validated scales to quantify this involvement in the research process. To address objective 1: a member of the research team (RZ) tracked all occasions when older adult residents and/or FCPs were engaged with the research team over a period of 13 months. Descriptions of PE events were journaled including: the reason for engagement, who was involved, why, and findings from any scales or interviews. A scoping review following the methods of the Joanna Briggs Institute (2020) is in process to address Objective 2. In summary, a search strategy confirmed by a librarian was completed with five health research databases; studies were included if older adults living in LTC were engaged by the

research team to contribute to the study. From the perspectives of the FCPs and older adult patient partners, it was very important for the research team to work at building relationships with them so that they felt connected with the research process. Upon reflection, the better ways to engage FCPs and older adults were individual emails and videoconference meetings, and recognition of contribution by gift cards. Additionally, FCPs and older adults informed the research team what changes needed to be made to a set of instructions' for ZOOM meetings that had been provided for virtual care planning. Preliminary results of the scoping review suggest that there is a lack of PE in LTC research. Our experiences with FCPs and older adult residents of LTC homes suggest that their voices are missing in the research literature. This experience is supported by finding very few research studies in LTC which included PE. There is opportunity to improve family and resident engagement, resident care and quality of life for older adults living in LTC homes. Our research with older adults in LTC intends to embed validated scales of PE to promote meaningful engagement and integration of lived experiences for improved outcomes

Poster Presentations in Engineering/Physics/Biophysics/Math/Computer Science

Developing a simple, robust, and cost-effective small animal monitoring system for MRI

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Studies involving imaging small animals, such as mice, in an MRI require constant monitoring of their vitals. One of such vitals is respiration rate, which is needed for the maintenance of experimental conditions; namely, the level of anaesthesia delivered to the mouse. However, vital function monitoring for a standard MRI is not tailored towards small animals, and may produce unreliable and inaccurate data. Small animal MRI scanners and current animal monitoring systems suited for whole body scanners are expensive, and it would be beneficial to avoid the extra cost if possible. In our work, we are using Arduino-based hardware to develop a cost-effective tool that continually measures small animal respiration rate. Specifically, we are creating an interface between the Arduino Integrated Development Environment (IDE) and MATLAB for serial monitoring. The transfer of data to MATLAB is expected to be favourable, as opposed to remaining within the Arduino IDE, as MATLAB has a more robust set of tools for manipulating data.

Development of extracellular matrix derived bio-ink for autologous skin analogue bioengineering via bioprinting

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Autologous split-thickness autograft is still the current standard of care for severe burn injuries with full-thickness skin wounds however, the availability of healthy donor skin to cover the wound is often limited, resulting in a lengthy hospital stay with increased risk of complication. A potential solution is to bioengineer skin analogs through extrusion-based bioprinting. Decellularized extracellular matrices (dECM) containing factors to support cell growth and tissue maturation can be used for the development of bio-ink, which can be further bio-printed into sheets to cover the wound. We hypothesize that extrusion-based bioprinting can be utilized to print skin analogues using burn-derived mesenchymal stem cells (BD-MSCs) incorporated within a biocompatible porcine skin dECM (ps-dECM) bio-ink. We aim to develop a decellularization procedure to generate ps-dECM bio-ink and characterize in vitro properties, as well as establish a lab-developed bioprinting platform for proof-of-concept bioprinting the ps-dECM bio-ink. The histological, morphological, temperature responsiveness and biocompatibility assessments of the ps-dECM bio-ink have been characterized in vitro, utilizing H&E/trichrome staining, live/dead cell staining, and MTS cell proliferation assays. Total collagen content was quantified. The residual DNA was assessed via DAPI staining. A lab-developed bioprinting platform and bio-ink extrusion head was fabricated for bioprinting of ps-dECM bio-ink. The ps-dECM derived bio-ink was successfully developed, reserving >40% of collagen content with all DNA content eliminated. The human fibroblasts showed increased proliferation rate for 14 days after incorporated into ps-dECM while maintaining their cell viability. 5x5 mm and 5x10 mm rectangular patches can be printed with the developed ps-dECM bio-ink using the developed extrusion-based FRESH bioprinting platform. With the ps-dECM bio-ink and bioprinting platform, the next step is to assess rheological and mechanical properties of the bio-ink and construct biolayer skin substitutes containing BD-MSCs and keratinocytes.

Selection for phosphorus-accumulating purple bacteria using intermittent P-rich feed with distinct substrates in wastewater treatment industry

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Wastewater treatment plants are transitioning into resource-recovery centers that reduce pollution from the wastewater by transforming it into valuable resources. Purple phototrophic bacteria (PPB) have been shown to exhibit accumulative properties under anaerobic conditions while utilizing infrared light as their primary energy source, which reduces energy input into the biochemical process. Manipulating their accumulative properties will allow carbon, phosphorus and energy recovery from wastewater in the form of poly-hydroxyalkanoates (PHAs), poly-phosphates (poly-P) and hydrogen gas, respectively. This work first aimed to investigate the viability of treating wastewater using PPB. A 4-L anaerobic photobioreactor was constructed and illuminated with 850 nm infrared light. Steady-state analysis showed satisfactory chemical oxygen demand (COD) removal with soluble COD dropping to less than 30 mg/L. The enriched biomass under this reactor accumulated about 5 mg-P/L of ortho-phosphates corresponding to 6% of the total dry weight of solids. Fluorescence microscopy analysis with the dye 4',6-diamidino-2-phenylindole (DAPI) suggested that a portion of the accumulated P was in the form of poly-P. An enrichment experiment was conducted to investigate the effect of isolating the carbon sources of the synthetic wastewater (normally comprises eight carbon sources) on the microbial community composition. The PPB accounted for 50% of the sequence reads when the reactors were illuminated with 850 nm, while they were only 30% of the reads with the 940 nm light. Microbial composition of the reactors fed complete wastewater appeared to be more similar to the fermentable substrates than the acetate reactors. Experiment was done to examine the effect of intermittent illumination on poly-P accumulation. The pH in all reactors other than the dark control increased significantly. Interaction between pH and poly-P accumulation appears to be significant, but the exact nature of these interactions remains unknown.

Comparison of MRI vessel imaging techniques: Clinical gadolinium-enhanced MRI vs. high-field time-of-flight angiography

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Contrast enhancing agents, such as gadolinium (Gad), have been used to improve imaging of brain vasculature in magnetic resonance imaging (MRI). However, gadolinium has been shown to have negative side effects (e.g. anaphylactic reactions, gadolinium retention) and is potentially nephrotoxic. Time-of-flight MR angiography (TOF-MRA) is a flow-dependent modality used to visualise vessels, without the same side effects since no exogenous contrast is required. When implemented using ultra-high field (7 Tesla) scanners, TOF-MRA can produce high-resolution sub millimetric images of the cerebral vasculature but has yet to be validated to the same extent as standard field Gad-MRI. Our primary aim is to determine the localization efficacy of identifying cerebral vessels with the two modalities. Additionally, we hope to understand which modality will be of greater value for diagnostic and treatment planning, thus aiding in the distinction between healthy and pathological brain regions. A subset of patients undergoing deep brain stimulation (n=5 out of 19) who have undergone scanning on both a clinical standard field Gad-MRI and 7T TOF-MRA will be examined. Using 3D Slicer, a protocol will be developed for the placement of fiducial markers on the vasculature permitting comparison between the modalities and will be applied to future subjects irrespective of pathology. In addition to visual inspection, statistical analysis will be performed to quantitatively assess the location of vessel features identified in both sets of images. We anticipate that 7T TOF will be comparable to standard field CE-MRI for the localization of cerebral vessels. Any unexpected vessel localization differences will be grounds for further optimization of 7T TOF sequences prior to implementation in clinic.

Characterization of unsharp mask filtering on X-ray image quality

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Medical imaging is a powerful tool for non-invasively visualizing anatomical structures and pathologies. Image processing is often used to improve the detectability of abnormalities such as lesions. The unsharp mask is a widely used processing technique which enhances the edges in the image, but previous studies found that it can degrade the image quality which may raise concern for clinical use. To better understand the limitations of unsharp mask, we aimed to characterize the effect of unsharp mask processing on the visibility of a pathological lesion. Using MATLAB, a simulated lesion was added to a

clinical x-ray image, and the unsharp mask filter was applied to demonstrate the impact on the visibility of the lesion. Additionally, Monte Carlo simulated x-ray images were generated using DQEPro and the unsharp mask filter was applied. Then, the modulation transfer function (MTF), noise power spectrum (NPS), and detective quantum efficiency (DQE) were calculated to quantitatively characterize the effect of unsharp mask. Visual interpretation of the clinical image revealed that unsharp mask made the simulated lesion more difficult to see. Similarly, the MTF, NPS, and DQE values were suppressed at low spatial frequencies, indicating that the lesion was more difficult to detect. Overall, the unsharp mask reduced the image quality as it resulted in decreased lesion conspicuity. Some limitations include characterizing only one mode of unsharp mask setting and the simulated lesion not being generalizable to all clinical lesions. Future investigation could explore various unsharp mask settings and provide mathematical explanation for this phenomenon.

Feasibility of thermally printing 3D PVA hydrogel shapes

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Polyvinyl alcohol (PVA) is a widely used polymer due to its nontoxicity, biodegradability, and inexpensiveness. In recent years, the usage of hydrogels in gel dosimetry and tissue engineering has become a popular area of research. As well, efforts have been made to produce three-dimensional (3D) gel structures with 3D printing techniques. However, few reports exist on the printing of PVA hydrogels. This feasibility study aimed to develop a low resolution, extrusion-based method to 3D print gel phantoms using PVA hydrogel and the chemical crosslinker glutaraldehyde (GTA). The printing was conducted by extruding gel formulations through the nozzle of a syringe. The experimental investigations showed that extrusion of heated gel into a heated water bath was a promising method because it allowed for the maintenance of gel structure, maintained hydration of the gel, and mitigated the flattening effects of gravity.

Improving temporal graph network messaging

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Graph Representation Learning can be used to encode a graph structure to better accomplish various tasks such as community detection, link prediction, and node classification. The addition of a temporal component however adds complexity and requires additional adaptation. The Temporal Graph Network algorithm introduced by Rossi et al. is one such dynamic graph neural network algorithm which was found to be efficient while also outperforming multiple recent algorithms such as JODIE, TGAT, and DyRep for dynamic link prediction. In this algorithm, each node has memory to store edge and node changes that affect it over time. Each change is introduced as input to a message function, with these messages then aggregated over batches to update the memory. In this work, improvements to the message function are explored, particularly to share messages to a node's neighbourhood so as to take into account neighbourhood changes when making predictions. The neighbourhood sample types considered are uniform, highest degree, and most recent. The adapted Temporal Graph Network algorithm is then tested on the bipartite dynamic network Wikipedia and unipartite dynamic network Social Evolution for link prediction. Results for the proposed variants show very small inconsistent improvements for both networks with comparable runtime to the original Temporal Graph Network algorithm. The number of neighbours selected did not seem to affect the variant's performance, but the best neighbourhood sample varied according to the network, perhaps reflecting their very different structure. Future work will consider additional dynamic network data with similar structure to Wikipedia and Social Evolution respectively to explore whether the neighbourhood sample pattern persists. As well, further variants would be tested, considering different choices for the embedding method, the number of neighbourhood nodes to be sampled, and which neighbourhood to consider.

Intra-day bitcoin price prediction with machine learning and ensemble methods

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This project compares the performance among five basic machine learning models to predict the intra-day five-minute average Bitcoin prices from August 5th to August 31st, 2021 on Coinbase and attempts to use ensemble methods (1) stacking, (2) bagging and (3) random forest to improve forecasting performance. The forecast evaluation criteria entail

forecast accuracy, directional accuracy and profitability. The results find that the random walk model outperforms other models and ensemble methods in the forecast and directional accuracy. However, ensemble methods are helpful to increase the profitability of basic machine learning models.

Conflicts of Interest

The author(s) declare that they have no conflict of interests.

Authors' Contributions

GJ: Co-Chair of the IDSTEM 2022 Conference Planning Committee, drafted the conference abstract booklet, and gave final approval of the abstract booklet version to be published.

OK: Member of the IDSTEM 2022 Conference Planning Committee, reviewed the abstract submissions and booklet and ensured that they adhered to correct formatting standards, and gave final approval of the abstract booklet version to be published.

SS: Co-Chair of the IDSTEM 2022 Conference Planning Committee, and gave final approval of the abstract booklet version to be published.

CS, NK: Member of the IDSTEM 2022 Conference Planning Committee, assisted authors with their abstract submissions, and gave final approval of the abstract booklet version to be published.

KH: Member of the IDSTEM 2022 Conference Planning Committee, and gave final approval of the abstract booklet version to be published.

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