DR. DAVID MASLOVE – TRANSFORMING CRITICAL CARE MEDICINE

UNTANGLING BIG DATA: The challenges of modern science
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(e)AFFECT is published twice a year by the Office of the Vice-Principal (Research). The mission of our office is to stimulate, enhance and facilitate ethical research and scholarship at Queen’s by providing leadership, support and services to advance Queen’s position as a research-intensive university, while raising awareness of the excellence of Queen’s research and providing accountability to our stakeholders.

Our goal is:
Helping people achieve excellence in research and scholarship.

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Dear Colleagues and Friends,

We are being swept up in the whirlwind of developments in advanced computing, analytics and big data. While this may not be new to a number of disciplines or fields of study, today, it is hard to imagine an area of scholarship, research or creative endeavour where digital technology and infrastructure are not important. Data are accumulating at an incredible rate – new sources, such as smartphones and social media, present both challenges and tremendous opportunities. That said, the resulting flow of information without the ability to effectively manage it is akin to drinking from a fire hose. How (and even if) we capture, store and manage datasets, with their exponentially increasing size and complexity, is the source of a variety of research questions – questions that Queen's researchers are actively addressing and are explored in issue 7 of (e)AFFECT.

Our feature story highlights the work of Drs. Richard Birtwhistle and David Maslove, researchers in the Faculty of Health Sciences who compile and analyze the reams of digital data collected from family practices or intensive care units to improve our understanding of disease more generally, and to ultimately deliver superior personalized care to patients. Importantly, it’s the sharing of information contained in these databases that will drive efficiencies in research and practice. Dr. Kathryn Brohman of the Queen's School of Business studies the policy perspectives of data collection and sharing – such as the possibility of patient-centred “ownership” of medical information – with the goal of increased collaboration and information exchange in the interests of improved service.

Today, Queen's researchers, in increasing numbers, are actively conducting research using the technologies that support big data, such as those provided by the High Performance Computing Virtual Laboratory (HPCVL). Located in Kingston, HPCVL is a core centre of expertise and infrastructure for managing secure and confidential data. At the same time, Compute Canada and Compute Ontario have emerged to oversee investments in digital infrastructure to ensure our researchers have access to the necessary tools to advance their research. Queen's is an active member of both organizations. Additionally, Queen's is one of the seven founding institutional members of the Southern Ontario Smart Computing Innovation Platform (SOSCIP) in collaboration with the IBM Canada R&D Centre. Through SOSCIP, researchers have free access to world-class advanced cloud computing, analytics software and supercomputing capabilities (including Canada's largest supercomputer), and the support necessary to fully leverage these resources.

I hope that you enjoy reading this issue and, as always, I welcome your comments and encourage you to explore, discover, and engage in the research enterprise at Queen's.

Dr. Steven N. Liss
Vice-Principal (Research)
Christopher DeLuca, Faculty of Education, discussed the process of developing a reliable and valid measure of teachers’ approaches to classroom assessment.

Data, Analytics and Computing Research Group

May 7th saw the launch of the Data, Analytics and Computing (DAC) Research Group at Queen’s University – a community of scholars who are committed to addressing the challenges of effective management and analysis of data and eager to stimulate activity in this area. Through discussion groups, seminars and workshops, the group will support the development of expertise in research, teaching, management and policy related to advanced computing and analytics, digital infrastructure and data, as well as foster synergies and collaboration among members of the group. Anyone interested in following DAC’s activities are encouraged to visit dac.queensu.ca.

Queen’s Research is Game-Changing

The Council of Ontario Universities’ Research Matters program is celebrating the top 50 game-changing historical moments in Ontario research over the past 100 years. Queen’s University has cemented its research legacy with eight of those moments, including one that revolutionized the movie industry — the 1916 patent of Technicolor™ developed by Herbert Kalmus, a physics professor in the then-School of Mining.

Vote Now!

To vote for your top game-changer, visit the Research Matters website (yourontarioresearch.ca/game-changers). The top five will be announced in Fall 2015.

Powered by PechaKucha

On April 7th, ten scholars in the disciplines of the social sciences, arts and humanities presented their research to a full crowd in the PechaKucha 20x20 format, in which only 20 slides are allowed per presenter and slides advance automatically every 20 seconds. The mini-lectures highlighted research funded by the Social Sciences and Humanities Research Council (SSHRC) and topics ranged from Indigenous-municipal relations in the context of land-use planning to transformational leadership in youth sport. Also in attendance at this fun and fast-paced event was Ursula Gobel, SSHRC Associate Vice-President, Future Challenges.
Across faculties and departments, Queen’s researchers are capturing headlines in Canada and around the world. Here are a few highlights from the past few months:

Prestigious Killam Fellowships for two Queen’s Researchers
Among Canada’s most distinguished awards, Killam Fellowships support scholars engaged in ongoing projects of outstanding merit and widespread interest in their fields. Queen’s made an excellent showing this year by earning two of the six 2015 Fellowships available nationally. Cathy Crudden (Chemistry) will carry out research important for advances in materials science, health care, energy production and the environment with her project, Organically Modified Metal Surfaces: Biosensing and Beyond. In the project, Designing Evolution-Proof Cancer Chemotherapy with Mathematics, Troy Day (Mathematics and Statistics) will work to understand the evolution of drug resistance and how to slow it down.

BIG research on small innovations
On April 24th, Queen’s University secured its place at the forefront of transforming innovative research with the opening of the Kingston Nano-Fabrication Laboratory (KNFL). The laboratory, located at Innovation Park, represents a milestone in the 30-year collaboration between Queen’s and CMC Microsystems for advancing Canadian strength in micro-nano innovation. The KNFL will enable researchers and industry to explore new frontiers in the design, creation and testing of innovations on an extremely small scale.

DID YOU KNOW?
MAKING PEACE
In 1998, John McGarry’s (Political Studies) publications on the Northern Ireland conflict redefined the terms of debate and informed the successful Good Friday Agreement.

“DID YOU KNOW?” is a recurring feature in (e)AFFECT. If you know of a Queen’s research discovery you would like to see in an issue of the magazine, contact research@queensu.ca
If you weren’t actively looking for the High Performance Computing Virtual Laboratory (HPCVL), odds are good that you would miss it altogether. Headquartered in a non-descript space tucked away in an industrial park in Kingston, HPCVL’s main office doesn’t even boast a sign. And that’s just the way HPCVL’s executive director, Dr. Ken Edgecombe, likes it.

After all, the 9,000 square foot data centre houses some of Ontario’s most critically important, and highly confidential, computational research data in areas ranging from the nature of human memory to airplane design. “We don’t advertise it much for security reasons,” says Edgecombe matter-of-factly of the facility, which employs nine highly-educated specialists who provide both methodological support and advice, with a particular sensitivity to issues of security.

Security is, of course, HPCVL’s primary raison d’être. The climate-controlled room that houses its rows of servers is equipped with motion and vibration sensors, as well as cameras. It is a place with a bunker-like feel where you have to raise your voice to have it heard over the constant hum of the machines. “We store data for a number of organizations – in some cases, even we can’t open the doors to their particular equipment racks unless requested,” Edgecombe explains. “They have cameras to see who touches their stuff.”

HPCVL’s original members were Queen’s University, the Royal Military College of Canada, Carleton University, and the University of Ottawa. Ryerson University and three colleges subsequently joined. Today, HPCVL is a member of Compute Canada, and while the majority of its clients continue to be from Eastern Ontario, the facility serves researchers from coast to coast. Impressively, HPCVL has supported over 350 Canadian research groups comprising more than 1,800 researchers. It is also host to the Ontario Brain Institute’s world-renowned “Brain-CODE” project, described as a “tool that will take brain research collaboration in Ontario to a new level,” but one requiring rigorous consideration around privacy, security and the use of patient data. HPCVL’s status as a secure site means that they can also help facilitate compliance with US Federal Drug Administration regulations for researchers working in the fields of medical research and drug design.
HPCVL may not look like much more than rows of lockers in an empty changeroom, but these cabinets hold some of Ontario’s most critically important and highly confidential data.

HPCVL was founded in the late 1990s – a time when universities, Queen’s included, had more or less ceased to support large scale computing. “It was a resource issue,” says Dr. Andrew Pollard, Queen’s Research Chair in Fluid Dynamics and Multi-scale Phenomena, who played a key role in HPCVL’s evolution. Pollard and his colleagues across a broad spectrum of disciplines and at each university recognized the need and value of high performance computing.

“We weren’t necessarily thinking about security,” says Pollard. “We were thinking about how to create an environment within the university to encourage and strengthen computing as the third leg in the scientific school – that is, theory, experimentation and computation.” At the same time, organizations like the National Research Council and the Canada Foundation for Innovation were increasingly interested in supporting opportunities for universities to work together.

“Rather than just going for a machine for Queen’s, it was clear we needed to broaden our focus,” recalls Pollard. “We thought, Why don’t we take the strength of Queen’s, the link to the military via RMC, and the proximity to Ottawa and Carleton to create an Eastern Ontario facilities group?” He remembers thinking that while they were dealing with high performance computing, he didn’t want people to worry about where those computers were based. “I wanted it to be considered a laboratory, but it’s virtual.”

The wall of Pollard’s office still boasts the oversized cheque for $7.3 million the team received from the Ontario Minister of Energy, Science and Technology to kick-start the project. Since then, more funding has been invested in HPCVL, including significant contributions from industry partners, and it is widely viewed as an example of a successful public-private partnership.

In 2013, Backbone Magazine, a Canadian business and technology publication, named HPCVL as one of the country’s ten best research facilities, a fact that clearly sits well with Edgecombe. “We provide expert advice and services that are not available elsewhere,” he says simply. “We are facilitating leading edge research that wouldn’t be possible if we weren’t here.”

hpcvl.org
BIG DATA:
TRANSFORMING MEDICINE
BY ALEC ROSS
Today, some of the most significant advances in medicine stem from digital information – ranging from detailed genetic data to high-level administrative data – captured during a patient’s various encounters with the medical system. By capturing and comparing these diverse data holdings, medical researchers are learning more about disease and developing more effective drugs and treatment protocols.

Obviously, data collection and analysis in medicine is hardly new. What is relatively novel is the sheer scale of it. The amount of data being collected is almost inconceivable, and only the combined skills of medical professionals, signal processing engineers, computer scientists, experts in genomics and bioinformatics and others can make sense of it all.

A number of medical researchers at Queen’s are on the forefront of this multidisciplinary “big data” work in Canada. We feature two of them here.
Richard Birtwhistle
Richard Birtwhistle is a professor in the Queen’s Department of Family Medicine and Public Health Sciences, the director of the university’s Centre for Studies in Primary Care, and the chair and principal investigator of the Canadian Primary Care Sentinel Surveillance Network (CPCSSN). The network collects patient information stored in electronic medical records (EMR) of primary care practitioners across Canada. Using complex algorithms, CPCSSN brings the data from these different EMR systems together into a consistent format. This enables researchers to use those data to answer questions about the incidence and treatment of diabetes, hypertension, depression, chronic obstructive lung disease, osteoarthritis and other chronic diseases that Canadian family physicians commonly deal with.

Launched in 2008, with funding from the Public Health Agency of Canada, CPCSSN now consists of more than 800 primary care practitioners – or “sentinels” – in seven provinces and one territory and the de-identified records of almost one million patients across Canada. Each doctor uses an EMR to record their clinical care of patients by inputting information such as body weight, blood pressure, body mass index, health conditions, referrals, risk factors for disease, lab investigations and any prescribed medications. Before any of this information is uploaded to CPCSSN, each patient is assigned a unique CPCSSN number that links them with their personal information, but this information does not leave the practice. Therefore, any data actually used for research remains anonymous.

The type of information collected in EMRs is difficult to get from other data sources (such as the Canada Health Survey), which is why a centralized repository holds such great potential for researchers and makers of health policy. The data are also useful to the network’s family doctors. Remarkably, although EMRs contain loads of information about individual patients, most systems don’t provide physicians with reports that shed light on all their patients as a group. The CPCSSN database provides this capability, thus allowing the doctors to track their patients better and provide better, more personalized care. This, by itself, is enormously useful.

“We have a system where doctors can find out how many people with out-of-control diabetes haven’t been seen in the last six months, then go back and link the CPCSSN numbers with the patients’ IDs and then contact them and get them into the clinic,” says Birtwhistle. “From a quality improvement point of view, it’s actually pretty important.”

Birtwhistle says EMR data that CPCSSN has collected is a gold mine for researchers seeking to learn more about chronic disease in primary care in Canada. Much of the data remain untapped. But CPCSSN’s greatest value may ultimately stem from enabling the data to be linked with other types of medical data, he says.

“Linking patients’ primary care data to genomic data, for example, could open up tremendous potential for understanding not only chronic diseases, but other diseases as well.”
The intensive care unit (ICU) in every hospital contains a bewildering array of sophisticated devices that track patients’ bodily functions. The *bleeping* and *blipping* monitors let doctors and nurses know what’s happening in the bodies of very sick patients whose conditions can turn on a dime.

Each of these devices constantly generates data, and some readings, such as blood pressure and heart rate, for example, are recorded in the patient’s EMR. Traditionally, however, most of these data have been discarded.

Thanks to the work of researchers like David Maslove, this situation is starting to change. Maslove is a clinician scientist in the Queen’s Department of Medicine and Critical Care Program and a critical care physician at Kingston General Hospital. His work involves capturing and analyzing massive volumes of detailed electronic data derived from patients in the hospital’s ICU to understand more about the nature and progression of acute illnesses.

Much of these data come from blood samples, which Maslove has been collecting for whole-genome transcription profiling for about a year. What sets this project apart from other genomics projects is the sheer number of samples collected over the course of a patient’s stay in the ICU. Starting this year, high-frequency waveforms from bedside monitors and ventilators will be added to the mix, generating gigabyte-scale data that must be assembled and analyzed using novel computational approaches.

The data-intensive work in Maslove’s field has the potential to transform critical care medicine. For decades, diagnoses in emergency and ICU medicine have been syndromic – that is, patients are assessed according to a set of criteria, and if their conditions meet those criteria, the doctors and nurses follow a certain treatment course. As with all treatments used in hospitals, the utility of that treatment will have been previously verified via a highly-regulated randomized clinical trial. In other words, the treatment used in the ICU is based on aggregated similarities exhibited by the group of patients in the trial. The physiologic individuality of each patient is largely lost.

In contrast, by analyzing detailed genomic data from the ICU, Maslove hopes to identify the differences, rather than the similarities, between critically ill patients who may have been categorized as having the same condition (such as sepsis, which is Maslove’s particular interest).

The Holy Grail for Maslove and others is a database of genomic and other ICU patient data that can be used by physicians and nurses at the bedside to make better treatment decisions in real time.

“From a scientific standpoint, it’s a very exciting cross-disciplinary endeavour that involves bringing together expertise from clinical medicine, computer science, signal processing, epidemiology, genomics,” says Maslove. “We’re trying to find a way to bring all those data under the same roof so that they can be made available to clinicians at the bedside who are treating patients with rapidly evolving illnesses.”
There can’t be many Queen’s professors who get to work with the most notable champ ever from TV’s long-running Jeopardy! quiz show.

Soon, that honour is going to fall to Professor Patrick Martin of the Queen’s School of Computing, who along with business professor Brent Gallupe, is being given the chance to use IBM’s Watson cognitive computing system as an integral part of the department’s CISC 490 course, Deep Analytics using Watson. Touted for its prowess in handling large volumes of disparate data and analyzing them in novel and complex ways, Watson is probably best known for defeating two human competitors on the popular general knowledge game show in February 2011.

The founder and long-time head of the Queen’s Database Systems Laboratory, and a visiting scientist
What is big data?

That is always the question

What is big data? "That is always the question," Martin replies patiently. "I guess the standard definition is the three v’s – volume, velocity and variety." Simply, you have a lot of data and it’s coming at you quickly and, perhaps most importantly, the data are wildly varied – some might be structured in relational databases, but could be almost anything – images, sound recordings, "emails, tweets, all kinds of things." These are data, says Martin, "that can’t be processed efficiently using our standard tools and algorithms."

Being able to manage and analyze big data can have incredible payoffs. "One application I am particularly interested in," says Martin, is neurological. The Ontario Brain Institute (OBI) is building a database called BrainCODE here at Queen’s, and they are integrating data from a lot of different research groups. Each of these groups has their own approaches and types of data. OBI is hoping that if they can give researchers an analytics platform they may be able to combine these data in new and different ways to solve their problems. So if there is one group that uses MRIs, and if they combine that with data from people who are working on the cellular level, they may be able to find things they couldn’t otherwise find without that level of integration.

Watson (named for the founder of IBM) represents a big leap forward in the handling of big data and deep analytics. Capable of understanding natural languages, it is, says Martin, "a whole set of programs in machine learning, data mining and statistics, and all these algorithms on top of a very large parallel machine, accessed through the IBM cloud." The Queen's students will be developing business applications on top of Watson. That requires creating a body of knowledge for it, called a corpus – all documents and data relevant to your potential application, which Watson will process and then index. "And then you have to train it by asking it questions and then rating its answers." Watson tries to figure out what the question means and then comes up with a whole series of hypotheses and tries to pick the best one. "It does this by running all these different algorithms. It may process hypotheses in different ways, key words or what it finds geographically, or by time, and then it will try to support them by going to its body of knowledge and using multiple algorithms to verify the answer." The more you work with Watson, the more specific its answers get – rather like a grand version of one of those simple algorithms online that help you pick books or music based on the preferences you give it.

Martin thinks the next few years will be spent working on ways to make deep analytics more accessible. There is a shortage of people who can work with these analytics, so if they can create something that’s easier for researchers to work with, "a nice interface on a tablet" for instance, that would be good. As part of their work with the Southern Ontario Smart Computing Innovation Platform (SOSCIP), Martin and his group created a "front-end service," essentially a webpage, for IBM analytic software kept on a cloud that sits at Western University and allows researchers to use this software in an easier way. "Researchers," he says, "shouldn’t have to know all the details about working in the cloud. Our service takes care of these details for them."

"This is such a great area to be in," he says. "It really keeps you on your toes."
Kathryn Brohman once had to take her nine-month-old daughter to a hospital in London, Ontario, where doctors examined the child and ordered a biopsy of her esophagus. A few weeks later, mother and baby found themselves at a hospital in Toronto. Again, doctors ordered a biopsy of the child’s esophagus.

“But she just had that done!” protested Brohman. “Can’t you just use the results of the biopsy they did in London?” The answer was no. They said they didn’t have access to the records. They did a second biopsy.

Since that upsetting episode, Brohman, a professor at the Queen’s School of Business, has been working to figure out a way for patient information to be more easily shared among medical professionals. While such data sharing already happens, of course, it is hard to do on a system-wide scale. Provinces have different health-care databases. Hospitals and family physicians use different types of electronic medical records (EMR). The data are often in different formats, and all are protected by strict privacy policies and laws.

On top of that, medical professionals are rightly concerned that if data are shared too widely, they may be misused, misinterpreted or fall into the wrong hands.

“Because of that, our health-care system is inundated with increased costs and data redundancies, straight down to the same X-ray being done multiple times,” says Brohman. “Nobody’s going to share that X-ray or ultrasound image. It’s easier for the hospital to just do it again.”

But what if there was a patient-centric health record that could be made available to anyone – the patient and their family, doctors, nurses, administrators, specialists – who needed it?

Answering this question is the focus of Brohman’s current work. She’s the co-principal investigator of a new research initiative called Healthcare Systems Leadership, a nonprofit research team of health-care providers and academics from across Canada that hope to streamline collaboration and information exchange in Canadian health care. In one project, she is working with the Health Quality Innovation Collaborative (HQIC), the developer of an online medical application called Synapse. Synapse is a social network, similar to Facebook, except it’s meant to be used only by patients, their family members and their various health-care providers. It is a platform to upload and store medical information such as prescriptions, referrals and so on, so that the patient’s various “friends” can access it if necessary. The system is designed to allow members of this “circle of care” to work together, using the same information, in service of a patient’s health-care needs.

While the technical part of Synapse is relatively straightforward, much needs to happen at the broader policy level to make it a viable private or public sector product. Specifically, privacy laws at all levels would need to be revised to explicitly make patients the owners of their medical information and compel doctors to provide it to them in a standardized format (such as a PDF) if the patient requests it. If patients own their information, they are free to share it with whomever they like – which is the idea behind Synapse.

“If I share my profile with somebody, that’s my choice,” says Brohman.

Although Brohman admits that the privacy policy hurdles are considerable, the potential benefits of Synapse, or something like it, are huge. Since patients’ information would be easy to access, millions of health-care dollars could be saved simply through the improved efficiencies. More importantly, patients would receive superior, better-coordinated care.

“It gets really powerful when you can actually think about Synapse as the personal health record of a patient,” says Brohman. “My research asks, ‘What needs to change in order to get there?’”
Beyond clouds and airfoils, turbulence is found everywhere – from the way cream moves through your coffee, to the flow of water over a whale’s flipper, to the turbulent eddies caused by stents in vascular arteries. Each is a specific problem to which Piomelli has applied his understanding and his research tools.

Oddly perhaps, science has had equations to describe turbulence since the mid-1800s. However, using those equations to solve anything beyond the simplest real-world problems has been beyond human capacity up until recently. Real turbulence is just so complex and dynamic that the calculations require not only computers, but the combined number crunching power of arrays of computers, known as supercomputers.

To take a specific application (and one that Piomelli is working on at the moment), consider the wear and tear that the blades of a hydroelectric turbine undergo during years of operation. The pitting and rust formation on the blades amplify the turbulence and friction in the flow of water over the blades which negatively impacts their efficiency. Yet, resurfacing the blades is a huge undertaking that requires halting that particular turbine and all the lost income that implies. So Piomelli studies the exact relationship between the topology of corroded blades and water turbulence in order to develop useful guidelines for Hydro-Quebec to determine when it makes sense to resurface a particular set of turbine blades.
The resolution that Piomelli works at is astounding – 600 million points are used to describe the flow over just a small section of a corroded turbine blade. And then the interaction of the roughness with the water flow is simulated over time at intervals of fractions of a second. Piomelli works in a world far far beyond pencil and paper or blackboard calculations. He and his team at the Turbulence Simulation Lab (TSL) at Queen’s make use of a 240-processor TSM Linux cluster, several clusters at the High Performance Computing Virtual Laboratory and a supercomputer at Hydro-Québec. Even with these supercomputers, running a simulation takes about a month to crunch all the data contained in barely four seconds of real time. Yet it is only at this resolution that the problem can truly be solved.

Of course, no single real world problem is ever as simple as just sending data to be modelled by the computers. One needs to know how to apply the equations to the specific problems in the right way. And that is what Piomelli and his graduate students work on, and undoubtedly the challenge that drives them from one problem to the next.

And while the turbulent flows and interactions under study seem to reduce to reams of data, Piomelli’s language often includes words like beauty and whirls and references to Leonardo Da Vinci’s notebooks. There is true beauty to the whirl of clouds, and the turbulent eddies of a rushing brook. And equally, there is a deep beauty in the understanding of these things.
POSITIVE REACTIONS:
New materials have the potential to transform electronics

BY KIRSTEEN MACLEOD
For award-winning professor and researcher Dr. Suning Wang, nothing compares to the magic of chemistry.

“It’s really fun, especially in my lab. We apply light or heat to molecules and watch the reaction – they change colour, and become luminescent or fluorescent,” Wang says. “Further, we manipulate the structure and properties of molecules, which is even more amazing.”

Of particular note, the Wang Group lab in the Queen’s Department of Chemistry, which employs 11 students, has discovered new phenomena and materials with the potential to revolutionize electronics. This, in turn, supports the various processes involving big data by enabling enhanced technologies, especially for data display and information storage, Wang says.

One ground-breaking result of the lab’s research was the discovery of photochromic boron compounds. A student noticed during an experiment that a crystal was changing colour as it was exposed to light. “It went from the usual pale-yellow colour and got darker and darker until it was almost black. It surprised us and took us six months to figure out what had happened.”

The result? A fundamental discovery of what a molecule can do when exposed to light. “It underwent a structural and colour change, and remarkably, the change was reversible,” says Wang. “This type of compound has potential applications in erasable papers … and molecular switches, which can enable better information storage.”

Another unprecedented discovery, one the lab’s researchers are most proud of, came after an excited student called Wang to see something unexpected. They had been heating up a white solid, a boron and nitrogen compound that was not emissive. As the temperature went up, however, green fumes began to spew out, forming a fluorescent coating on top.

“When I saw it I was intrigued. I wondered, ‘Is this thing going to explode?’” Wang recalls with a laugh. “Bright green vapours coming out of a solid? I couldn’t believe it.” Analysis revealed that they’d discovered a new aromatic molecule formed via structural transformation of the original molecule under heat.

Wang’s lab can produce new and highly emissive materials using light as well. “This has potentially important applications in chemistry – for new ways to make materials, especially luminescent and semiconducting materials, which could then be used in organic devices.”

Building on this discovery, Wang’s team found a better way to make a new graphene-like material. Graphene was first isolated in 2004 and is often referred to as “a wonder material” because of its vast range of high-tech applications.

Wang and her team have created a simple, bottom-up method that could produce graphene-like materials by replacing some carbon atoms with boron and nitrogen, using light or heat. The materials could potentially be used in electronics, semiconductors, mobile device displays, solar cells, fast-charging lithium-ion batteries, and sensing and imaging devices.

Currently, about half the Wang lab’s work focuses on designing and synthesizing novel compounds that emit blue luminescence for use in organic light emitting diodes (OLEDs), devices that convert electricity into light.

“Blue organic LED generates high-energy colour, and is the most difficult to achieve in the OLED industry,” Wang says. Advances would boost the commercialization of OLEDs, with far-reaching effects. “OLEDs are very efficient devices that consume little energy, and will be used more and more generally in cell phones and TVs, displays, and lights.”

Asked about futuristic applications for her new materials, Wang says flexible displays on devices is one example. “However, I think the fundamental impact is more on the energy side. You can use organic-based materials to make new solar cells that use renewable energy, or energy-efficient lighting devices.”

Fundamental discovery, or “a new trick by a molecule and a new phenomenon that no one has ever seen before,” is what she finds most rewarding about her work. “But it’s also great to think that in future, people can likely exploit these phenomena to discover new materials in chemistry – and eventually, apply them to the wider world.”
Almost everyone can appreciate the beauty of the night sky. It was once wisely stated, “When it is dark enough, you can see the stars.” For some, however, the beauty comes with what we can’t see – the dark matter – that comprises most of the mass out in space.

The unique focus on dark matter investigations at Queen’s University was one of many attractive features that lured astrophysicist Stéphane Courteau to Kingston in 2004. Already in the 1990s, Queen’s had initiated an intensive campaign at the deep-underground Sudbury Neutrino Observatory (SNO) to track some of the dark matter produced by the Sun – the elusive, nearly massless, and invisible neutrino particles. (In 1999, SNO scientists solved the three-decade old “solar neutrino problem,” to significant international acclaim.) Courteau’s own search for dark matter is of a different yet complementary nature. Rather than conduct his investigations underground, he and his team look up into space with large ground-based telescopes, and use images and spectra of galaxies taken at different wavelengths to map out the distribution of visible and invisible light in, and around, galaxies.

Every known galaxy, like two of his favorites (the Andromeda and Sombrero galaxies), is surrounded by a halo of dark matter that accounts for more than 90% of its total mass. Because the dark matter is invisible, its presence is inferred through the activity and behaviour of surrounding visible objects. For example, by measuring the movement of stars, which are being accelerated by dark matter, we can infer the amount of dark matter. It can also be measured by looking at visible distortions caused by gravitational lensing (a light-bending process first proposed by Einstein and Zwicky in 1936). Understanding where the dark matter is located and how much there is allows Courteau, his team, and collaborators (including Larry Widrow and Kristine Spekkens of Queen’s) to create models for the typical mass distribution in galaxies and clusters of galaxies. These can, in turn, be compared to theories of galaxy formation and evolution to understand how galaxies like our own have emerged, and also test models for predicting the nature of the invisible mass which SNOLAB* scientists are also actively chasing.

Courteau collects data on some of the largest telescopes in the world, located in remote, dry, mountaintop locations away from light pollution, such as those in the Chilean Atacama desert or atop the Mauna Kea extinct volcano on the Big Island of Hawaii. His observational campaigns always involve students. For instance, two of his current PhD students, Jonathan Sick and Nathalie Ouellette, have pursued some of the most extensive studies of the nearby Andromeda galaxy and the Virgo cluster of galaxies (see photos) to date. Besides mapping the dark matter, they can identify the different stellar populations (that is, for example, the age and/or chemical composition of each stellar group) within galaxies that ultimately constrain how they evolve. Together with the SNOLAB group, Queen’s astrophysicists like Courteau, and their students, form one of the most active centres for research on dark matter in the world.

*With the solar neutrino problem essentially solved, dark matter detections in the revamped SNOLAB observatory now focus on measuring other properties of neutrinos, as well as the detection of the so-called ‘cold dark matter’ particles that are more massive than the neutrino but far harder to detect. SNOLAB is the premier laboratory of its kind in the world.
Courteau contemplating an uncertain and unwanted cloudy sky at the Canada-France-Hawaii telescope.

Credit: ©NeilRabinowitz.com
The Sombrero galaxy is a bright spiral galaxy in the Virgo cluster. The dark dust lane and the large bulge give this galaxy the appearance of a sombrero. One of the most super massive black holes in any of the nearby galaxies lives in its core.

Credit: NASA/JPL-Caltech and The Hubble Heritage Team (STScI/AURA)

Courteau on site in Hawaii overlooking the Gemini-North telescope at an altitude of 4,200 m. Hawaii is an important hub of activity for astronomers, where some of the biggest telescopes in the world are located.

Access and exposure to world-class research facilities is central to Courteau’s research program for all of his students. Pictured at the Canada-France-Hawaii telescope are Jonathan Sick, Joel Roediger and Melanie Hall. Like most of his students, all three secured competitive career opportunities in astrophysics upon graduation.

This picture of the Andromeda galaxy by Jonathan Sick was “stitched” together from images collected for his PhD thesis at the Canada-France-Hawaii telescope over a four-year span. This is the most complete picture of Andromeda, one of our closest neighbours, ever assembled.
Queen’s University – Prizes for Excellence in Research

Each year, Queen’s celebrates major research contributions of faculty members in the humanities, social sciences, natural sciences, health sciences, and engineering. Tejay Gardiner recently took time to interview each of the five winners about their research accomplishments and academic paths.
Dr. Stephen Hughes is a professor in the Department of Physics, Engineering Physics and Astronomy. His research group has garnered much international recognition for their development of theoretical models used in nanophotonics and quantum optics.

Have you ever experienced a mass shift in your research focus? What led to it?
When I first came to Canada in the early 2000s, I got a taste for things small when I joined a nanophotonics start-up company in Vancouver – Galian Photonics Inc. That was a fantastic experience and since then I have, in one way or another, been involved in the study of light-matter interactions in photonic nanostructures. This miniaturized interaction regime results in some pretty cool physics while enabling emerging nano and quantum-technologies.

If you weren’t a physicist, you would be a…?
I asked my wife this and she said I could not be anything else. But in the past I did have some desire to be a blues guitarist or play for the Scottish football [soccer] team – which used to be quite good!

What research question would you love to answer?
What is a photon? — since nobody knows, really. That’s what makes studying them so much fun!

Dr. Glenvile Jones is a professor in the Department of Biomedical and Molecular Sciences. He was recently featured in the Canadian Institutes of Health Research (CIHR) series Celebrating the Impact of Health Research for his work on idiopathic infantile hypercalcemia (IIH) – a rare disease that causes the build-up of calcium in the blood and kidneys.

What was the “tipping point” for your research?
What’s important is doing the basic research and then applying it – we’ve been using the concept “from bench to bedside.” The tipping point for me was the development of a fool-proof method to determine or predict whether a patient has hypercalcemia due to IIH.

What do you see as the value in your research?
Recently, I learned of a 73 year-old man in New York who had experienced hypercalcemia all his life, including painful renal stones. The hospital where he was receiving treatment sent us a blood sample, along with genetic tests from Germany, and in a very short time we determined he had IIH. After 73 years of living with it his physicians could tell him “we know what’s wrong with you.”
At the end of the day, it’s these small advances in understanding the mechanisms of living systems that are important.

Dr. John Kirby is a professor emeritus of educational psychology in the Faculty of Education. He is a Fellow of the Association for Psychological Science and serves on the editorial boards of many influential journals.

What’s the best advice you’ve ever received?
As I was finishing my PhD, I was offered a job in Australia. When one of my committee members congratulated me, I said I might not take it. He was very forceful in telling me that it was an incredible opportunity, and that I would be a fool not to take it. It was a great 11-year experience.

Have you ever experienced a mass shift in your research focus? What led to it?
In 1993, I went to Oxford to get advice from Professor Peter Bryant on what measures of phonological awareness to include in a major six-year longitudinal study that I was about to begin. His advice was that phonological awareness “had been done to death” and that I should look at morphological awareness. That started me on a line of research that has lasted 20 years and should continue long into the future.

If you weren’t an education scholar, you would be a…?
I spent a number of vacations in the early 1980s in Nepal trekking in the Himalayas. I considered staying there as a guide.
**Dr. Ian Moore** is a professor of civil engineering and the Canada Research Chair in Infrastructure Engineering. He is also the executive director of the GeoEngineering Centre at Queen’s – RMC and Fellow of the Canadian Academy of Engineering. In 2002, he became the second civil engineer to be awarded a Killam Research Fellowship.

**What was the “tipping point” for your research?**

Two things. One was a project where I started doing experiments with Richard Brachman and Kerry Rowe. I combined my analysis work with high quality measurements – a powerful combination that can lead to great advances in both fundamental understanding and engineering application. The other tipping point was getting my first CFI grant, which was used to build our buried infrastructure test facility at West Campus. It allowed me to follow big dreams. For instance, if you had the money, what infrastructure would you build to take your research beyond what has been possible before.

**What research question would you love to answer?**

*What controls the longevity of steel, reinforced concrete, and polymer pipes in situ?*

**If you weren’t an engineer, you would be a…?**

Not sure, but my identical twin Peter is an ancient historian, and that is cool.

**Dr. Christine Overall** is a professor of philosophy and Queen’s University Research Chair. She is recognized for her contributions in bioethics and reproductive ethics, and is the recipient of the prestigious Royal Society of Canada’s Abbyann D. Lynch Medal in Bioethics.

**Have you ever experienced a mass shift in your thought or research focus?**

The biggest shift in my thinking came from my discovery of feminism, first as a social movement and then as a philosophical perspective.

**What was the “tipping point” for your research?**

After my children were born I found myself preoccupied with philosophical questions about procreation. I first taught about reproductive ethics in Montreal, and then was fortunate to receive a humanities fellowship at Queen’s that enabled me to write my first book, *Ethics and Human Reproduction: A Feminist Analysis*. It was thrilling to be at the beginning of a new philosophical subfield.

**What research question would you love to answer?**

As an undergraduate I was interested in questions about the meaning of human life, but at the time, orthodox analytic philosophers believed that it was not a legitimate philosophical question. That perspective has changed, and I would love to contribute to the debates, although I have no illusions I can answer the questions that originally concerned me as an undergraduate.
When war or environmental disaster strikes a country, society descends into chaos. Homes, neighbourhoods, hospitals, schools and other essential services are destroyed. Citizens are killed, maimed and often forced to flee to refugee camps in new and unfamiliar territory. There, poor or nonexistent housing, hunger, disease, and further violence compound the misery of their displacement.

Susan Bartels, a clinician scientist and attending physician in the Queen's Department of Emergency Medicine, investigates the plight of people whose lives are torn apart by conflict, earthquakes or other natural calamities. Over the past 10 years, her global public health research with the Harvard Humanitarian Initiative has taken her to Lebanon, Gabon, Kenya, Ethiopia, Tanzania, and the Democratic Republic of the Congo (DRC) – often-dangerous places that have been ravaged by internecine wars or drought and overwhelmed by millions of refugees and victims of violence.

The broad goal of Bartels’ research is to help improve the delivery of humanitarian aid and services, especially to women and children. One of her current projects is set in Lebanon, where hundreds of thousands of refugees from the civil war in Syria are housed in crowded, makeshift camps near the Syria-Lebanon border. Bartels has found that, since the onset of the war, families have begun to marry off daughters as young as 13. In rural Syria, Jordan and Turkey, marriages are arranged by the parents, but the brides are typically in their late teens. The men they marry might be as old as 50.

Bartels is exploring possible reasons for the lower marriage age using a novel research tool called SenseMaker. In it, people simply relate personal stories that researchers record on an iPad. Afterwards, the interviewees identify major themes in their stories using an app that converts their answers into digital data that can be plotted on charts and graphs. This “mixed method” allows the meaning in oral anecdotes to be quantified in a way that reduces researcher bias that would otherwise skew the results.

Bartels also completed another project – benignly billed
GLOBAL REACH

as a “Women and Children’s Health Study” – in the eastern DRC, where rebel militants occasionally raid and burn villages, kill men and kidnap women and girls. The victims are transported to forest hideaways where they are often raped and otherwise abused. Some of them become pregnant by their abusers. The phenomenon is well known.

What’s less understood is the later plight of women who become pregnant or bear a child as a result of sexual violence. If the women are freed by their captors or manage to escape, their problems are far from over. In this part of rural Africa, women who have been raped or have an abortion are stigmatized. Friends and family shun them. Husbands often leave the women and their children. If the husband stays, he might abuse his wife for bringing dishonour upon the family. The child of a raped woman fares no better because they may be seen as the enemy’s progeny. As a result, they may be prevented from attending school, be ostracized, or be the last to be fed or given medical care.

For this study, Bartels used another relatively novel research technique called respondent-driven sampling (RDS), in which the sexually abused women recruited other abused women to tell their stories of stigmatization to the researchers.

“The recruitment was all done by peers, so we as researchers did not approach subjects primarily and ask them to participate,” says Bartels. “We stayed in the study office and waited for participants to come to us. There was a lot of doubt about whether they would come, but they did. In high numbers.”

In about a month, the study gathered 850 stories from a vulnerable, highly stigmatized group that would normally be difficult to reach using more traditional research methods.

By strategically using innovative research approaches, Bartels is helping the voices of these women, and those of other vulnerable groups affected by war and disaster, to be heard. Ultimately, she hopes, their stories will lead to improved health outcomes in troubled regions around the world.
Professor Margaret Walker pushes back her chair with a squeak, steps around her desk and begins to tap out a rhythm with her feet: “Right-left-right-left,” she says, and then “left-right-left-right.”

It’s called a tatkar, she explains, the basic step in the classical dance of northern India known as kathak. The tatkar, properly danced barefoot, can be performed rapidly or slowed down until it becomes a sort of gliding walk.

A gliding walk that owes something to the dances once performed by courtesans is one of the elements that Walker says in her recent monograph, *India’s Kathak Dance in Historical Perspective*, went into the creation of the form, but which has been largely, and very deliberately, erased from history.

The director of the Queen’s School of Music, Walker is an ethnomusicologist by training, a field she became interested in by chance. Trained as a pianist and an Associate of the Royal Conservatory of Toronto, she decided to take a degree in music at the University of Toronto in her late twenties. Most of the course offerings were subjects she already knew about. “The only new thing was non-Western music.” She learned to play the gamelan and worked with James Kippen, a tabla (Indian drum) scholar at the university. With a background in percussion and dance, drumming interested her but because it was very much a male domain in India, “researching drum traditions would be difficult.”

Studying kathak dance, however, which uses many tabla-inspired rhythms “fit right in.” Walker has
studied kathak extensively, including spending a period of several months in Delhi working with a teacher there. Perhaps surprisingly, Walker says a Westerner studying in Indian music there is not regarded as anything special. “People have been coming to India from North America and Europe since George Harrison went to study with Ravi Shankar.” She felt at sea in India at first, but ultimately embraced it.

Which brought her to write about kathak dance. “If you Google kathak dance, you’ll read that it was an ancient story-telling tradition,” she says. Dating back millenia, the accounts say Brahmins danced it in temples to tell “the puranas, the ancient tales, to the illiterate population.”

“What my work has shown is that this has no foundation in fact whatsoever.” Kathak on her account is very much a 20th century creation, developed out of a number of different dance traditions, “some of which can be traced back as far as the 1200s but not to 3000 BCE.” There were the dances of the courtesans, which the British called “nautch.” There was the community of actors and musicians known as Kathaks (the word kathak comes from the Hindi or Sanskrit word that means a story). Some were dancers, but many were not. Finally there was what she calls “an embodied drum” repertoire whose steps are based on tabla drumming.

Kathak arose out of Indian nationalism in the period leading up to independence, born of “Indian people reacting against colonialism,” and the idea that India had no noteworthy culture or history. Kathak, on this account, linked modern India to its ancient classical culture, one “as ancient or more ancient than European culture.” This wasn’t unusual, says Walker. Something similar happened in Irish culture in the 19th century – “it’s a very common thing … a reclamation or invention of an identity as a reaction against whoever has been occupying you.” What Walker has done in her monograph is to reconnect it to the people in the immediate past from the men and women “who were the dancers and singers and so on in late 19th and early 20th century,” but who have been written out of the story – in the case of the courtesans (not prostitutes but women who did resist conventional female roles) because they represented a reality people would rather forget.

India’s Kathak Dance in Historical Perspective only appeared in September, so it is hard to say what the reaction to it will be. Walker admits to being “in some ways a little nervous.”

“The narrative of the ancient temple dance is very embedded,” she says, and her book “does call some accepted legacies into question.”

Due for a sabbatical this year when she steps down as head of the School of Music, Walker plans to be looking at the influences of Indian nautch on the Western classical tradition. “Operas and ballets,” for example, “from the late 18th century that feature dancing girls and exoticism,” based on Indian dance. “Eventually you get into modern dance and then this links back to Indian dance through [dancer and teacher] Uday Shankar. It’s a sort of figure eight pattern of back and forth influence.”
BULLYING, DEPRESSION AND THEORY OF MIND: Chloe Hudson

BY ATIF KUKASWADIA

Bullying is a common problem among Canadian youth. Forty-seven percent of Canadian parents report that their child is a victim of bullying, and one in three adolescent students in Canada report being recently bullied. Bullying can take different forms, such as physical bullying (kicking and punching another student), relational bullying (excluding someone from social activities or spreading rumours), and cyberbullying (making fun of someone using the internet). Bullying impacts victims in different ways, and has been associated with anxiety, depression and increased suicidal ideation. However, there is significant variation in how children respond to bullying. Why is it that some children are less affected when they are bullied, while others are deeply affected? How can we explain this?

Currently a second-year student in the MSc Clinical Psychology program in the Department of Psychology, Chloe Hudson is fascinated by these questions, and hopes to answer them using “Theory of Mind.” Theory of Mind, or ToM, is a branch of cognitive science that describes the ability to understand the beliefs and intentions of others, and how those may be different to your own. Using this theory, Hudson intends to explore the relationship between bullying and depressive symptomology, and whether ToM can explain why some victims are more deeply affected by victimization. She hypothesizes that adolescents having strong ToM abilities, i.e., being more in tune with how others feel, may result in increased depressive symptoms when victimized.

To answer these questions, participants aged 12-18 years complete a series of tests which include computer-based tasks, interviews with the researchers, paper-based questionnaires, and standardized tests aimed at measuring intelligence and executive functioning. The computer-based tasks are aimed at measuring two components of ToM: decoding and reasoning. The decoding tasks measure how well the respondent can identify another person’s emotional and mental state. For example, one task has the participant look at a picture of someone’s eyes and then select the emotion displayed from a series of four words. The reasoning tasks evaluate the ability to explain or predict others’ actions based on an integration of knowledge about a person and the contextual environment. This is measured by first presenting the participant with a short story in which one of the characters unintentionally says something that is offensive to another. The participant must identify what the person said, and why it might be offensive. With 77 of a target number of 80 participants enrolled in her study, Hudson is excited to finish her master’s degree this summer, and start on a PhD degree soon after.

Graduate school was a homecoming for Hudson. Originally from Kingston, Hudson left the Limestone City to pursue undergraduate training at the University of Guelph. While there, she realized that she enjoyed research and designing her own research questions. She started working as a research assistant with Dr. Kate Harkness in the Mood Research Lab, while also volunteering with Dr. Elizabeth Kelley in the Autism Spectrum Disorders (ASD) Lab. She chose Queen’s for her graduate training because of the blend of research training, clinical opportunities, and the strong coursework component offered by the Department of Psychology. She continues to work with Dr. Kelley. After completing her master’s, Hudson hopes to continue studying depression. Depression is surrounded by stigma and misinformation, and the opportunity to help unpack the causes and consequences of this disease is something she looks forward to.

Hudson is also actively involved with Research Matters – a collaborative project among Ontario’s 21 publicly-assisted universities to bring research knowledge to the broader public. As the Queen’s University student representative to this campaign, she is participating in numerous public outreach events, including a Virtual Scavenger Hunt that leads people to read online about cutting-edge research happening in the province.
Ask Valerie Michaelson what connects her research in the Department of Public Health Sciences and the School of Religion and she’ll give you a simple answer: childhood. The way that researchers understand childhood and listen to children – not as mini adults, but as children – has a profound impact on both the process and the results of research. Her research explores aspects of what children need to thrive.

In the Department of Public Health Sciences, Michaelson works with the Child Health 2.0 project, led by her post-doctoral supervisor, Dr. Colleen Davison. The research team uses both quantitative and qualitative methods to explore child health in a holistic way. While modern health research typically focuses on individual characteristics that contribute to health, the Child Health 2.0 project (childhealth2.com) focuses on the whole person, including the dynamic interaction between the physical, mental, social and spiritual domains that all contribute to health.

Michaelson sees her work in the Queen’s School of Religion as a natural complement to this work. Etymologically, the word “health” is rooted in the words “whole” and “holy,” and many ancient cultures and religious traditions are rooted in beliefs around human beings as holistic, integrated beings. For example, Davison’s work has introduced Michaelson to Inuit traditional social values or Inuit Qaujimajatuqangit (IQ). Inuit also speak of Inunnguiniq which translates into English as “the making of a human being.” The Child Health 2.0 project is learning about these Inuit ideas and teachings as one window to explore holistic aspects of child health. Michaelson’s co-supervisor, Dr. Tracy Trothen from the School of Religion, also brings an interesting perspective. In her recent book on “transhumanism,” Trothen examines how technological advances could radically alter the human species, and in turn raises complex ethical, spiritual and ontological questions about what it is that makes us human.

One of the research areas that Michaelson is most intrigued by is her work on spiritual aspects of health. She stresses that while some people may draw from religion to gain a spiritual experience, religion and spirituality are not always linked. In her words, “spirituality captures the sense of wonder inherent to the human experience, and it is often described in our relationships within four domains: with ourselves, with others, with the natural world, and with some sense of transcendence or mystery.”

Over the past four years, Michaelson and her research colleagues have been refining a quantitative measure for spirituality in adolescent populations. In 2014, the measure was used for the first time in a broad general adolescent health survey in eight countries, including Canada. Preliminary data are now being analyzed, and the research team is fascinated by what they are seeing. Trained as a qualitative researcher, Michaelson enjoys trying to understand the human story behind the numbers. What is going on in the patterns we are observing? Why is this important to children as they navigate adolescence? This is a story the team hopes they will soon be able to tell.

Michaelson’s course Religion and Childhood (RELS 201) will be offered in the School of Religion this fall. Drawing from a large and interdisciplinary literature base (including works from IQ and many of the world’s major religions), students will explore the human experience through the lens of childhood. This course has a particular focus on “rites of passage.” Drawing examples from the ancient world to modern children’s literature (including Harry Potter’s Sorting Hat ceremony), this course will investigate how rituals help to mark important life transitions.

Michaelson cites her own children as an inspiration for her work. The proud mother of three teenage girls, she often asks herself, “In this complex and perpetually connected world, what do they need to thrive and be whole?” She says, “If my research can help me answer even a small part of that question, I’ll be very happy.”
Q&A
WITH IAN JANSSEN
FINDING THE FORMULA FOR PHYSICALLY ACTIVE KIDS
BY TIM LOUGHEED

Are you sitting comfortably to read this? Naturally. Are you reading it on yet another electronic screen? Probably. Should you get up and move around more? Absolutely.
It is hard to avoid worries that we are becoming an overweight, feeble society and parents worry most of all. They wonder if children are active enough to be both physically and mentally healthy, and they struggle with the best way of addressing that challenge. Amidst all these fears, however, hard data can be hard to come by. Research on this topic tends to rely largely on self-reported accounts as opposed to objective measures of how active children are.

Ian Janssen, a professor in the School of Kinesiology and Health Studies, is meeting this shortcoming with a mix of innovative measures and common sense analyses. Over the last four years he has undertaken three projects with the support of the Heart & Stroke Foundation, each with the aim of pinning down just how active Canadian children are, what factors affect their activity, and how their activity influences their health.

The most recent of these undertakings is the most ambitious: outfitting hundreds of Kingston-area elementary school kids with GPS-enabled smart-watch monitors they wear on their wrists and movement monitors attached at the hip. This technology takes readings every 20 seconds over 7 days, creating a huge database of recorded physical motion for Janssen and his colleagues to study.

The findings add empirical weight to many of the concerns linking a child’s environment with their activity behaviour. For example, it is possible to identify barriers that have been imposed on children and limit their movement, such as a busy street they have been forbidden to cross.

More subtle observations reveal just how much time is actually spent being active under circumstances intended to promote physical activity. Research into cardiovascular health supports a recommendation that school-aged children engage in at least an hour of moderate-to-vigorous physical activity every day. However, Janssen cautions against assuming that an hour spent at a hockey game will suffice. As the movement monitors show, a good portion of that hour – perhaps two thirds – will be spent being sedentary during stoppages in play, while sitting on the bench, or waiting for the Zamboni to tidy up the ice.

“Usually kids have to participate in activities for three hours to get the one hour of movement time they need,” he says, noting that organized sport and physical education at school are not enough. These organized and supervised activities need to be supplemented with unorganized and unsupervised activities such as walking to school and playing outdoors.

Unfortunately, many parents do not encourage these options because they perceive them as being too dangerous. The perceived threat usually involves the possibility of being abducted by a stranger or hit by a car. Janssen argues that these perceptions are unfounded, with only one stranger kidnapping per year in Canada and seven times more children being injured as passengers in a car.

“Parents accept the risks of their kids riding in the car but don’t accept the much lower risks of being hit by a car,” he observes.

For Janssen, such conflicted thinking often denies children the freedom to play independently – even in their own front yard or driveway – which could make them far more physically active. Far from being a trivial loss, the denial of this play can limit the learning of how to take responsibility for one’s actions.

It also calls for parents to surrender some of their perceived responsibility for looking after their offspring, so that children can develop a sense of independence. That cannot happen when adults hover too close, refusing to stay out of arm’s reach when faced with the slightest risk of harm, such as on a playground.

“You don’t have to be right beside them,” he advises. “Get away from the play structures and give your children some freedom.”

As the father of a little boy and a little girl, Janssen appreciates how hard it is for parents to give their children this freedom. On the other hand, as an academic concerned with the well-being of our population, he would prefer to live in a country inhabited by healthy kids who face up to risk rather than sickly kids who remain forever timid.

“When parents ask me what they should do to get their kids more active, my message is usually ‘less is more,’” he concludes. “Fewer rules that limit your child’s outdoor time, the ways that they can play, and the places they can play at unsupervised.”
Q: People want to take direct action to get their children to be more active. Does that mean enrolling them in some kind of organized sport?

A: One of the challenges with organized activities is that you can only do so much. I have a five-year-old and a four-year-old and they’re in organized activities, but we can’t do it every day. You might spend 20 minutes driving there and 10 minutes getting ready for one kid to get 45 minutes of activity. Poorer families might not be able to afford it or they simply can’t get to wherever the activity takes place. Active, self-directed play helps decrease those socio-economic barriers and it’s not as much of a time-constraint issue. You can do it anytime in most places by just opening your door and going outside.

Q: Why is there not more discussion of how to encourage active play?

A: We just don’t value the kid-led activity as much as we do organization. There’s a perception out there amongst a lot of parents and caregivers that it’s got to be structured, it’s got to be organized and it’s going to be better for the child if it’s that way. The other issue is around perceptions of safety.

Q: How important is it to let children engage in unorganized, “unsafe” activities?

A: Children should learn how to engage in risky outdoor play when they’re young, so that they can better mitigate and understand the more substantive risks they encounter when they’re older. If you toboggan for the first time on a ski hill when you’re 22, bad things are likely to happen. If you start tobogganing on smaller hills when you’re young and appreciate how to mitigate the risks, then when you are confronted with risky situations when you’re older, you’ll better understand what you shouldn’t do.