PROGRAM FOR WICI COMPLEX SYSTEMS STUDENT PROJECT SYMPOSIUM

GRADUATE STUDENT PRESENTATIONS 1 – 2:30 P.M.

1:00 *[Multimedia eco art portfolio] Art as an interface for watershed community resiliency** – Adrienne Mason (Environment, Resources and Sustainability)

1:05 **3C: complexity, climate change, and cities: behaviors of cities in the network of complex adaptive system in tackling climate change** – So Youn (Annie) Kim (Balsillie School of International Affairs – Global Governance)

1:10 **Addressing barriers to adoption of source-control stormwater management practices on private residential yards in Kitchener/Waterloo** (Hazem Ahmed, School of Planning)

1:15 **Analysis of the environmental degradation crisis in urban systems: Dharavi Slum** – Shaieree Cottar (Geography and Environmental Management)

1:20 **Campus food environments require improvements to foster healthy eating among students** – Kirsten M. Lee, Michelle Marcinow, Leia M. Minaker, Sharon Kirkpatrick (School of Public Health and Health Systems)

1:25 **Cauvery River: Path dependencies and feedbacks in water sharing conflicts** – Ajar Sharma, Vanessa Schweizer (Systems Design Engineering)

1:30 **Climate change & the future of forest-grassland mosaics** – Kathryn Fair (Applied Mathematics)

1:35 **Determining the impact of reason for use information in pharmacy practice** – Colin Whaley (School of Pharmacy)

1:40 **Dietary quality differs by weight management efforts, but not weight perception, among Canadian young adults** - Amanda Raffoul, Vicki L. Rynard, Samantha Goodman, David Hammond, Sharon I. Kirkpatrick (School of Public Health and Health Services)

1:45 **Examining the association between campus recreation involvement and psychological well-being among university students: Growth mindset matters** – Narges Abdeahad (Recreation and Leisure Studies)

1:50 **Navigating health and safety in Airbnb's self-regulating system** – Julia Goyal, Ellen MacEachen (Public Health and Health Systems, Mechanical and Mechatronics Engineering)

1:55   **The northern gateway pipeline - seeking consensus is a slippery slope** – Truzaar Dordi (Sustainability Management)

2:00   **Physician views on a computerized decision support system for home care information exchange** – Amanda Nova (School of Public Health and Health Systems)

2:05   **Political corruption networks** – Mahta Ramezanian (Physics and Astronomy), Ollin D. Langle Chimal, David Sutherland Blair, Sonya Ahamed, José R. Nicolás Carlock

2:10   **A Question of Roots: De(con)structing socio-ecological systems for transition** – Perin Ruttonsha (Environment, Resources and Sustainability)

2:15   **Sub-zero mediation** – Simon Leroux (Architecture)

2:20   **Youthquakes: cognitive-affective mapping of social movements and responses in China, Europe, and the US** – Jonathan Hui (Balsillie School of International Affairs)

UNDERGRADUATE STUDENT PRESENTATIONS 5 – 6:30 P.M.

5:00   **Conceptually Designing a Mobile Experience to Help Student-Athletes Develop Mental Resilience During Competition** – Nathan Flach, Dr. Wade Wilson (Knowledge Integration)

5:05   **Examining the association between marginalization and emergency room wait times in Ontario** – Erica J. McDonald, Matthew Quick & Mark Oremus (School of Public Health and Health Systems)

5:10   **Exploring the complex factors influencing support in the lives of youth without a home** – Rachel Lois Bair (Public Health and Health Systems)

5:15   **Intentional weight gain behaviours among Canadian youth and young adults** - Carolyn Minnick, Amanda Raffoul, Sharon Kirkpatrick, David Hammond (School of Public Health and Health Systems)

5:20   **Potential unintended consequences of co-operative education: Food insecurity among undergraduate students at the University of Waterloo** – Mona Qutub, Sharon Kirkpatrick (Public Health and Health Systems)

5:25   **Quality of care for persons with concurrent substance use and mental health** – Amanda Pereira (Health Studies)

5:30   **Youth in the region of Waterloo: Substance use trends in adolescents** – Liam Taylor Ralph (Public Health and Health Systems)

ABSTRACTS – GRADUATE PRESENTATIONS

Multimedia eco art portfolio: Art as an interface for watershed community resiliency* – Adrienne Mason (Environment, Resources and Sustainability)

Can art help to convey the idea that: restoring watershed resiliency at a community level, can be a method of conserving eco system services, supportive of the dynamic system state, of the Anthropocene epoch? Art is a method that inherently bypasses certain language barriers present in transdisciplinary watershed restoration work. It is the focus of this paper to explore whether art can efficiently convey concepts of complexity, connectivity and capacity as they relate to small socio-ecological watershed communities in southern Bruce County Ontario, and to larger hydrological systems, which in turn compose the current system state, that has defined the Anthropocene epoch. This paper draws from the work of ecological and transdisciplinary artists, restorationists, hydrologists and theorists, and presents:

- socio ecological restoration case study data from the South Pine River headwaters project, to track the effect of increasing water storage capacity on the landscape and lateral hydrological connectivity on a series of agricultural fields, as part of the Healthy Lake Huron Rural Stormwater Management Model
-a qualitative study of a beaver wetland complex on Willow Creek and its ability to increase floodplain connectivity and water storage capacity on the landscape
-a feedback driven social study including a survey, focus group and interviews among peers, to test the hypothesis that increasing connectivity and capacity can increase watershed resiliency using theoretical, and case study based findings;
- a multimedia folio of interactive ecological art, as an exploratory method of conveying findings that: increased capacity and connectivity in a watershed community, can increase its resiliency during the Anthropocene to a general audience.

The primary pieces within the multimedia eco art portfolio are: a Bernoulli Watershed model; the Hand-Held Holling's Hydrology loops (HHHH) and a kinetic sculpture called the 'Water Balance', which are meant to serve as an interface, for a transdisciplinary audience to learn about systems theory, hydrology and watershed restoration and allow for experiential learning. It is proposed that this type of artistic experiential learning may broaden the uptake for the methodologies and motivators for watershed restoration, as a method of increasing system resiliency, at this stage of the Anthropocene.

3C: complexity, climate change, and cities: behaviors of cities in the network of complex adaptive system in tackling climate change – So Youn (Annie) Kim (Balsillie School of International Affairs – Global Governance)

Climate change is an Anthropocene problem within the earth system, triggering actions at trans-planetary scale. Cities, which are human-created spaces, and where 70% of GHG (greenhouse gas emissions) occur, have some positionality in the issue. The slow pace of state-centric climate change agreements under United Nations Framework Convention on Climate Change create policy gridlock and caused cities to become active promoters of climate policies. In this regard, reflecting the global trend of non-state centric and non-traditional global governance frames, the study of city networks on climate change deserve attention. The subject of the study is the C40 Climate Leadership Group, founded in 2005 by the Mayor of London, UK, which was created to promote city-cooperation in mitigation and adaptation measures. This paper argues that the C40 is a complex adaptive system of norms that cities follow and can be justified under the logic of complexity theory. The paper argues that each of cities possesses schema that helps them organize and make sense of information. First, the paper will describe complexity theory and its contribution to network theory and social science to explain the C40. This will be followed by a demonstration on why we need to look at C40 from complexity theory. This paper then will explain what a complex adaptive system is and lay out the key qualities of the system. This will be complemented by analysis of the complex adaptive system into the category of organization, actor-network, and behavior. The paper will analyze the C40 with concepts and features of the complex adaptive system extracted from

Communian's research (2011), 1) the context and development 2) space of possibilities, far-from-equilibrium, and innovation, 3) non-linearity, feedback, and co-evolution, 4) connectivity, interdependence, and self-organization, 5) emergent properties, clusters, networks, and interconnections. This paper will conclude with the policy implications of the C40 itself, the prospect of policy to the future global climate governance and finally, acknowledgment of limitation and potentials of complexity theory.

Addressing barriers to adoption of source-control stormwater management practices on private residential yards in Kitchener/Waterloo – Hazem Ahmed (School of Planning)

Rapid urbanization, resulting increases in urban impervious surface, and increasingly severe rainfall events, create accelerating challenges for management of urban storm water runoff - which can cause flooding, increased non-point source pollutant loads in surface and groundwater, and degraded stream networks.   As private household properties occupy ~60% of urban areas, household investments in storm-water-mitigating green infrastructure (GI) are needed to transform private yards into functional nodes within neighborhood GI networks, while maintaining their social amenity functions. As GI benefits are largely public but investment costs largely private, status-quo household investments are too low. Evidence points to barriers of landscaping tastes and preferences, neighbor acceptability of non-standard landscaping, and economic and technical barriers to adoption. This research project seeks to combine empirical social and urban simulation modeling through qualitative/quantitative mixed methods to develop a novel agent-based simulation model (ABM). Through stakeholder-lead scenario analysis, the modeling will explore the relative influences of household information, household preferences and norms, social and neighborhood influences, economic incentives, and the role of relevant bridging organizations such as REEP.

Analysis of the environmental degradation crisis in urban systems: Dharavi Slum – Shaieree Cottar (Geography and Environmental Management)

Environmental degradation has become a growing challenge in Mumbai, India. The exponential rise in waste that is permeating the marketplace has contributed to the development of the informal recycling sector. This research explores the relationship between precarious workers, government officials, NGOs, waste management practitioners, waste refiners, and consumers, and helps to illuminate the flow of materials from production to consumption in order to facilitate the advancement of product stewardship in India. Rapid product obsolescence and the lack of national stewardship principles for waste has resulted in open burning and the improper disposal of e-waste residuals into landfills and urban slum peripheries. This paper contends that revision of Mumbai's municipal waste management efforts is needed in order to include a variety of more comprehensive, green, and modern approaches such as: Extended Producer Responsibility (EPR) and Integrated Waste Management (IWM) models. With projected flows of waste rising globally and in India, there is an urgent need to understand the hazards associated with the improper disposal of metals and to educate citizens on the importance of formal collection and recycling programs. This research uses qualitative data (ex. composition of solid wastes, slum population, trend of urbanization in metropolitan) and case studies to create a framework of understanding the system dynamics for lower-impact recycling and disposal mechanisms. The ultimate goal of the research is to analyze the factors of environmental degradation in Dharavi and apply western management practices in order to mitigate environmental impacts while helping to create social cohesion between the formal and informal recycling sectors.

Campus food environments require improvements to foster healthy eating among students – Kirsten M. Lee, Michelle Marcinow, Leia M. Minaker, Sharon Kirkpatrick (School of Public Health and Health Systems)

Young adulthood is a critical period for establishing healthy eating patterns that may track into later life. Although over half of all young adults in Canada attend post-secondary institutions, there has been relatively little attention to the healthfulness of campus food environments, which consist of a complex interaction of cues (e.g., promotion, price) that can impact food and beverage purchasing among young adults. We examined a sample of eateries (two food courts, two residence cafeterias, and one grab-and-go venue) at the University of Waterloo to determine whether there were changes in healthfulness over a two-year period (late 2015 versus late 2017/early 2018). We hypothesized that due to increased attention to food and nutrition, such as Canada's Healthy Eating Strategy, healthfulness would improve over time. Audits using the Nutrition Environment Measure for University Campuses (NEMS-UC, scores range from -5 to 23) captured data on the availability of healthy options and facilitators of and barriers to healthy eating. We also examined product placement to contextualize NEMS-UC scores. Across five eateries, scores were low at both time points, ranging from 7 to 14 points at time one and 7 to 13 points at time two (with higher scores indicating healthier food environments). For all eateries except one residence cafeteria, scores at time two were the same or lower than scores at time one. All venues carried whole fruit and vegetable options and lower-fat milks, and most offered whole-wheat choices at both time points. However, healthier items were often located in low-traffic areas and priced higher than less healthy options. Nutrition labelling and other identifiers (e.g., symbols) of healthier options at the point of purchase were lacking. Strategies aimed at supporting healthy eating within post-secondary institutions should consider the complex interaction of consumer food environment cues and their potential impact on eating patterns. Improvements are needed to enhance the availability of healthy options and reduce contradictory cues (e.g., price and placement) that may offset efforts to promote healthy eating among students. Considerations may include fiscal measures to incentivize healthier options, as well as rethinking contracts and partnerships with branded chains and soft drink manufacturers.

Cauvery River: Path dependencies and feedbacks in water sharing conflicts – Ajar Sharma, Vanessa Schweizer (Systems Design Engineering)

Cauvery River, one of the biggest rivers in southern India, has been in midst of a water sharing conflict for over a century. Over the years the Central Government of India has established tribunals and committees to solve this conflict, but none have been able to achieve a proper resolution. This conflict transcends various levels of governments as well as many ethnic, religious and economic groups. The dispute has been analysed independently by hydrologists, economists, and political analysts, which is justified because it is simpler that way. In order to comprehensively understand and potentially solve the conflict, Pierson's "Path Dependence and Positive Feedback" approach is applied. The status quo bias of the respective state governments plays a major role in further complicating the issue. During the initial days of the conflict, the per capita resource availability was very high. Either states were able to meet the demands easily. The farmers in the southern state of Tamil Nadu became used to ample amount of water for agriculture and other purposes. Similarly, the availability of water in the vicinity spawned the cyber-hub city of Bangalore in Karnataka. However, over the last two decades due to climate change and increasing population, the dependence towards this natural resource further exacerbating the conflict. The different layers in the governmental structure from central to panchayat (rural government) are analysed. The path dependencies are highlighted using causal loop diagrams. These causal loops help identify the positive feedbacks in the system that lead to lock-in effects. For example, the government is docile in its handling of the matter, therefore a system which does not depend on them can be beneficial. The "enough" solution that the conflict is resolved by the people in the region itself, is checked against the technologically/politically/economically feasible solution. An intersection between the enough and feasible solution sets gives the desirable solution. Ideally, the solution shall be democratic in some sense, that would require majority of the stakeholders in the region to participate and eventually agree upon that solution.

Climate change & the future of forest-grassland mosaics – Kathryn Fair (Applied Mathematics)

Mosaic ecosystems, such as the forest-grassland mosaics of Southern Brazil, consist of multiple land-states existing in proximity. Atlantic Forest and Campos grassland are alternative stable states for the ecosystem, appearing as distinct spatial clusters. Both states have high species richness, with the Atlantic Forest hosting several endemic species including the endangered Paraná Pine. Transitions between states occur through tree mortality and recruitment and are mediated by forest fire and other disturbances. Changing environmental conditions, along with feedback loops and ecological thresholds impact system behaviour.

These mosaics are endangered, with the conversion of both forest and grassland into agricultural land leading to substantial reductions in natural land-states. In addition to these direct impacts, it is crucial to consider the effects of anthropogenic climate change. Due to changing atmospheric CO_2 concentrations and the resultant shift in environmental conditions, dynamics governing transitions between land-states will be altered and lead to changes in the make-up of the mosaic.

We construct a spatially-explicit agent-based model of a forest-grassland mosaic, parameterized for Southern Brazil. Model behaviour in different areas of the parameter plane is investigated, both in terms of forest cover, and spatial metrics. Using CO_2 concentration trajectories for 1765-2500, we estimate how system dynamics could change over the coming centuries. Simulations using these temporally-varying dynamics explore the effects of anthropogenic climate change; both how it will alter the proportion of land-states in, and impact the spatial structure of, these systems.

Our preliminary results suggest that, for a case where climate change impacts manifest through an alteration in how forest fire mediates recruitment, this region may experience forest expansion. The speed and extent of this expansion will differ depending on the CO_2 concentration trajectory. Simulations are run for all Representative Concentration Pathways (RCPs); potential trajectories outlined in the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC).

These simulations provide insight into the future of these unique ecosystems and may enhance the development of conservation policies. Additionally, this model provides a basis for examining mosaics as coupled human-environment systems by incorporating human dynamics.

Determining the impact of reason for use information in pharmacy practice – Colin Whaley (School of Pharmacy)

Background: Pharmacists have critical roles in helping patients manage their prescription medications, and they represent the final opportunity to identify if the medication is indicated, effective, safe, and if the patient is willing and able to take it. Further, pharmacists are responsible for providing any final information on the prescribed medication before the patient takes the medication home. In Ontario, prescribers are not required to provide pharmacists with the reason for use (RFU) for a medication. As a result, to determine RFU information about a patient's prescription, the pharmacist must either guess, ask the patient, or contact the prescriber— all options that are often unreliable and/or time consuming.

Objectives: To determine the barriers and benefits that including RFU information would have on pharmacist practice.

Methods: Twenty semi-structured interviews were conducted with practicing pharmacists in the Waterloo Region and GTA. Interview questions probed participants on the frequency with which RFU information was provided by prescribers, and details about how pharmacists would use RFU data. Interviews were recorded, transcribed and thematically coded.

Results: Preliminary themes include barriers to implementation, benefits to pharmacy practice, and technological solutions to obtaining RFU information. Pharmacists indicated that having RFU information

would aid in their ability to counsel their patients and allow them to better detect prescription errors, however getting prescribers to include RFU information on their prescriptions may prove challenging.

Conclusion: These results can be used to better advocate for the inclusion of RFU information by prescribers to improve patient care.

Relevance to Systems Thinking: Canadian healthcare is an amazingly complex system that includes numerous stakeholders like healthcare providers, administrators, private companies and taxpayers. Optimizing the use of taxpayer dollars by healthcare providers requires parties to share information in transparent and clinically useful ways. Ensuring pharmacists have the information they need in order to best help their patients is one avenue by which healthcare can be better streamlined, and patient outcomes improved.

Dietary quality differs by weight management efforts, but not weight perception, among Canadian young adults - Amanda Raffoul, Vicki L. Rynard, Samantha Goodman, David Hammond, Sharon I. Kirkpatrick (School of Public Health and Health Services)

Efforts to lose, gain, or maintain weight are complex behaviours that are highly prevalent among young adults. Since weight management attempts, and the weight perceptions that often motivate them, can significantly vary in their overall healthfulness, they may uniquely affect overall dietary quality. The objective of these analyses was to explore associations between weight change intentions and perceptions with dietary quality among young adults.

Cross-sectional data were drawn from the first wave of the Canada Food Study, a national cohort study of young adults (aged 16 to 30) recruited in five Canadian urban centres. The Healthy Eating Index-2015 (HEI-2015) was used to characterize dietary quality among participants who completed a self-administered 24-hour recall (n=2,040). Respondents reported their weight change efforts over the past year (lose, gain, maintain, or do nothing about their weight) and their weight perception (underweight, just about right, or overweight). Multiple linear regression analyses were conducted to investigate the relationship between weight change intentions and weight perceptions, separately, and dietary quality, controlling for known covariates.

The average HEI-2015 score was 52 of 100 possible points. Nearly one quarter (24%) of respondents reported not trying to do anything about their weight, while 16% reported trying to maintain, 16% trying to gain, and 44% trying to lose weight. Approximately two-thirds reported their weight was just about right (65%) and one-quarter felt they were overweight (26%). Trying to gain or maintain weight were each significantly associated with higher HEI-2015 scores, indicative of higher dietary quality, compared to not making an effort to manage weight. Weight perceptions and HEI-2015 scores were not significantly related. Respondents who were younger, male, non-White, and who had missing height and weight data or had "obesity" based on body mass index had lower dietary quality scores.

Weight management attempts, but not weight perceptions, are associated with dietary quality. This work provides evidence for future behavioural nutrition research that uses a complex systems lens to explore the strategies used by youth to manage weight, helping to guide interventions that recognize links among weight-related behaviours, dietary quality, and other determinants of health.

Examining the association between campus recreation involvement and psychological well-being among university students: Growth mindset matters – Narges Abdeahad (Recreation and Leisure Studies)

Over the last decade, university student wellbeing has been a focus of attention across Canada (Canadian Association of College and University Student Services and Canadian Mental health association, 2013). Recent research suggests that university students experience strain, depression and anxiety, sleeping problems due to worries, and inability to enjoy day to day activities (Levecque et al., 2017; Peluso et al., 2011).

Participation in campus recreational activities is a potential resource for coping with stress related to student life (Iso-Ahola; 1989). The effectiveness of campus recreation activities in supporting coping may be due to its role in enhancing psychological well-being by helping students develop a sense of personal growth, positive relationships with others, and purpose in life (Bowman, 2010). Experiencing personal growth may be a key component explaining why campus recreation enhances well-being since personal growth has been shown to be a crucial buffer against depression for students by helping them develop a mindset to see setbacks as opportunities to learn rather than as a test of their basic self-worth (Dykman, 1998). In sum, I will examine the role of UW Warrior Recreation Club participation (e.g., dance, skating, squash, martial arts, fitness) in enhancing well-being and the potentially mediating (explanatory) effects of a growth mindset leading to enhanced coping.

For this study, survey data will be collected at two time points from UW students involved in Warrior Recreation Clubs as well as non-participants. The nature of their participation in recreation clubs will be assessed with behavioural measures (e.g., frequency of participation) as well as a subjective assessment of the meaning of this participation in their lives (i.e., ego-involvement; Kyle, Absher, Norman, Hammitt, & Jodice, 2007). Well-being will be assessed with a positive psychology approach to psychological well-being (Ryff, 1989). The mediators will be assessed with a short-form of Goal Orientation Inventory (Dykman, 1998) that assesses the degree to which students see challenges and setbacks as opportunities to learn, and coping will be assessed with the Leisure Coping Strategies Scale (Iwasaki & Mannell, 1999) and the COPE inventory (Carver, Scheier, & Weintraub, 1989).

Navigating health and safety in Airbnb's self-regulating system – Julia Goyal, Ellen MacEachen (Public Health and Health Systems, Mechanical and Mechatronics Engineering)

The sharing economy is changing the landscape of work and disrupting traditional business practices. This economy includes any platform that uses a mobile app to connect dispersed networks of individuals and provides on-demand shared access to goods and services. One key example of this, as well as the focus of my Master's work, is the growing, lucrative, and unregulated sphere of Airbnb. As a social network platform, Airbnb is fundamentally complex with multiple nodes (actors: hosts, guests and Airbnb as an overarching identity) and ever-changing links (interactions) that connect them. This complexity comes with the very many autonomous and diverse components that are highly interconnected and independent. These components are arranged in a specific order for them to function as an entity, and a formation of networks results from the nature and structure of these connections. An element of uncertainty exists especially considering Airbnb through the lens of public health and safety, as it is a system very much self-regulated. Instead, it heavily relies on the social currencies of trust, reputation and reciprocity through its peer-to-peer rating systems in the absence of policy and regulations. Hosts interact within the network and use signalling mechanisms on Airbnb's online interface, which in turn influence and/or modify consumer behaviour and decision-making processes as they come to know about the system. Using a qualitative design, I used forum analysis of posts by Airbnb hosts on the community.withairbnb.com forum, as well as in-depth interviews, to explore the nature of the links between host and guest as well as hosts' sense-making and decision-making processes.

The northern gateway pipeline - seeking consensus is a slippery slope – Truzaar Dordi (Sustainability Management)

In December 2013 the Joint Review Panel (JRP) for the Northern Gateway Pipeline (NGP) was tasked with preparing a recommendation to the National Energy Board (NEB) on whether to approve the construction of one of Canada's most divisive pipeline projects. While considered critical to the economic growth of Canada's oil industry, support for the pipeline is deeply divided due to the disproportionate environmental, social, and economic risks and benefits associated with the project. This six-party, multi-issue, scorable negotiation simulation replicates the complex nature of real-world negotiations in a classroom setting, requiring students to adopt the position of regulatory, civilian, and industry representatives to jointly achieve consensus on the construction of a pipeline that is in the best interest of all Canadians. The purpose of the negotiation is to apply the pedagogy of active learning through a collective action problem. Undergraduate and graduate students alike will learn that competing perspectives and trade-offs occur in any complex decision involving a collective action problem, which can lead to agreements but also to failure.

Physician views on a computerized decision support system for home care information exchange – Amanda Nova (School of Public Health and Health Systems)

Objective. This study explores physician views on a proposed computerized decision support system (CDSS) for exchanging information with home care for the purpose of improving communication, collaboration, and integration in the health care system.

Design. Qualitative Study.

Setting. Telephone or in-person at the participant's clinic or in coffee shops, based on participant preferences.

Participants. Interviews were conducted with an adequate sample of 10 physicians from southern Ontario. Participants were recruited with snowball and convenience sampling. They had experience as a physician in Canada ranging from three years to forty-five years and were comfortable with using computers at work.

Method. Twenty-minute interviews were conducted by a single researcher, audio-recorded, and transcribed. Coding was conducted by two independent researchers and their collaborative analysis followed a framework analysis structure with elements of grounded theory.

Main Findings. We found that physicians value communication with home care providers and recognize that current methods of information sharing are limited. CDSS for information exchange with home care is seen as a potentially beneficial but must fit a set of requirements. The ideal CDSS for physicians is integrated into the electronic medical record (EMR), concise, and actionable and provides administrative information, clinically relevant changes to the patient, recommendations to action, and supporting evidence. The reliability, validity, and clinical utility of the CDSS, the RAI-HC, and measurement tools are not widely understood.

Conclusion. Education surrounding these concerns, among others, is required to ensure CDSS trust and acceptance. The intention of this research is to create a knowledge product for designing and creating a usable CDSS that can facilitate information exchange between physicians and home care. Design will require iterative usability testing and collaboration with various stakeholders.

Political corruption networks – Mahta Ramezanian (Physics and Astronomy), Ollin D. Langle Chimal, David Sutherland Blair, Sonya Ahamed, José R. Nicolás Carlock

The rationale for our project is drawn from the United Nations Convention against Corruption (UNCAC-2003) that acknowledges corruption as a transnational phenomenon that affects all societies in deep and multiple ways, at political, economic, ecological and social fronts. Therefore, comprehensive and multidisciplinary approaches are recommended to prevent and combat the complexity of corruption effectively. For our project we focused on a particular case of corruption in Mexico: the phantom companies of ex-governor of the state of Veracruz, Javier Duarte. This is a recent and paradigmatic case of documented political corruption in Mexico that involves a complex network of hundreds of shell companies used to embezzle billions of dollars. We made use of many qualitative and quantitative methods to study the structure and time-evolution of the system. Networks were built according to the available infor- mation and data. The data-set contained information about the relationship among 356 shell companies and 357 people, as well as information about the date of creation of each company. Two types of nodes (companies and people) and five edge categories between those two types of nodes were defined: administrators, legal representatives, share holders, commissioners, and notaries. A bi-partite approach was used (see Fig. 1) to obtain different metrics as function of time and/or edge-type, such as: edge density, clustering coefficients, eigenvalue distributions, assortativity, betweeness and eigenvector centrality, and other ad-hoc quantities. Some commonalities and differences between this case and other cases of criminal networks reported in the literature were checked in order to find a possible 'signature for corruption networks'.

A Question of Roots: De(con)structing socio-ecological systems for transition - Perin Ruttonsha (Environment, Resources and Sustainability)

As a concept and practical objective, transition along sustainability and resilience pathways could encompass nearly everything. In this way, it is slippery, diffuse, indistinct, unbounded. Many of the related issues have been referred to as *wicked*, meaning they are difficult to neatly define, delineate or trace to isolated causes (Curran, 2009; Rittel & Webber, 1973). More so, the novelty that can accompany complexity continues to modify the contexts in which we are transitioning: "The human living world is open, radically emergent, governed by no entailing laws, and like the biosphere, flows into an often unprestatable and largely unintended Adjacent Possible whose shape we often do not foresee, but co-create" (Kauffman, p. 83, 2016). How then might we navigate this dynamically changing space, to regenerate our human-influenced systems from their very foundations? Roots connote a source, but also something that is integral, fundamental, or a key operative. In his writing on language, truth and Being, German philosopher, Martin Heidegger (2001/1971), turned to linguistic origins, as well as poetry, to reveal the essential meaning of things, as they exist in relation to one another. In a comparable way, biologist, Humberto Maturana (2016), encapsulated environmental and social justice concerns within a single question, "*how do we want to live together?*" To deconstruct the roots of the transition problem domain, this research develops coarse-grained conceptual distillations, offering broadly applicable interpretive boundaries that cut across conventional, issues-based categories, with a few general premises, as follows: **(1)** Key challenges for sustainability and resilience have arisen primarily against the backdrop of accelerating complexity of human life on Earth, including culture, consciousness, and power structures, calling for a renewed *social science for transition*; **(2)** sustainability and resilience rests in the effective coordination of relationships between social and ecological systems within a shared living world, calling for a *sustainability science of order and dynamics within living systems*; **(3)** socio-ecological systems interactions are embodied within globalized, multiscale human settlement networks, calling for a *science of settlement tracing emergent patterns of organization.* This research aims to describe the roots of sustainability and resilience as a function of socio-ecological systems complexity, while advancing the ways of knowing by which we navigate its diverse and fluctuating states.

Sub-zero mediation – Simon Leroux (Architecture)

From the earliest integration of air-conditioning in buildings of late modernism, designers have sought to provide optimal comfort through neutral thermal conditions[1]. In 1970, P. O. Fanger introduced the Predicted Mean Vote, or the first heat balance model for assessing human thermal comfort. This model aimed to satisfy a group of people with thermal neutrality, i.e. having no sensation, warm or cold[2]. A study by R. J. de Dear and G. S. Brager showed that the model allowed for 80% satisfaction of the thermal environment among occupants, thereby leaving up to 20% dissatisfied – quantified by the Predicted Percentage Dissatisfied (PPD) calculation[3]. This model, developed for the indoor environments of moderate to warm climates, has been applied globally in the building industry and remains widely in use for the assessment and provision of thermal comfort.

In contrast, developments in human sciences have shown that the human body thrives in thermally dynamic environments[4]. Human thermoregulatory mechanisms are thus that without heat loss, a body's temperature at rest would gradually increase by roughly 1°C per hour[5]. Further research in biometeorology has shown that people working in air-conditioned buildings have greater comfort expectations than those working in naturally ventilated buildings[6].

Upon noting the promotion and implementation of neutral environmental conditions in the North American building industry for nearly a century, the relationship of human thermal comfort to the dynamic conditions of outdoor public space gains relevance. Unlike indoor spaces, urban outdoor conditions allow for a wide range of thermal sensations. Of particular interest is the influence of design to address human adaptation to cold climate, as opposed to design promoting expectations of thermal conditions finely tuned to 'neutral'. Considering our growing expectations for comfort, it is crucial that adequate steps be taken to ensure an ethically responsible use of energy.

This research will provide policy writers, design professionals, and city dwellers with strategies and design guidelines for the integration of thermal comfort in the everyday winter experience of urban outdoor public space.

Youthquakes: cognitive-affective mapping of social movements and responses in China, Europe, and the US – Jonathan Hui (Balsillie School of International Affairs)

Youth activism, roughly comprised of those under the age of 35, has become a focal point around the world, as political leaders attempt to navigate amid rising populism, unpredictable geopolitics, worsening climate impacts, and a slowing global economy. Using a Neo-Gramscian lens, this paper seeks to roughly situate recent youth movements as they challenge the hegemony of neoliberal capitalism from both the progressive and conservative ends of the political spectrum. I argue that the shape of these movements signal budding counter-hegemonic historical blocs, ones that lay the foundations for dramatic systems change as the present political-economic configurations continue to lose resilience. Using cognitive-affective mapping to visualize webs of partisan concepts and keywords, my case studies cover the arguments of Progressive and Conservative youth-majority movements in China, Europe, and the US, such as those led by Greta Thunberg, Alexandria Ocasio-Cortez, Charlie Kirk, and Markus Willinger. This project hopes to act as a comparative contribution around how youth movements are being shaped historically, socially, and ideologically in different regions yet in response to an increasingly globalized, inter-connected, and fragile world system.

ABSTRACTS – UNDERGRADUATE PRESENTATIONS

Conceptually Designing a Mobile Experience to Help Student-Athletes Develop Mental Resilience During Competition – Nathan Flach, Dr. Wade Wilson (Knowledge Integration)

The purpose of this 4th year Knowledge Integration senior design project was to use existing research in the field of sport psychology to create a mobile application. Currently, there is a lack of resources for student-athletes to easily use that will help prepare them for competition. As opposed to traditional text, mobile apps are accessible, easy to use, and engaging. This application serves as a one-stop training tool to help student-athletes continuously improve positive mental habits throughout competition. There are few apps offered that have simple consistent mental training for student-athletes; this application will provide an easy-to-use interface where athletes can form habits to help their training. It is important to note that this app is not fully coded - it is a detailed prototype with mock data that users can still interact with. The creation of the app started with ideation by means of the Jobs-To-Be-Done framework to establish core mental resilience techniques such as weekly journals, imagery, and goal setting. Through an iterative process with user needs at its focus, hand-drawn wireframes were transformed into digital mockups using prototyping software Figma and Invision. To further improve the simplicity and ease of use, usability sessions were conducted. Participants would walk-through the app with prompting questions and the feedback given would be used to iteratively revise the app. Usability testing is still ongoing and will be continuous as the app is refined further.

Examining the association between marginalization and emergency room wait times in Ontario – Erica J. McDonald, Matthew Quick & Mark Oremus (School of Public Health and Health Systems)

Objectives: Marginalized individuals face material and social disadvantages compared to other groups in society. Access to healthcare is thought to decrease as marginalization increases; however, it is unclear if this is true in emergency room (ER) settings. To date there have been no investigations exploring the potential association between community-level marginalization and ER wait times. This study combines the fields of geography, social determinants of health, and healthcare research to explore this association in Ontario.

Methods: We will use the Thiessen Polygon Method to create geographical catchment areas for each Ontario ER. Previously published 2017 hospital wait time data will provide the average, median and 90th percentile wait times for high and low acuity patients in Ontario ERs. The Ontario Marginalization Index will provide a marginalization score for the census subdivisions that fall within each catchment area. A sensitivity analysis exploring the association in metropolitan areas of Ontario, instead of the province-wide data, will be completed to examine whether any trends seen at the provincial level persist when considering smaller geographical units. When possible, we will employ spatial regression methods to adjust for a catchment area's population.

Preliminary Results: Community-level marginalization does not appear to be associated with average, median or 90th percentile ER wait times for either high or low acuity patients (even when controlling for a catchment area's population). These results were also seen in smaller geographic units. Analyses are ongoing, using qGIS and R 3.5.1, and will be completed in April 2019.

Discussion: Understanding any social determinant of health is complex. This study challenges the notion that marginalization uniformly impacts access to care. We demonstrate the value in exploring how specific social determinants of health intersect with clinical care to ensure that generalizations are not erroneously made.

Exploring the complex factors influencing support in the lives of youth without a home – Rachel Lois Bair (Public Health and Health Systems)

The purpose of this study is to explore the various levels and intersectionality of support available to youth, as well as, the impact of supportive factors on the status of homelessness. This is a matter of complexity as what renders support varies and homelessness itself is not homogenous, instead It is shaped by various factors and circumstances that differ from person to person. Further, it is influenced by an intersection of situational, lifestyle and economic factors. Youth are the fastest growing segment of the homeless population, and by far the most vulnerable, facing various barriers to attainment of health and wellbeing.

The existence of positive support has been found to mitigate adverse outcomes and stand as a protective factor. An extension of this research can result in a greater understanding of support networks and could lead to the development of improved outreach programs to help youth work through their current experience, as well as work to remove barriers. The achievement of improving rates of transition out of youth homelessness lies not only with individual motivation but the surrounding influencing factors, at all levels. Research on homelessness is important to allow for awareness, better-informed policy decisions, resource allocation, and community-based care.

Intentional weight gain behaviours among Canadian youth and young adults – Carolyn Minnick, Amanda Raffoul, Sharon Kirkpatrick, David Hammond (School of Public Health and Health Systems)

Efforts to manage and change body weight are prevalent among young adults in North America. However, focus is often on attempts to lose weight, whereas intentions to gain weight may also be common given societal ideals related to body shape and size. Existing evidence suggests methods used for the purposes of weight loss among young adults are often health compromising (e.g., fad dieting, diet pill usage). While weight gain behaviours have been studied among particular groups, such as bodybuilders and members of the military, the nature of weight gain attempts among the general population is not well understood. The objectives of this study were to examine the prevalence of intentional weight gain efforts and to characterize the specific behaviours reported among young Canadian adults. Data were drawn from the 2017 wave of the Canada Food Study, conducted in five cities across Canada with participants aged 16 to 32 years (n=1,022). In addition to sociodemographic information, respondents were queried about their weight change intentions and behaviours over the past 12 months. Information on perceived weight, body image, and reported height and weight was also collected. Preliminary analysis indicates that more than one in ten (14%) of respondents reported attempting to gain weight in the past 12 months. Among the entire sample 22% of males and 6% of females reported that they were looking to gain weight. Approximately three distinct weight gain behaviours were reported per person, on average. The most common behaviours included eating more overall, eating more protein, and exercising/weight lifting. Logistic regression models will be used to determine associations between intent to gain weight and sociodemographic characteristics as well as body perceptions and body image. By applying a systems thinking lens, this paper challenges the traditional approach to understanding weight change efforts. Focusing on weight loss only ignores the potential health implications of weight gain behaviours, highlighting the need for a holistic approach to weight and health, particularly within the context of a weight-focused society. This holistic approach may also have relevance to planetary health given that diets followed for weight gain may not be environmentally sustainable.

Potential unintended consequences of co-operative education: Food insecurity among undergraduate students at the University of Waterloo – Mona Qutub, Sharon Kirkpatrick (Public Health and Health Systems)

Co-operative education programs are increasingly being adopted across post-secondary institutions to provide students with practical learning opportunities. The University of Waterloo (UW) is a leader in co-operative education, engaging a large proportion (close to 70%) of undergraduate students in over 100 co-op programs. Despite the demonstrated benefits of co-op, there may be unintended consequences for students' well-being, including financial precarity. Although UW encourages reimbursement, rates of pay differ depending on the employer and the student's program and level of study. Prior research has suggested that students experience uncertainty related to co-op work-terms and earnings, as well as burdens associated with relocating to secure placement opportunities. Financial precarity increases students' vulnerability to a range of challenges, including food insecurity, or the lack of access to adequate food due to insufficient finances. The objectives of this cross-sectional study were to 1) assess the prevalence of food insecurity among undergraduate students, exploring differences between those in co-operative education and non-co-operative education programs, 2) examine associations between socio-demographic characteristics and food security status among co-op and non-co-op students, and 3) examine characteristics of students' co-op placements (e.g., earnings, frequency of relocation) in relation to food security status. On-campus flyers and social media platforms were used to recruit undergraduate students in year 2 or above to complete a web-based survey from January to February 2019. The survey queried program of study, participation in co-op, socio-demographic characteristics (e.g., sources of income, subjective social status, living situation), and household food security (measured with the Household Food Security Survey Module, used in national surveillance). Those enrolled in co-op were asked about earnings and whether they had relocated for one or more work-terms. A total of 261 undergraduate students from across the six faculties completed the survey. Of these, 75% (n=198) were enrolled or previously enrolled in co-operative education programs. Analyses are underway, using a systems thinking lens to consider the array of factors that may influence vulnerability to food insecurity among students. The findings of this research will inform further evaluations of programs such as co-op to ensure that potentially negative unintended consequences can be identified and mitigated.

Quality of care for persons with concurrent substance use and mental health – Amanda Pereira (Health Studies)

Concurrent disorders refer to the experience of having a mental/psychiatric disorder in conjunction with the abuse of alcohol and/or a psychoactive drug. Individuals who have concurrent disorders are observed to experience poorer physical health and more psychological distress as compared to individuals with a single disorder. The intersection of the two also has a negative impact on the treatment trajectory of the substance use disorder, as well as on the course of the mental illness. Traditionally, substance use and mental health systems acted independently of each other. The expansion of services in both these fields surged in the 1970s and 1980s. By the late 1990's, there was a growing realization that many people who needed substance use services, also had mental health disorders, and consequently there was a push towards the integration of both these systems in order to enable easier access and navigation. In Canada, this integration was facilitated by a recognition of the complexity of clients entering the substance use and mental health systems, an understanding that concurrent disorders can have a negative effect on treatment and support, an expanding range of skills and capacity to manage the rising complexity of concurrent disorders, and finally, the growing collaboration between the administrative structures that provide both of these services. However, there have been wide variations in the quality of care that patients receive, as well as heterogeneity among indicators used to measure care. With the utilization of standard quality indicators for individuals with concurrent disorders, our systems can move towards drawing comparisons and gaining a nuanced understanding of what levels of performance are feasible. For this to be realized, there is a need to identify quality indicators that are meaningful and actionable. Given the need for a robust understanding of quality measures, this research aims to examine the breadth of health care quality indicators currently present for persons with concurrent substance use and mental

health conditions in a community care and in-patient psychiatry settings. This research aims to summarize current findings and identify gaps for future work in this area of study using a scoping review.

Youth in the region of Waterloo: Substance use trends in adolescents – Liam Taylor Ralph (Public Health and Heatlh Systems)

The aim of this pilot project is to examine the risk and protective factors that influence illicit substance use levels of youth in the Region of Waterloo. This study consists of collecting data from local Grade eight students from three schools. Five levels of ethics approval (university, school board, school, parent, student) are required to make the study age appropriate, since this sample population is under 18. This highlights the complex and multidisciplinary process of obtaining consent to collect data from vulnerable populations. The survey in the study will involve the collection of information on youth leisure behaviours, in particular drug and alcohol use, extracurricular activity participation, mental wellbeing, relationships, and demographics. Early adolescence represents a critical period when certain characteristics of one's social environment may influence illicit substance use levels. We believe our survey will identify and quantify risk and protective factors such as extracurricular activity and peer associations. The results of the study may be used to produce local and evidence-based recommendations to delay illicit substance use and enhance student wellbeing.