9h Annual Kinesiology Graduate Research Day
May 18th, 2022

Conference Program and Abstracts

9th Annual Kinesiology Graduate Research Day Itinerary

May 18th, 2022

8:30 am	Coffee/Snacks	
9:00 am	Opening Remarks: Dr. Juliet Daniel	
9:10 am–11:50 am	*Morning Sessions*	
9:10 am- 10:25 am	Session 1: (Chairs: Ravjot Rehsi and Billy Bostad)	
Time	**Presenting Author**	**Title**
9:10 am	Elric Allison	The role of arterial stiffness on structural neurodegeneration in the UK Biobank
9:20 am	Jack Bone	Effects of exogenous ketone body supplement dose and relative intensity on exercise economy: A research proposal
9:30 am	Dan Mulla	Musculoskeletal modelling as an educational tool for understanding rotator cuff tendon transfer surgeries and myoelectric prosthetic control
9:40 am	Matthew Ruder	Between day waveform reliability of wearable inertial measurement units in an osteoarthritis population
9:50 am	Sheereen Harris	Effects of mental fatigue and message framing on physical activity effort discounting
10:00 am	Joshua Keogh	The ecological validity of countermovement jump asymmetry metrics to on-court asymmetry in collegiate female basketball athletes
10:10 am	Stephanie Mattina	Voluntary wheel running safely improves skeletal muscle function in the severe D2-mdx model of Duchenne muscular dystrophy
10:25 - 10:35 am	**BREAK**	
10:35 - 11:50 am	Session 2: (Chairs: Laura St. Germain and Jonathan McLeod)	
10:35 am	Stevie Foglia	The feasibility of rTMS and sensorimotor training task for the treatment of complex regional pain syndrome
10:45 am	Alysha D'Souza	A comparison of measures of lean body versus D3-Cr measures of skeletal muscle mass: A validation study using the COSIAM approach in young, healthy women
10:55 am	Fiona Powley	The effect of brief bodyweight exercise on acute glycemic control in healthy inactive adults: A randomized crossover study.
11:05 am	Zaryan Masood	Tracking real-world changes in osteoarthritic gait patterns following corticosteroid injections
11:15 am	Karishma Ramdeo	Does accelerated theta-burst stimulation enhance synaptic plasticity in individuals with mild cognitive impairment and in aging?
11:25 am	Ryan Chhiba	Evaluating the influence of multiple pressure points on the hand and fingers
11:35 am	Sydney Valentino	What are the physiological determinants of perceived exertion during incremental exercise to capacity?
11:50 – 1:00 pm	**Lunch**	
1:00 – 3:40 pm	*Afternoon Sessions*	

1:00- 2:15 pm	Session 3: (Chairs: Michael Kamal and Dan Mulla)	
Time	**Presenting Author**	**Title**
1:00 pm	Rozhin Raziee	Exploring changes in PRMT expression and activity in response to 48-hour fasting
1:10 pm	Nigel Majoni	Markerless motion capture of the hand and finger
1:20 pm	Imran Haider	Goal conflict and the intention-behaviour relationship in emerging adulthood
1:30 pm	Jacob Pickersgill	Modulations in sensorimotor integration following training on a tactile discrimination maze task
1:40 pm	Emma Waddington	Using orienteering to examine the interactions of exercise and cognitive training on human cognition
1:50 pm	Keegan Nhan	Giving repetitive isometric exercise as a prevention for dementia: the grip study
2:00 pm	Ravjot Rehsi	Investigating the intrasession reliability of short and long-afferent inhibition
2:15 – 2:25 pm	**BREAK**	
2:25 – 3:40 pm	Session 4: (Chairs: Andrew Mikhail and Zaryan Masood)	
2:25 pm	Laura St. Germain	Low prevalence of a priori power analyses in motor behaviour research
2:35 pm	Dusan Kovacevic	Investigating changes in and predictors of adolescents' physical activity behaviour during the COVID-19 pandemic: Insights from the ADAPT study
2:45 pm	Billy Bostad	Peak cardiac output determined using inert gas rebreathing: a comparison of two exercise protocols using a non-inferiority, randomized crossover design
2:55 pm	Aidan Hatt	Androgen receptors, sex-based differences and skeletal muscle repair
3:05 pm	Stephen Toepp	An EMG-based biofeedback system to reinforce use following neurological injury
3:15 pm	Jennifer Williams	The impact of natural menstrual cycle and hormonal contraceptive phase on substrate oxidation during rest and submaximal aerobic exercise: preliminary analysis
3:25 pm	Daniel Trafford	Effects of self-control training and brain endurance training on endurance performance and RPE
3:40 pm	Closing Remarks	
4:00 pm	Social at The Phoenix Bar & Grill	

Abstracts
Presenting authors are in bold.

THE ROLE OF ARTERIAL STIFFNESS ON STRUCTURAL NEURODEGENERATION IN THE UK BIOBANK

Allison, E. Y., Al-Khazraji, B. K.

Arterial stiffening affects brain neurodegeneration, as defined by changes in brain structure and function; yet it remains unknown how trajectory in arterial stiffening impacts brain outcomes over time. Using UK Biobank data, our primary objective was to investigate how the rate of arterial stiffening relates to the rate of structural and functional (grey matter cortical thickness, white matter hyperintensity volume, digit symbol substitution test) neurodegeneration over ~10 years. Linear mixed effect models were used to assess the longitudinal associations between arterial stiffness and neurodegeneration. Linear regressions were used to examine the relationship between arterial stiffness and digit symbol substitution test performance at baseline. We hypothesized that increases in arterial stiffness will be associated with increased rate of structural and functional neurodegeneration. This research will increase our understanding of links between vascular pathology and brain health, and our findings may inform future studies focused on attenuating arterial stiffness and subsequently slowing progression of pathological brain aging.

EFFECTS OF EXOGENOUS KETONE BODY SUPPLEMENT DOSE AND RELATIVE INTENSITY ON EXERCISE ECONOMY: A RESEARCH PROPOSAL

Bone, J., Gibala, M. J.

Exogenous ketone body supplements can affect exercise responses but there are equivocal data regarding the nature of this response including the influence of supplement dose and exercise intensity. The purpose of this study is to clarify the effect of these two factors on indices of whole body exercise economy. Endurance-trained participants will complete three trials in a randomized, double-blind, crossover manner after completing baseline measurements including a ramp test of peak oxygen uptake (VO_{2peak}). Participants will ingest either a 300 or 600 mg/kg dose of a commercial ketone monoester supplement, or a flavour-matched placebo, 30 min prior to exercise. A blood sample will be obtained ~5 min prior to exercise for the measurement of ketone bodies, glucose, lactate, and pH. Participants will then cycle continuously for 10 min each in a step-wise manner at three progressively higher workloads corresponding to ~25%, 50%, and 75% of peak power at VO_{2peak}. Exercise economy will be determined based on measures of heart rate, ventilation, expired gases, and respiratory exchange ratio at each workload. This study will advance fundamental knowledge regarding the effect of nutritional ketosis on physiological responses to exercise in humans.

MUSCULOSKELETAL MODELLING AS AN EDUCATIONAL TOOL FOR UNDERSTANDING ROTATOR CUFF TENDON TRANSFER SURGERIES AND MYOELECTRIC PROSTHETIC CONTROL

Mulla, D., Keir, P.

There is pervasive anxiety for learning biomechanics among undergraduate Kinesiology students. Tackling meaningful real-world problems can be an effective method for engaging students, overcoming anxiety, and promoting learning. We aimed to develop two teaching activities in an open-source modelling software to enhance students' knowledge of biomechanical concepts and expose students on how biomechanical modelling can be used to tackle clinical problems. The first activity investigated tendon transfer options for restoring function following simulated rotator cuff tears. The second activity used recordings of biceps and triceps muscle activity to predict elbow kinematics with a forward dynamics model, as motivated by myoelectric prosthetic devices. Students appreciated gaining new skills and learning how biomechanics can be used to address real-world problems. Comments from formal course evaluations included "*it was really cool to actually use tools and learn skills that are actually used by researchers and in the real world*" and "*assignments were really engaging and did not feel like work*". Integration of meaningful real-world problems with musculoskeletal models can be an effective method to engage students with biomechanics concepts, develop problem-solving and technical skills, and be exposed to clinical challenges that can inform future career endeavors.

BETWEEN DAY WAVEFORM RELIABILITY OF WEARABLE INERTIAL MEASUREMENT UNITS IN AN OSTEOARTHRITIS POPULATION

Ruder, M., Masood, Z., Kobsar, D.

Gait analysis can provide valuable information on the progression of knee osteoarthritis and wearable inertial measurement units (IMU) could collect this data out of the lab. The purpose of this study was to assess the reliability of waveforms from wearable IMUs between four out-of-lab collections in an osteoarthritis population. Nine older adults with moderate-to-severe knee OA were recruited four weeks prior to intraarticular knee injection. Participants completed a total of four data collections at least five days apart using two IMU sensors to complete an outdoor 6-minute walk test. Reliability of the waveforms was assessed via correlation of multiple correlation (CMC) for the first 100 steps between each trial and averaged. Sagittal plane angular velocity demonstrated excellent reliability (CMC: 0.98-0.99), while vertical, anteroposterior, and resultant accelerations, as well as transverse plane angular velocity demonstrated good reliability (CMC: 0.76-0.86). Mediolateral acceleration and frontal plane angular velocity demonstrated fair reliability (CMC: 0.64-0.74). While mediolateral acceleration and frontal plane angular velocity demonstrated fair reliability, the good-to-excellent reliability for all other axes show the reliability of IMU sensors across multiple out-of-lab data collections in a clinical population.

Effects of Mental Fatigue and Message Framing on Physical Activity Effort Discounting
EFFECTS OF MENTAL FATIGUE AND MESSAGE FRAMING ON PHYSICAL ACTIVITY EFFORT DISCOUNTING

Harris, S., Mardlin, J., Bray, S. R.

Mental fatigue (MF) amplifies perceived effort costs and makes people less likely to engage in PA. Message framing is one strategy used to enhance motivation for PA. This study examined the effects of MF and message framing on PA motivation. Participants (N=204) were randomized to receive gain-framed (GF) or loss-framed (LF) PA messages, or a no message (NM) control group. Next, they made a series of hypothetical choices between engaging in PA of three intensities crossed with six durations for a fixed reward ($20) or a sedentary task for varying reward amounts ($2-$20). A point of indifference score was computed for each intensity-duration combination representing the monetary value at which both options would be chosen equally. Results showed a significant message frame X MF ($p<.001$) interaction. Post-hoc comparisons revealed lower motivation at low levels of MF that increased as MF increased in the GF ($p=.04$) and NM ($p=.007$) groups. However, motivation was higher in the LF group than the GF/NM groups at lower levels of MF and decreased as MF increased ($p=.001$). Findings suggest message framing effects depend on MF and may inform the development of messaging interventions adapted to momentary variations in people's psychological states (e.g., SMS prompts).

THE ECOLOGICAL VALIDITY OF COUNTERMOVEMENT JUMP ASYMMETRY METRICS TO ON-COURT ASYMMETRY IN COLLEGIATE FEMALE BASKETBALL ATHLETES

Keogh, J., Ruder, M., Kobsar, D.

Jump-based asymmetry is often used as an indicator of injury susceptibility. However, countermovement jump (CMJ) asymmetry may not be representative of on-court asymmetry due to task specificity. As such, we assessed the ecological validity of CMJ asymmetry metrics (n = 4) compared to on-court impact asymmetry metrics (n = 4) using linear regressions ($\alpha = 0.05$). Fifteen female basketball athletes completed CMJ and on-court sessions across an entire competitive season. A significant negative association was found between peak landing force asymmetry and both overall and medium acceleration on-court asymmetry ($b = -0.1$, $R^2 = 0.08$, $p = 1.8 \times 10^{-4;}$ $b = -0.1$, $R^2 = 0.11$, $p = 7.2 \times 10^{-6}$, respectively), as well as between peak propulsive force asymmetry and on-court medium acceleration asymmetry ($b = -0.24$, $R^2 = 0.04$, $p = 0.01$). Alternatively, both peak landing and peak propulsive force asymmetry were significantly positively associated with on-court high acceleration asymmetry ($b = 0.17$, $R^2 = 0.08$, $p = 1.6 \times 10^{-4}$; $b = 0.35$, $R^2 = 0.02$, $p = 0.04$, respectively). While some overlap may exist, CMJ and on-court impact asymmetry appear to be independent. Thus, sport-specific monitoring may be necessary to adequately monitor injury susceptibility using asymmetry.

VOLUNTARY WHEEL RUNNING SAFELY IMPROVES SKELETAL MUSCLE FUNCTION IN THE SEVERE D2-MDX MODEL OF DUCHENNE MUSCULAR DYSTROPHY

Mattina, S., Ng, S., Mikhail, A., Rebalka, I., Hawke, T., Ljubicic, V.

Duchenne muscular dystrophy (DMD) is an X-linked neuromuscular disease that is characterized by muscle weakness and wasting. Voluntary wheel running (VWR) is a form of self-regulated exercise that leads to functional improvements in the mild C57-*mdx* mouse model of DMD. The current study explores the role of voluntary exercise on muscle function in the more severe and clinically relevant D2-*mdx* mouse model. Seven-week-old male D2-*mdx* mice were randomly assigned to either a sedentary (SED) or VWR group for eight-to-ten weeks. Following the intervention, functional tests were conducted and *ex vivo* muscle force, including during eccentric contractions (ECC), was measured. While individual VWR activity was variable (0.01-3.48 km/day), the average running distance across the eight-to-ten-week period was 0.93 km/day (n=14). Grip strength and exploratory activity levels in an open field were similar between groups. Extensor digitorum longus (EDL) muscles from VWR mice displayed significantly greater *ex vivo* force production at varying stimulation frequencies compared to SED animals. VWR also protected EDL muscles against absolute force loss during ECC ($p=0.04$), while relative force drop was similar between groups. These data suggest that VWR endows greater muscle-specific function without exacerbating the dystrophic phenotype in the severe D2-*mdx* mouse model.

THE FEASIBILITY OF RTMS AND SENSORIMOTOR TRAINING TASK FOR THE TREATMENT OF COMPLEX REGIONAL PAIN SYNDROME

Foglia, S., Shanthanna, H., Nelson, A. J.

Complex regional pain syndrome (CRPS) is a debilitating condition characterized by severe pain and associated disability affecting the upper or lower limbs. Effective pain relief is a current unmet medical need in patients with CRPS. CRPS is associated with neurophysiological changes including decreased cortical territory representing the affected limb. One treatment approach may be to reinforce afferent connections between the affected limb and the somatosensory cortex. This study will use non-invasive repetitive transcranial magnetic stimulation (rTMS) with novel sensorimotor training (SMT) to reinstate cortical territory and aid in pain relief in patients with CRPS affecting the upper limb. rTMS will be used to prime the brain prior to SMT to increase the propensity for neuroplastic changes from the SMT. SMT uses peripheral nerve stimulation (PNS) to trigger targeted actions with the fingers and wrist of the affected hand. The goal of each movement is to move a potentiometer which controls a sliding bar on custom designed software. Participants will take part in 4 days of rTMS plus SMT per week for 4 weeks. Clinical outcomes will include measures of pain perception, assessments of function, sleep, analgesia medication use, and quality of life. Neurophysiological outcomes before and following the intervention will be used to assess neuroplasticity.

A COMPARISON OF MEASURES OF LEAN BODY VERSUS D3-CR MEASURES OF SKELETAL MUSCLE MASS: A VALIDATION STUDY USING THE COSIAM APPROACH IN YOUNG, HEALTHY WOMEN

D'Souza, A., McKendry, J., Lim, C., Phillips, S. M.

The COSIAM approach is the first method to simultaneously measure muscle protein synthesis (MPS), breakdown (MPB), and skeletal muscle mass (SMM). Uniquely, it uses the D_3-Cr method to measure SMM. Currently, the gold standard methods for measuring SMM are expensive and often inaccessible. Thus, lean soft-tissue mass (LSTM) as a proxy for SMM has emerged in popularity within research and diagnostic practices. However, LBM is not an appropriate surrogate for SMM. The D_3-Cr method is a novel approach that uses the stable isotope tracer, D_3-Cr, to measure SMM quickly and directly. Thus, the objective of this study is to first evaluate the feasibility of applying the COSIAM approach in young, healthy women and, second, to assess the agreement between D_3-Cr measures of SMM and various measures of LSTM. The COSIAM approach will measure MPS, MPB and SMM in 20 young, healthy females. SMM will be assessed using the D_3-Cr method and ultrasound. LSTM will be measured using DXA, BodPod and BIA. Muscle strength will be assessed via leg press 1RM, and knee-extensor MVC. Projected availability: May 2023.

THE EFFECT OF BRIEF BODYWEIGHT EXERCISE ON ACUTE GLYCEMIC CONTROL IN HEALTHY INACTIVE ADULTS: A RANDOMIZED CROSSOVER STUDY.

Powley, F. P., Riddell, M. C., Richards, D. R., Adamo, L. M., Gibala, M. J.

Brief vigorous exercise can enhance indices of glucose control. Limited work has investigated the effect of simple, practical interventions that require no specialized equipment. The present study examined the potential for brief bodyweight exercise (BWE) to

improve acute glycemic control using continuous glucose monitoring (CGM; Abbott Libre sensor). The ClinicalTrials.gov identifier is NCT05144490. A calculation performed using G*Power for a one-tailed dependent means (matched pairs) t-test estimated that a sample size of 27 was required to detect a medium effect size with 80% power at an alpha level of 0.05. Twenty-eight healthy inactive adults performed two virtually-supervised experimental trials in a randomized crossover manner after familiarization. These trials involved an 11-min exercise protocol that consisted of five, 1-min bouts of BWE performed at a self-selected “challenging” pace or an equivalent non-exercise sitting control period. Measurements include 24-h mean glucose, 2-h postprandial area under the curve and glucose variability under standardized dietary conditions with all food provided to participants. Data collection will be complete as of May 2022 with results presented at the meeting. This study will advance our understanding of the potential for brief BWE to enhance acute glycemic control under free-living conditions.

TRACKING REAL-WORLD CHANGES IN OSTEOARTHRITIC GAIT PATTERNS FOLLOWING CORTICOSTEROID INJECTIONS

Masood, Z., Ruder, M., Madden, K., Yan, J., Adili, A., Kobsar, D.

Wearable sensor-based gait analyses have the potential to support clinical decisions for osteoarthritis (OA) and are becoming increasingly popular for studying OA. However, much of this work involves highly controlled and short walking protocols which are not indicative of daily gait fluctuations. We utilized corticosteroid knee injections as a model for reducing pain, to assess if inertial sensors and machine learning algorithms could identify changes in gait, amidst day-to-day fluctuations. Our aim was to determine if three gait trials could define an everyday typical gait pattern, and if post-injection gait would display a greater proportion of atypical strides than pre-injection gait. Four participants (2F) with moderate-to-severe knee OA completed four walking trials pre-injection and three walking trials post-injection, while fitted with three wearable sensors. Inertial signals were used to train and test a one-class support vector machine (OCSVM) within each individual to model gait profiles. All but one pre-injection trial fell within the stable OCSVM, resulting in a mean of 4.7% anomalies. Post-injection atypical strides were not significantly different ($p=0.34$) when compared to pre-injection atypical strides. This study highlights the ability of wearable sensors and machine learning in understanding day-to-day fluctuations in gait and identifying meaningful changes within those fluctuations.

DOES ACCELERATED THETA-BURST STIMULATION ENHANCE SYNAPTIC PLASTICITY IN INDIVIDUALS WITH MILD COGNITIVE IMPAIRMENT AND IN AGING?

Ramdeo, K., Fahnestock, M., Nelson, A. J.

Over the years, the incidence of Mild Cognitive Impairment (MCI) leading to dementia has increased. With early detection becoming more widespread, the need for therapeutic interventions is dire. A key finding has been the positive effect of exercise regimes in MCI management, but this poses an issue for elderly individuals who have diminished mobility and increased frailty due to aging. Synaptic plasticity is fundamental to preserving and creating memories, and at the level of the synapse yields long-term potentiation (LTP). In humans, synaptic plasticity can be assessed *in vivo* by delivery via a form of Transcranial Magnetic Stimulation (TMS) called *intermittent theta- burst stimulation (iTBS)*. When this stimulation is delivered over the target area of interest it induces synaptic plasticity as measured by short-term increases in the efficacy of cognition. Accelerated intermittent theta-burst stimulation (aiTBS), characterized as repeated levels of high-frequency stimulation, has increased excitatory effects leading to induced LTP in a shorter time frame than other rTMS protocols. The proposed research will assess whether synaptic plasticity is enhanced after a 2- week delivery of accelerated intermittent theta-burst stimulation (aiTBS) in individuals with MCI. It is hypothesized that *synaptic plasticity will be greater in the aiTBS intervention compared to sham aiTBS, thereby demonstrating in-vivo synaptic plasticity induced by aiTBS.* If confirmed, future work will identify combinations of aiTBS with additional interventions that may alter synaptic plasticity.

EVALUATING THE INFLUENCE OF MULTIPLE PRESSURE POINTS ON THE HAND AND FINGERS

Chhiba, R., Tilley, P. M., Majoni, N. T., Keir, P. J.

Forces acting on the hand during everyday tasks are complex. Rather than assuming points of contact, a pressure mapping system can provide pressure magnitudes and locations over the palmar surface of the hand. The objective of this study is to determine

local Centres of Pressure (CofP) on the fingers and hand during hand actions to use as input for computational modelling to examine how internal tissue loads are affected by point of force application. A hand pressure mapping system was used to determine the local CofP in each region of the hand during 4 hand grips. Preliminary results indicate variations within and between participants CofP during tasks. The complete protocol contains a more comprehensive series of static and dynamic hand actions. Additional collection will distinguish points of force application for each region. Further statistical analyses will reveal whether simple scaling or more detailed methods are needed for modelling. The distribution of loads at multiple sites on the hand and fingers will be used with force magnitudes to better inform the needed inputs to describe internal muscle and joint forces in computational models. The knowledge of this study can be applied to existing biomechanical models of the upper extremity to increase its representation.

WHAT ARE THE PHYSIOLOGICAL DETERMINANTS OF PERCEIVED EXERTION DURING INCREMENTAL EXERCISE TO CAPACITY?

Valentino, S., MacDonald, M., Killian, K.

Skeletal, respiratory and cardiac muscles all contribute to the power required to of exercise. Perceived effort during exercise can be subjectively quantified using the modified Borg scale. While the physiological responses to exercise at various intensities have been extensively explored, the perceptual responses and their physiological contributors are still poorly understood. Participants referred for clinical cardiopulmonary exercise testing from 1988 to 2012 were assessed. The modified Borg scale was used to assess perceived exertion for both the legs and breathing effort during a graded cycle ergometer exercise test, adjusted in increments of 100kpm each minute. Height, weight, age<20, age>35, quadriceps muscle strength, forced expired volume over 1s, diffusion capacity for carbon monoxide, graded cycle ergometry power, and maximum power output were considered as potential contributors in the forward additive linear regression analysis to predict leg and breathing effort. 35,597 participants were included for analysis (53±17yrs, 60% male). Power and maximum power output were the strongest physiological contributors to the leg and breathing perceived effort. Quadriceps muscle strength was the dominant physiological contributor to maximum power output. This study suggests that leg power and strength are the primary physiological determinants of perceived effort required to cycle and to breath during incremental exercise.

EXPLORING CHANGES IN PRMT EXPRESSION AND ACTIVITY IN RESPONSE TO 48-HOUR FASTING

Raziee, R., Mikhail, A. I., VanLieshout, T. L., Edgett, B. A., Bonafiglia, J. T., Gurd, B. J., Ljubicic, V.

Protein arginine methyltransferases (PRMTs) catalyze the addition of methyl groups onto arginine residues of target proteins, thereby altering their activity. PRMTs have emerged as mediators of skeletal muscle biology in health and disease, though their role in response to nutritional cues for muscle remodeling in humans remains unclear. **Thus, the purpose of this study is to investigate PRMT biology during fasting-induced skeletal muscle plasticity.** Muscle biopsies were collected from eight healthy men prior to and after a 48-hour fast and processed to examine changes in PRMT biology and regulators of muscle mass. Our data demonstrate a significant decrease in PRMT7 protein content and a decrease in PRMT4 methyltransferase activity following fasting, indicated by altered expression of downstream proteins. Concomitantly, we observed significantly reduced dimethylation and a trending decrease ($p=0.0687$) in monomethylation. The activity of proteins regulating muscle protein synthesis (MPS) were significantly diminished following fasting while the expression of autophagy markers significantly increased. Finally, a trending decrease ($p=0.0722$) was observed in muscle atrophy F-box, a marker of muscle atrophy. Overall, our results demonstrate that PRMT7 and PRMT4 may play a role in fasting-induced muscle remodeling in humans and that fasting blunts MPS-related signaling and upregulates autophagy in human skeletal muscle.

MARKERLESS MOTION CAPTURE OF THE HAND AND FINGER

Majoni, N., Mulla, D. M., Keir, P. J.

Hand and finger movements are poorly captured in workplace assessments but play important roles in the development of hand-related musculoskeletal disorders. Marker-based motion capture systems may provide the desired accuracy but are not practical or feasible in the workplace. Recent developments in computer vision have influenced the production of programs with the ability to track motion by recording a simple video of the desired motion,

without the use of markers. Currently, a 2D model was developed to track hand motion using DeepLabCut. The neural network was trained with 1,000,000 iterations using a training dataset to enable 2D motion capture. The current model is limited to analyzing movements in two dimensions using a single camera. Following successful model development in 2D, a second camera will be included to move to 3D tracking of hand motion. The multicamera system will be developed with mobility in mind such that non-laboratory settings may be used for video capture. This work aims to use an open source markerless motion capture program and train a network to evaluate and track hand and finger movements and postures. The data will be used to improve the representation of the hand in biomechanical and ergonomics assessments to improve our assessment of the risk of developing musculoskeletal disorders in the workplace.

GOAL CONFLICT AND THE INTENTION-BEHAVIOUR RELATIONSHIP IN EMERGING ADULTHOOD

Haider, I., Kwan, M., Bray, S.

While many emerging adults intend to engage in regular physical activity (PA), evidence suggests the ability to act on these intentions represents a significant challenge. Pursuing multiple goals across several facets of life, including work, school, and PA during this life stage, prompts a need to balance or prioritize among several motivations. Given time and energy are limited, goal conflict arises when pursuance of multiple goals interferes with PA intentions. Therefore, the purpose of this study was to investigate the potential moderating effect of goal conflict on the intention-behaviour relationship during emerging adulthood. A subsample of 140 participants (M_{age} = 17.78 ± 0.47; 62% female) were drawn from a larger prospective cohort study (ADAPT). Intention strength and anticipated goal conflict were measured at Time 1 and self-reported moderate-to-vigorous physical activity (MVPA) was assessed at Time 2, approximately 4 weeks later. A linear regression model predicting MVPA was significant (p<0.01), with a strong main effect (p<0.01) of intention; however, the main effect of anticipated goal conflict (p=0.11) and the interaction effect (p=0.50) were non-significant. Interestingly, intentions and anticipated goal conflict (r=-0.233) were significantly correlated (p<0.01), suggesting participants may implicitly factor in the impact of other goal pursuits when reporting PA intentions.

MODULATIONS IN SENSORIMOTOR INTEGRATION FOLLOWING TRAINING ON A TACTILE DISCRIMINATION MAZE TASK

Pickersgill, J, Foglia, S., Toepp, S., Rehsi, R., Ramdeo, K., Turco, C.V. and Nelson, A.J.

Short-Latency Afferent Inhibition (SAI), Long-Latency Afferent Inhibition (LAI) and Afferent Facilitation (AF) are Transcranial Magnetic Stimulation (TMS) measures that assess sensorimotor integration in humans. No studies to date have investigated the influence of a tactile discrimination task on these measures. This study aimed to quantify changes in SAI, LAI, and AF in the right FDI muscle of the hand following two 15-minute blocks of training on a sensorimotor task using the right index finger. This task required participants to use their sense of touch to successfully navigate through a custom made 3-d printed maze with interchangeable paths. Participants performed a high difficulty, low difficulty, and control condition on separate visits in a randomized fashion. Neurophysiological measures were collected before and immediately after training on all visits. Participants wore a small magnet on the fingertip during training in order to track movement performance measures including total time to complete each trial, number of errors made, and dwell time in each intersection. Preliminary data demonstrates that changes in SAI, LAI and AF are different depending on the difficulty of the maze training condition. Further, there are mixed results related to the relationship between improvements in maze performance and changes in TMS measures.

USING ORIENTEERING TO EXAMINE THE INTERACTIONS OF EXERCISE AND COGNITIVE TRAINING ON HUMAN COGNITION

Waddington, E., Heisz, J. J.

Engaging in high intensity exercise can improve cognition across the lifespan by stimulating neural plasticity in the human hippocampus. Similarly, when combined with cognitive training, neural plasticity is augmented through independent yet synergistic pathways. Orienteering, a sport integrating exercise with navigation similar to our hunter-gatherer history, naturally combines exercise and cognitive training. Moreover, emerging animal research suggests that lactate, a metabolic by-product of anaerobic metabolism, can fuel neural processes which support hippocampal neural plasticity and increase neurotrophins to support hippocampal neurogenesis and improve high-interference memory. Using

orienteering, this study will address the current research gap on the effects of simultaneously combining cognitive and exercise training at different intensities, and determine whether lactate mediates this intervention's additive effects. One-hundred and twenty healthy, recreationally active male and female participants will be randomly assigned to one of four exercise conditions: moderate intensity, or high intensity exercise, with or without active navigation (orienteering). Intensity will be monitored using heart rate, rating of perceived exertion and blood lactate. Neuroplasticity will be measured using plasma biomarkers (lactate, BDNF), and completion of the Mnemonic Similarity Task will assess hippocampal functioning. This fundamental research will help inform intervention models to promote cognition throughout life.

GIVING REPETITIVE ISOMETRIC EXERCISE AS A PREVENTION FOR DEMENTIA: THE GRIP STUDY

Nhan, K., Al-Khazraji, B., Heisz, J. J., McGowan, C., Walsh, J.

Hypertension significantly increases the risk of dementia in later-life. A promising dementia prevention strategy is isometric handgrip exercise (IHG). IHG is the 'gold standard' non-pharmacological treatment for hypertension that may also potentiate cognition; however, the mechanisms are unknown. This study will investigate the effect of acute IHG on cognition and cerebral blood flow (CBF) in middle-to-older aged people with hypertension. In a randomized crossover design, participants will perform IHG or seated rest. Exercise will be 4 sets of 2 min IHG at 30% maximal voluntary contraction and 3 min of recovery. Serial blood samples will be collected to assess neuroplasticity hormones. Continuous blood pressure will be measured throughout using a finger cuff. Following the completion of either protocol, participants will undertake a 5-min recovery period prior to the commencement of cognitive testing. Cognition will be assessed using a computerized battery of psychometrically valid tests. CBF will be measured during cognitive testing to assess neurovascular coupling using transcranial Doppler ultrasound. We hypothesize that handgrip exercise will decrease blood pressure, increase neurovascular coupling and neuroplasticity hormones, and improve cognition. Our study will establish the mechanisms by which IHG can protect and improve brain health in people with hypertension.

INVESTIGATING THE INTRASESSION RELIABILITY OF SHORT AND LONG-AFFERENT INHIBITION

Rehsi, R. S., Ramdeo, K., Foglia, S. D., Toepp, S. L., Pickersgill, J. W., Nelson, A. J.

Afferent Inhibition is the reduction in motor output when transcranial magnetic stimulation (TMS) of the motor cortex is preceded by peripheral nerve stimulation. Afferent inhibition can be subdivided into two circuits of Short-Latency (SAI) and Long-Latency Afferent Inhibition (LAI). Reliability as a metric can be broken down into two concepts. Relative reliability refers to the ability of a measure to identify individuals on repeated testing, measured through the Intraclass Correlation Coefficient (ICC); absolute reliability is the repeatability of scores through repeated testing, measured through % standard error of measurement (%SEMeas). This study aims to quantify the relative and absolute intrasession reliability of SAI and LAI. 30 individuals (21 ± 2.74 years) participated in a single session with 3 repeated measures of SAI and LAI spaced by 30 minutes. SAI had moderate-high, and LAI had high-excellent relative reliability, while both measures had similarly high amounts of measurement error. LAI was seen to have high reliability including only 5 frames of data, whereas reliability continued to increase for SAI until a plateau was reached at ~20 frames of data. These results can be used to inform future work regarding the clinical utility of these measures, particularly in terms of their diagnostic ability.

LOW PREVALENCE OF A PRIORI POWER ANALYSES IN MOTOR BEHAVIOUR RESEARCH

St. Germain, L., McKay, B., Corson, A., Vinh, M., Jeyarajan, G., Tandon, C., Brooks, H., Hubley, J., Carter, M. J.

A priori power analyses can be used to ensure studies are unlikely to miss interesting effects. Recent metascience has suggested that kinesiology research may be underpowered and selectively reported. Here, we examined whether power analyses were currently being leveraged to ensure informative studies in the kinesiology subdiscipline of motor behaviour. We reviewed every article published in three motor behaviour journals (Journal of Motor Learning and Development, Journal of Motor Behavior, and Human Movement Science) between January 2019 and June 2021. Our results reveal that power analyses were reported in 13% of all studies (k = 636) that tested a hypothesis, but no study in the sample targeted the

smallest effect of interest. Instead, most studies with a power analysis relied on estimates from previous studies, pilot studies, or benchmarks to determine the effect size of interest. Studies in this sample without a power analysis reported support for their main hypothesis 85% of the time, while studies with a power analysis found support 76% of the time. The median sample sizes were n = 16 with a power analysis and n = 17.5 without a power analysis, suggesting the typical study in this sample was underpowered for all but the largest plausible effect sizes. At present, power analyses are not being used to optimize the informativeness of motor behaviour studies; a trend that likely extends to other kinesiology subdisciplines. Adoption of this simple and widely recommended practice may greatly enhance the credibility of motor behaviour and kinesiology literature.

INVESTIGATING CHANGES IN AND PREDICTORS OF ADOLESCENTS' PHYSICAL ACTIVITY BEHAVIOUR DURING THE COVID-19 PANDEMIC: INSIGHTS FROM THE ADAPT STUDY

Kovacevic, D., Brown, D., Kwan, M., Bray, S.

Evidence indicates the onset of COVID-19 negatively impacted adolescents' physical activity (PA) behaviours. Examining prospective predictors of PA during COVID-19 may assist in future PA promotion efforts. The Multi-Process Action Control (M-PAC) model offers a comprehensive framework of reflective, regulatory, and reflexive constructs to examine potential predictors of PA. This study investigated M-PAC variables as predictors of year-over-year changes in adolescents' moderate-to-vigorous PA (MVPA) during the COVID-19 pandemic. High-school students (*N*=579) from a large school board participated as part of the ADAPT study. MVPA and M-PAC measures were collected prior to the beginning of the COVID-19 pandemic in Fall 2020 and again in Fall 2021. Analyses showed MVPA was significantly lower during the pandemic compared to before (p<.05). A linear regression model examining M-PAC constructs revealed that, after controlling for covariates, habit was the only significant predictor. Adolescents who reported stronger PA habits prior to COVID-19 engaged in greater amounts of MVPA one year later. Findings suggest that the pandemic created an environment in which people's activities were curtailed, while leaving some aspects of habitual MVPA routines intact, and neutralizing typical positive effects of reflective and regulatory processes on MVPA. Habit-formation strategies should be prioritized in future interventions for adolescents.

PEAK CARDIAC OUTPUT DETERMINED USING INERT GAS REBREATHING: A COMPARISON OF TWO EXERCISE PROTOCOLS USING A NON-INFERIORITY, RANDOMIZED CROSSOVER DESIGN

Bostad, W., McCarthy, D. G., Helal, L., Richards, D. L., Gibala, M. J.

Peak cardiac output (Q_{peak}) can be measured non-invasively using inert gas rebreathing (IGR). There is no consensus on the optimal exercise protocol to assess Q_{peak}. A randomized crossover design with a margin of non-inferiority for Q_{peak} of 0.5 L/min was used to compare two methods: a constant load protocol modelled after peak oxygen uptake (VO_{2peak}) verification phase testing (Q_{CL}) and an incremental step protocol (Q_{step}). Following baseline VO_{2peak} testing, participants [n=34 (19 females); 25±5y] performed the Q_{CL} and Q_{step} protocols on two separate occasions each in a randomized order. Q_{peak} was measured using IGR (Innocor). The first Q_{CL} and Q_{step} tests were compared for non-inferiority and the second tests were used to measure the typical error (TE). The Q_{CL}protocol was non-inferior to Q_{step} (Q_{CL}=17.1±3.2, Q_{step}=16.8±3.1 L/min; 95% CIs=-0.16-0.72 L/min; p=0.20). The baseline VO_{2peak} (3.13±0.83 L/min) was achieved during both Q_{CL} (3.12±0.72 L/min, p=0.87) and Q_{step}(3.12±0.80 L/min, p=0.82). The TE was 6.6 and 8.3% for $Q_{CL}$and Q_{step}, respectively. The Q_{CL} protocol was non-inferior to Q_{step} and may be a more convenient method because it allows for the measurement of Q_{peak} during the same session used to determine VO_{2peak}, whereas Q_{step} must be performed on a different day.

ANDROGEN RECEPTORS, SEX-BASED DIFFERENCES AND SKELETAL MUSCLE REPAIR

Hatt, A., Kamal, M. J., Brown, A. Fortino, S. A., Wageh, M., Joanisse, S., Parise, G.

The influence of androgen receptor (AR) expression on acute skeletal muscle damage and its influence on the adaptive response to resistance training (RT) in females is poorly understood. Our aim was to 1) investigate changes in AR content during skeletal muscle repair and 2) characterize AR-mediated sex-based differences following RT. A biopsy from the *vastus lateralis* was obtained from 26 healthy young participants (13F) at baseline, following 300 eccentric contractions and after 10 weeks of RT. AR protein content increased from baseline following damage and RT by ~218% and ~199%, respectively

($p<0.05$). Post-damage, individuals with greater increase in satellite cells (SC) exhibited a potentiation in AR content ($p<0.05$). We found a positive relationship between the change in AR protein following damage and RT, relative to post-RT muscle hypertrophy. We observed higher expression of *AR* mRNA at baseline (~155%) and post-damage (~226%) in females, relative to males ($p<0.05$). Males had greater skeletal muscle AR protein content than females after damage and RT ($p<0.05$). Collectively, AR protein is elevated following damage and RT, while sex-based differences are apparent in relation to AR. These findings suggest an interplay between AR content and SC expansion which may impact RT-induced hypertrophy between males and females.

AN EMG-BASED BIOFEEDBACK SYSTEM TO REINFORCE USE FOLLOWING NEUROLOGICAL INJURY

Toepp, S. L., Nelson, A. J.

Stroke and spinal cord injury often disrupt voluntary control during common movements and severely impacts quality of life. Unsuccessful movement attempts can cause frustration, leading to limb disuse and further functional decline. Opportunities to use the impaired limb in scenarios that reinforce, rather than discourage, use are therefore essential for maximal recovery after injury. One way to support the use of the impaired limb is to reward voluntarily produced changes in muscle activity independent from their success in producing the intended movement pattern. Electromyography signal contains sufficient information to detect and classify changes in muscle activity according to movement intention. Once determined, intention can be used to provide optimized feedback that maximizes reward and minimizes frustration. The biofeedback system presented here maps EMG activity patterns to the controls of the popular game, Tetris. The system integrates real-time visual and audio feedback, and stores user data for future analysis by clinicians and researchers. A wide array of movements and their associated muscle activities can be targeted, including those of the upper limb, lower limb, shoulders, and neck. This system has been successfully tested using healthy participants but must be validated in clinical populations with motor impairment to better assess its therapeutic potential.

THE IMPACT OF NATURAL MENSTRUAL CYCLE AND HORMONAL CONTRACEPTIVE PHASE ON SUBSTRATE OXIDATION DURING REST AND SUBMAXIMAL AEROBIC EXERCISE: PRELIMINARY ANALYSIS.

Williams, J.S., Masood, Z., Stone, J., Bostad, W., Gibala, M.J., MacDonald, M.J.

Previous research has identified sex differences in substrate oxidation during submaximal aerobic exercise, including a lower respiratory exchange ratio (RER) in females compared to males, which may be a result of differences in sex hormones. This study examined the impact of natural menstrual cycle (NAT) and 2nd and 3rd generation oral contraceptive pill (OCP2, OCP3) phases on substrate oxidation during rest and submaximal aerobic exercise. We have recruited 35 females to date (14 NAT, 16 OCP2, 5 OCP3). After assessing peak oxygen uptake (VO_2peak), participants took part in two randomized experimental visits in the low hormone/early follicular phase and high hormone/mid-luteal phase of their hormonal cycle. Visits included measures of gas exchange to calculate RER during 10 minutes of supine rest, 5 minutes of seated rest, and 8 minutes of submaximal exercise at ~40% and ~65% of VO_2peak. RER was not different between phases, in all groups, during rest and exercise. RER was higher in NAT compared to OCP2 and OCP3 during exercise at 45% and 65% of VO_2peak ($p=0.01$ and 0.02 respectively), but not during rest. However, this difference was absent when VO_2peak was controlled for in analysis. We conclude that, under the conditions studied, natural and contraceptive hormonal cycles do not influence substrate oxidation.

EFFECTS OF SELF-CONTROL TRAINING AND BRAIN ENDURANCE TRAINING ON ENDURANCE PERFORMANCE AND RPE

Trafford, D., Winkel, M., Bray, S. R.

Self-Control Training (SCT) and Brain Endurance Training (BET) are novel training modalities designed to enhance physical endurance by building fatigue resiliency. This study investigated the effects of SCT and combined BET+SCT on performance of a maximal exertion isometric endurance task (high plank) and ratings of perceived exertion (RPE). Participants (N = 29) were randomized to engage in 4 weeks (18 training sessions) of SCT (isometric handgrip; n = 10), BET+SCT (10-minute cognitive task, followed by SCT; n= 10), or no-training/control (n = 9). Isometric endurance task trials were completed at pre-, mid-, and post-training. Results showed a significant condition X time interaction (p= .043) for high-plank performance (time to failure

[TTF]). Post-hoc analyses showed significant TTF increases of 9% in the SCT and BET+SCT conditions compared to an 8% TTF decrease in the control group. Visual inspection of RPE scores reported during the endurance trials showed all groups had similar trajectories of RPE to maximum at pre-test. However, during the post-test, experimental groups sustained performance at maximum RPE, while controls did not. Findings support the use of SCT for improving physical endurance performance and suggest that BET may not offer additional performance benefit compared to SCT alone.