

# Annual Report 2018 - Highlights

## Human Performance Lab



Human Performance  
Laboratory

## The Year 2018

One of the attractive features of the Human Performance Lab (HPL) at the University of Calgary has always been the fostering of multi-disciplinary, and multi-scale experimental and theoretical approaches to research. Another attractive feature has been the diversity in backgrounds, in philosophy about scientific research, and countries of origin of the HPL community.

Presently, about half the faculty members and half the trainees in the HPL are of non-Canadian origin. This in itself ensures a rich environment of vastly diverging ideas, approaches to science, and training environments. With trainees from all continents (except Antarctica!), one becomes exposed to the different educational backgrounds, and the privileges and hardships of trainees from different parts of the world. A former postdoctoral trainee of mine fled his native Morocco as a 15-year-old, equipped with nothing but his intellect, he lived on the streets of France for a year, surviving by begging and stealing, and somehow finished high school, studied mathematics, and made it to Canada where he became one of the major contributors to theoretical research on muscle contraction.

I grew up poor in a rich country. Coming from a small farming community, and having parents with a grade 6 education, I was not supposed to study. In most countries, I probably would not have. However, I also grew up in a country where education was free, the public system was excellent, and where scholarships were given based on financial need. I was paid to go to university, no strings attached, and no student debt.

This year, we are organizing the conference of the International Society of Biomechanics (ISB2019). Many scientists and students, particularly those from economically developing countries (EDC), will not be able to attend for financial reasons. That is why our primary funding efforts were aimed at supporting EDC scholars and students, and the community responded generously. We were able to raise \$90k, and will be able to pay for registration and hotel accommodation for 58 graduate students and provide a substantial discount on registration fees for many scientists from EDC countries attending ISB2019. We have no illusions. This support is not enough, and will not reach all who would wish and would deserve to attend ISB2019. But we hope it might provide an impetus for future congress organizers to attempt to do the same.

Education should not be a privilege, but a right.

My “thank you” this year goes to Delsys and the Faculty of Kinesiology at the University of Calgary, who were the first to provide funding for our ISB2019 EDC initiative, and to all the faculties, departments and labs of the University of Calgary who so generously contributed to this effort.

Walter Herzog  
Director



The full version of the  
annual report can  
be found at  
[www.ucalgary.ca/hpl](http://www.ucalgary.ca/hpl)

# Awards and Honors

Members of the Human Performance Laboratory that were honored for their scientific contributions:

## Internal Awards

<b>Venus Joumaa</b>	HPL Faculty Award
<b>Michael Asmussen</b>	HPL Post Doctoral Fellow Award
<b>Andrew Sawatsky</b>	HPL Staff Award
<b>Danilo Iannetta</b>	HPL Student Award
<b>Brent Edwards</b>	Outstanding Supervisory Award Biomedical Engineering Graduate Program
<b>Juan Murias</b>	GREAT Supervisor Award Faculty of Graduate Studies
<b>Salvatore Federico</b>	Teaching Achievement Award Schulich School of Engineering

## External Honors

<b>Walter Herzog</b>	Killam Prize in Engineering Canada Council for the Arts Body of work in musculoskeletal biomechanics
<b>Brian MacIntosh</b>	Canadian Society for Exercise Physiology Inaugural Fellowship

## Special Appointments

<b>Kevin Boldt</b>	Student Representative of the Executive Council of the Canadian Society for Biomechanics
<b>Salvatore Federico</b>	President of the Canadian Society for Biomechanics

## External Awards

<b>Saša Čigoja</b>	1st place in the 2018 International Sports Engineering Association (ISEA) Student Project Competition
<b>Nathaniel Morris</b>	Dr. Gord Sleivert Young Investigator Award, Sport Innovation Summit
<b>Teja Klančič</b>	Best Poster Award, Obesity Week
<b>Jodi Nettleton</b>	Basic Science Poster Award, Obesity Week
<b>Jaqueline Rios</b>	David Winter Doctoral Young Investigator Award, Canadian Society for Biomechanics
<b>Rosemary Twomey</b>	Astellas Award for Best Cancer-Related Poster Presentation 2018 International Behavioural Trials Network (IBTN)

## Support

Our work was financially supported by many different sources, the University of Calgary, Government Grants, Industry and Non-Government Sources and External Student Support. The corresponding amounts in Canadian dollars were:

<b>University</b>	<b>\$5.8M</b>	<b>36%</b>
<b>Gov. Grants</b>	<b>\$4.0M</b>	<b>25%</b>
<b>Industry</b>	<b>\$5.3M</b>	<b>34%</b>
<b>Ext. Students</b>	<b>\$0.8M</b>	<b>5%</b>
<b>Total</b>	<b>\$15.9M</b>	

For 2018, the average research dollars available per faculty member, was about \$794,538. We would like to thank all supporters of our work, the Faculty of Kinesiology, the University of Calgary, all Granting Agencies, Industry and our major sponsor, Engineered Air.

## Killam Award Recipient



The Killam Prize from the Canada Council for the Arts is awarded to active Canadian scholars who have made substantial and meaningful contributions to one of five research fields. The 2018 Killam Prize for the Engineering Sciences was given to Dr. Walter Herzog, in recognition of his outstanding contributions in Biomedical Engineering and his ground breaking work in the areas of molecular and cellular biomechanics of muscle contraction, and hard and soft tissue cell mechano-biology. Dr. Herzog is the fourth winner of the Killam Prize for the University of Calgary since its inception 38 years ago, and the first since 1991.

## The Function of the Meniscus

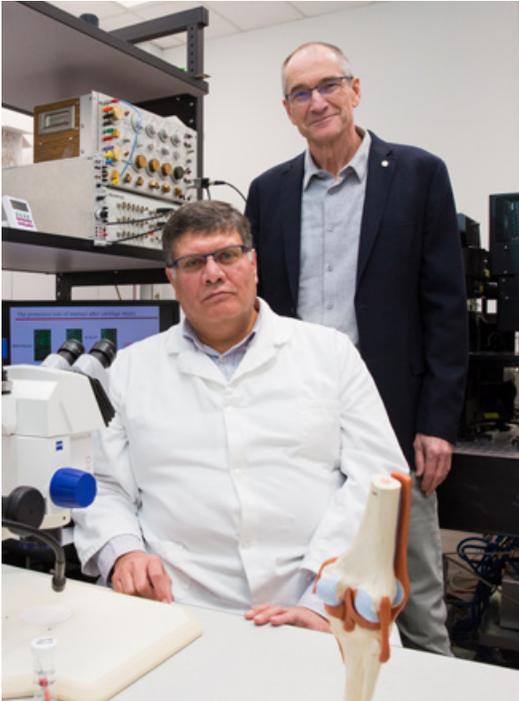


Photo by Riley Brandt

The menisci are an important component in the knee joint, playing a multifunctional role in knee stability and lubrication; while helping to evenly distribute forces throughout the knee. This load-sharing also helps to avoid knee injury and is extremely important to the function and health of the knee. Meniscus tears are common, especially in sports with quick cutting or turning movements. Forty years ago, it was thought that the meniscus did not play a significant role in the knee joint. Orthopedic surgeons would often recommend the removal of all or part of a torn meniscus – as was the case with hockey great Bobby Orr. It was later discovered that after removal of the meniscus, the majority of patients began to develop osteoarthritis within a few years.

In our most recent study, we asked the question – “What is the role of the menisci and how do they protect our knees?”. We developed a powerful microscope-based system to study the mechanics of the knees in living animals during walking and running exercises. We also studied the role of the meniscus in cases where there was already some underlying joint damage. For the first time, we were able to explore the loading and health of cartilage cells in real time, during exercise. We examined knee joints with an intact meniscus and knees with the meniscus removed from the joint. Surprisingly, after only four hours of a running-like exercise, half of the cartilage cells died in the knee where the meniscus had been removed. This extensive cell death puts the knee at a high risk of degenerating and developing osteoarthritis – as these cells make and maintain all of the components of the cartilage matrix. We are also the first to show how the meniscus protects an already injured joint from further injury and how it reduces the extent of cell death away from the injury site. Our findings suggest that running or vigorous exercise in a knee with the meniscus removed may be

associated with extensive cell death. Early treatment interventions should be aimed at retaining the meniscus to help prevent cell death in cartilage and maintain the health of the knee joint

## Gut Bacteria and Mental Health



The human gut contains trillions of bacteria that influence our digestive health, immune responses, obesity risk and now a growing body of research shows our mental health. These bacteria are called our gut microbiota. Research has shown that there is a communication highway between our gut and our brain and that the bacteria in our intestine play a major role in producing signals that affect our mental health. Imbalances in the types and amounts of certain bacteria in the intestine have been linked to depression, anxiety, autism and Parkinson’s disease. Knowing that changes in the profile of intestinal bacteria are linked to these diseases, researchers in the Faculty of Kinesiology have been busy investigating how changes in diet could be used to shift the bacteria back to a healthy state. Research conducted in Dr. Raylene Reimer’s laboratory, and executed by PhD student Jodi Nettleton showed that consumption of the artificial sweetener aspartame and the natural alternative

stevia by pregnant rats, altered their intestinal bacteria and that of their offspring even though the offspring didn’t directly consume the sweeteners. Most interesting was the observation that the reward pathways in the brain (i.e. those that make us seek out and eat high fat and high sugar foods) were changed alongside the changes in the intestinal bacteria. While we can learn many things from studies in rodents, the Reimer laboratory is also actively engaged in research that will help us understand precisely how the intestinal bacteria affect human mental health and behavior. Graduate student Emily Macphail has been examining how the intestinal bacteria of youth with obsessive compulsive disorder (OCD) might differ from the intestinal bacteria in healthy youth of a similar age. OCD is a disorder in which a person has uncontrollable, reoccurring thoughts (obsessions) and behaviors (compulsions) that he or she feels the urge to repeat over and over. As a follow-up, Emily will test whether or not a particular type of fiber called prebiotic fiber can improve the profile of intestinal bacteria in the youth and help to improve their thoughts and behaviors. Given that diet is one of the most influential factors affecting our intestinal bacteria, the Reimer lab is committed to ongoing research that will identify microbiota-friendly foods and designer fiber blends that could be used as new therapies for mental health, obesity and numerous other diseases.

## Introducing



Dr. Martin MacInnis's laboratory investigates how humans respond to acute exercise and chronic changes in physical activity and the extent to which these changes are influenced by nutrition, sex, and the environment. His research group, which launched in 2018, focuses on the responsiveness of the skeletal muscle, cardiovascular, and hematological systems to different exercise training programs and the mechanisms underpinning this plasticity. Current projects involve investigations of: (1) skeletal muscle fitness in men and women; (2) the molecular mechanisms responsible for exercise-induced improvements in skeletal muscle fitness; and (3) the influence of oxygen availability on aspects of aerobic metabolism. His laboratory employs a wide breadth of techniques, ranging from the biochemical and molecular analysis of human tissue (e.g., blood and muscle) to whole-body measures of exercise metabolism, tolerance, and performance. The overall aims of his research program are to understand how the human body responds to exercise and to develop evidence-based strategies for improving health and wellness in diverse populations.

## ISB/ASB in Calgary



We will be hosting the Conference of the International Society and the American Society of Biomechanics at the Calgary Convention Centre from July 31st to Aug 4th, 2019.

It is a great pleasure to host this conference for the second time (since 1999), and to welcome the world elite of biomechanics to Calgary. We received 1751 abstracts and expect approximately 160 additional abstracts for the keynote presentations, invited presentations, and the special symposia. That is a record number of submitted abstracts. Based on these numbers, we are expecting well over 2,000 scientists, trainees, guests and exhibitors to attend the conference: also a record number.

We believe this enthusiasm for our conference is a reflection of the quality of biomechanics research over the past 30+ years, and the leading role that Calgary has played in the international biomechanics community. This excellence has been acknowledged in the recent Shanghai rankings, of kinesiology, physical education, and sport and health sciences departments and faculties, in which the Faculty of Kinesiology at the University of Calgary ranked 1st in North America, and 7th world wide among 374 evaluated schools. We are proud to have contributed to this achievement.

However, the great response to our conference is likely not only a reflection of the biomechanics research in Calgary, but also a result of the network that has evolved from the Human Performance Lab. For almost 40 years, we have trained hundreds of graduates, and have welcomed dozens of visiting students, researchers, and faculty

members from all parts of the world. The University of Calgary, and the Faculty of Kinesiology made this possible, and they have been generous hosts of our lab, and enthusiastic supporters of our research.

The University of Calgary and Faculty of Kinesiology have been generous again, supporting the ISB/ASB 2019 conference financially for the explicit purpose of supporting scientists from economically developing countries (EDC). Because of their generosity, we are able to host up to 30 EDC students by paying for their registration and accommodation for the five days of the conference, and are able to offer registration to EDC scientists at a vastly reduced rate. Our thanks go to all faculties and departments at the University of Calgary who made this possible.

We are just a short four months away from the ISB/ASB 2019 conference, and we hope you will attend and have an exciting scientific, cultural, and social experience. We hope that you will meet old friends and colleagues, and make new friends. We hope that young and aspiring scientists make important connections with senior leaders in the field, and that the senior scientists will make friends with those future scientists, and will be open to their revolutionary ideas that might challenge old-seated beliefs. To quote A. V. Hill: "It is odd how one's brain fails to work properly when pet theories are involved". So, I encourage you to have your pet theories (I certainly have mine), but remain open to the new, the unexpected, and the miracles and surprises that sometimes invade our scientific minds.

What fun, to be a scientist. We cannot wait to welcome you in Calgary for the most exciting biomechanics research event of the year. Let the Science begin!