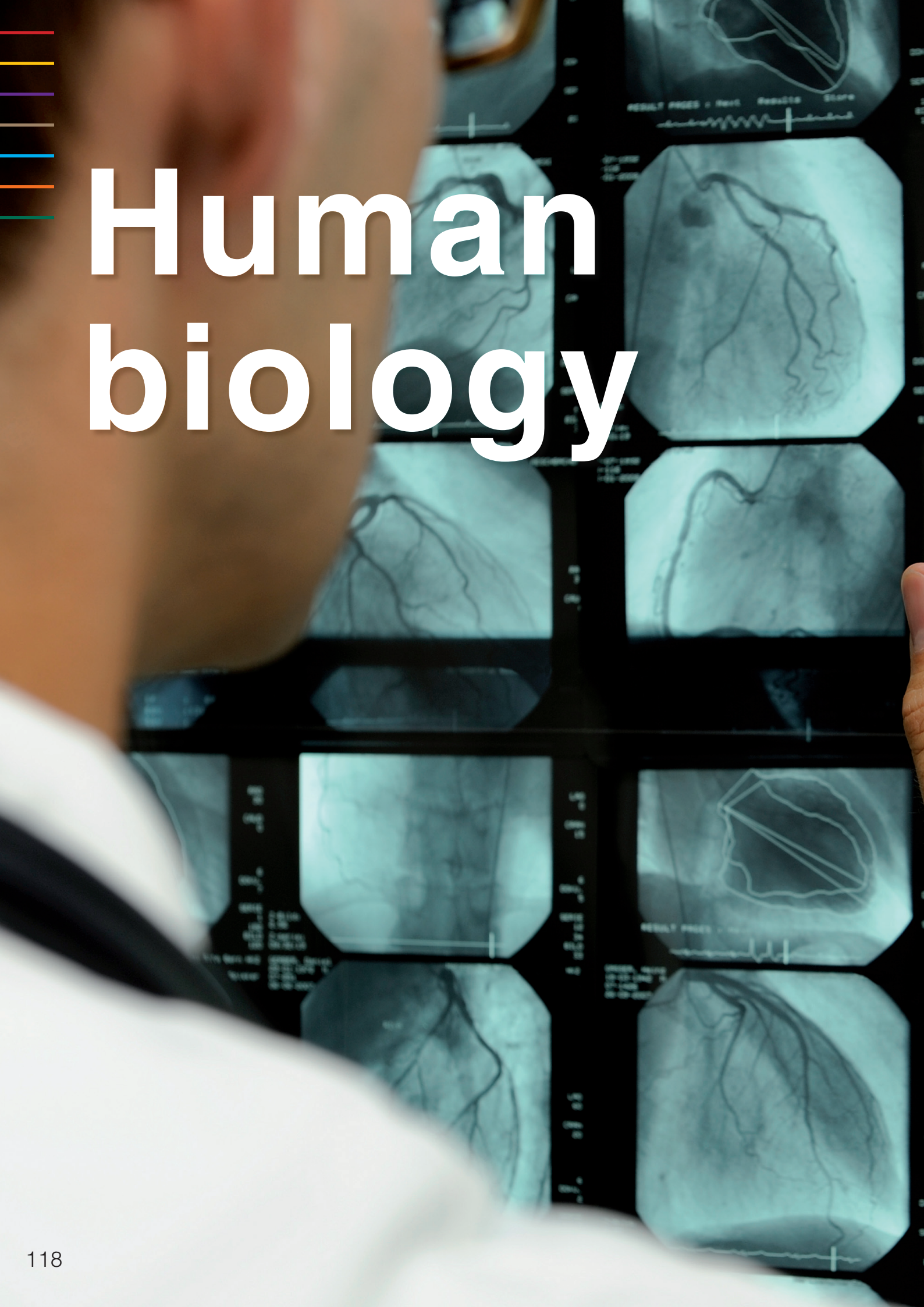
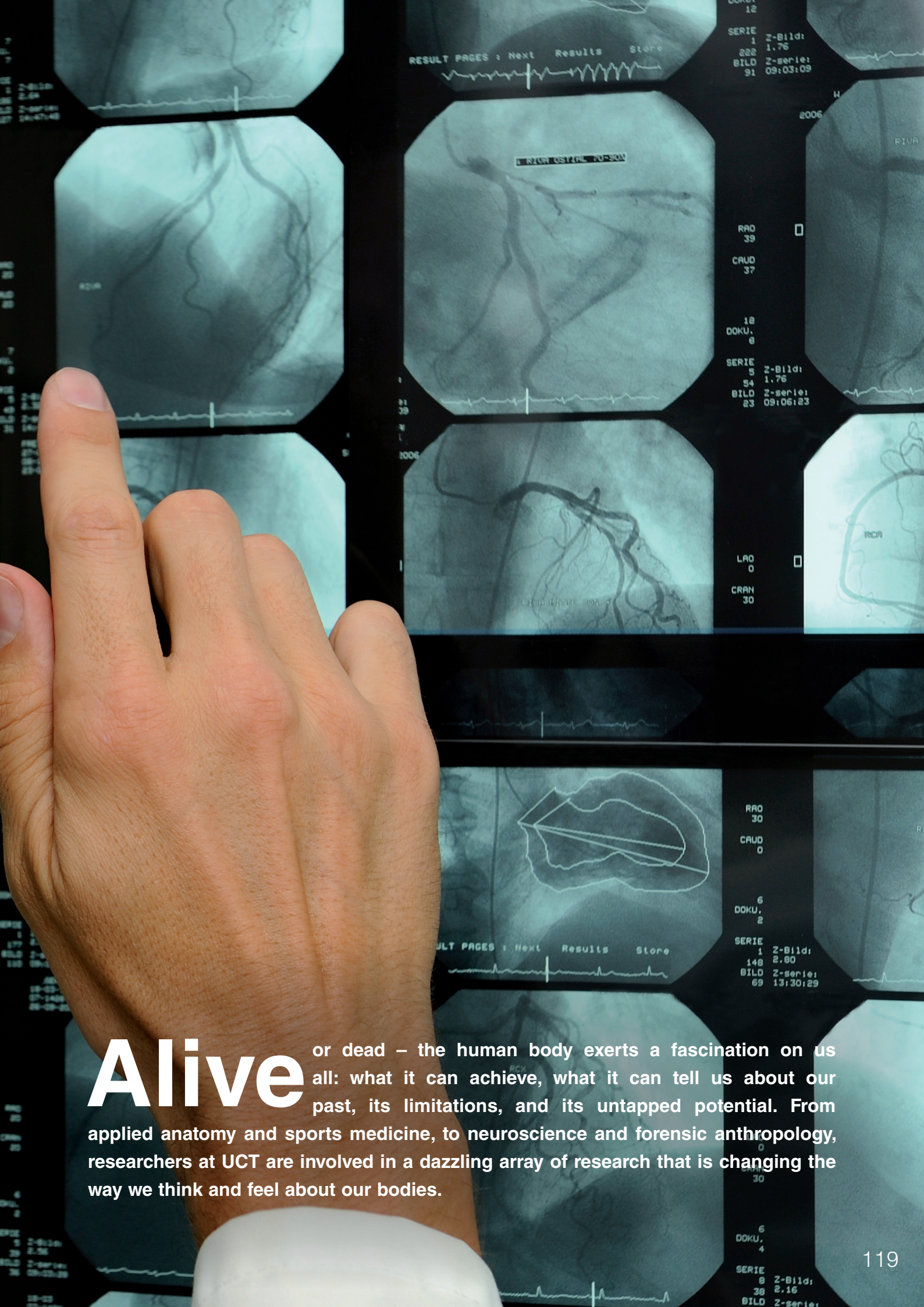
Human biology





Alive

or dead – the human body exerts a fascination on us all: what it can achieve, what it can tell us about our past, its limitations, and its untapped potential. From applied anatomy and sports medicine, to neuroscience and forensic anthropology, researchers at UCT are involved in a dazzling array of research that is changing the way we think and feel about our bodies.

In praise and pursuit of the human body

UCT's Tim Noakes, Discovery Health Professor of Exercise and Sports Science, and director of the Medical Research Council/UCT Research Unit for Exercise Science and Sports Medicine (ESSM), is used to throwing the cat among the pigeons when it comes to research on the human body, and in 2011 he duly did so again with his latest work.

In his much-anticipated memoir, *Challenging Ideas: Memoirs of a Career, and Elsewhere*, he argued that carbohydrates, the bedrock of many a diet, should be minimised. He and others, says Professor Noakes, could be classified as carbohydrate resistant, which could lead to diabetes, as the body must over-secrete the hormone insulin to help rid the body of glucose, the breakdown product of ingested carbohydrates.

His dump-the-carbs credo is not the first time that Professor Noakes has bucked the trend, as his book illustrates. It was he and his team at ESSM who warned race organisers around the world of the dangers of exercise-associated hyponatremia, or water intoxication, in which essential salts in the body are diluted when endurance athletes consume too much liquid during a race. And his work with Lewis Pugh, the so-called human polar bear, has illustrated the phenomenon of anticipatory thermogenesis – the ability of the body to raise its temperature by several degrees in anticipation of being plunged into icy waters.

Professor Noakes' book clearly shows his passion for human biology and research in this field; and in it he argues the case for science and research, and their importance in shaping the world.

"The book tries to explain how and why we do research, and how it impacts on society," he says. "When you start doing research, you must decide what impact you want to make."

Certainly, there is no shortage of projects across UCT that are making an impact in the field of human biology. For example, Associate Professor Malcolm Collins, also from ESSM, published extensively in 2011 on the genetic basis for connective tissue and tendon injuries, and on the genetic elements that could give some the upper hand in the endurance stakes. Associate Professor Collins is employing his findings in athlete profiling, which will make it possible to identify those athletes who might be at greater risk for injury.

Others in ESSM – in collaboration with UCT's Brain and Behaviour Initiative – have enhanced the understanding of how the body and brain work when under pressure. Together, the groups are attempting to map brain function during exercise, so as to understand and describe the involvement of the brain and central nervous system during exercise and performance regulation.

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That builds on the central governor theory now being championed by Professor Noakes, which holds that the brain regulates exercise, putting the brakes on any exertion that may threaten its own and the rest of the body's safety.

Imaging the future

The link between body and brain is gaining ever-greater traction in the world of research, thanks largely to enhanced scientific techniques such as medical imaging.

In 2011, Associate Professor Ernesta Meintjes of the Medical Research Council/UCT Medical Imaging Research Unit (MIRU), and holder of the DST/NRF SARChI Chair in Brain Imaging, made headway with some long-nursed projects. Not the least of these was the award of R6,6 million from the National Research Foundation towards a new magnetic resonance imaging (MRI) scanner for Groote Schuur Hospital; although even that princely sum has made no more than a dent in the sticker price of the scanner.

Three grants from the National Institutes of Health (NIH) in the USA delivered more immediate results, however. One grant, for example, allowed Associate Professor Meintjes and her team to begin their contribution to the Children with HIV Early Antiretroviral Therapy (CHER) Study at the University of Stellenbosch. While CHER sets out to identify the optimal time to put HIV-infected infants on antiretroviral (ARV) therapy, the UCT study – that started with brain scans of 65 five-year-olds – will look at the effect that ARVs

Cyclist Ian McClarty is strapped into the MRI simulator, while Dr Fabien Basset of the Memorial University of Newfoundland (left, in blue) and Eduardo Torres (at back) set up the rest of the equipment, as part of a study to explore brain activity during exercise by the MRC/UCT Research Unit for Exercise Science and Sports Medicine (ESSM).

have on brain development (the study will follow up with the children when they turn seven and again at age nine).

But expecting a restless five-year-old to lie still for a scan that takes anything from 35 minutes to an hour is a big ask. So the exercise also allowed Associate Professor Meintjes and her team of engineers and psychology and anatomy students, who are all interested in paediatric neuroimaging and its analysis, to test the techniques that they have developed to compensate for the child's inevitable movement, through what they call real-time motion-tracking and correction.

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In a second NIH-funded project, Associate Professor Meintjes will continue her work with children suffering from foetal alcohol syndrome. This includes taking scans of babies within two weeks of birth (the patients conveniently nod off, she says); a strategy they are adopting for reasons other than trying to find a docile subject.

"We want to see if we can detect brain damage at that age already," explains Associate Professor Meintjes. "The problem is if you do the scans later, they have perhaps already been subject to poor nutrition, poor stimulation, and poor schooling."

The MIRU team is going even further with a third project funded by the NIH. In this project they are trying to establish whether such babies can benefit from the administration of the nutrient choline – classified by some as part of the vitamin-B family – to pregnant mothers, as has been found in mouse models.

One of Associate Professor Meintjes's colleagues and head of the MIRU, Associate Professor Tania Douglas, shares her interest in technology and in foetal alcohol syndrome. The two are working together in more than one study where they have combined their expertise in the syndrome and brain imaging.

The power of industry partnerships

Associate Professor Douglas has also struck up partnerships with others in the department, with some enterprising results. For example, she joined forces with former colleague Emeritus Professor Kit Vaughan, in the research and development of what is now known as the PantoScanner. Designed and built under the auspices of CapeRay Medical, a UCT spin-

Research grouping associated with this theme

UCT/MRC Research Unit for Exercise Science and Sports Medicine

The UCT/MRC Research Unit for Exercise Science and Sports Medicine is part of the Department of Human Biology, within the Faculty of Health Sciences. The primary functions of the unit are to research factors influencing physical performance and health, and to disseminate knowledge and skills through education. Specifically, the research aim is to develop a novel understanding of integrated human function during exercise and to use this knowledge to promote health and well-being; to treat and prevent specific chronic diseases; to treat and prevent injuries and medical conditions associated with sport and exercise; and to optimise exercise performance.
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off company set up by Professor Vaughan, this machine combines digital X-ray with ultrasound to improve the odds of an accurate and early diagnosis of breast cancer.

The PantoScanner is scheduled to go on the market in 2012, at which time its designers will also put the machine to the test in clinical trials at Groote Schuur Hospital.

Associate Professor Douglas is also working with Lodox Systems, the South African company that broke new ground with its full-body scan, made possible through its digital radiography machine. Her team, which includes three postgraduate biomedical-engineering students and two senior electrical engineering undergraduate students, a radiographer, and research manager, are running a series of projects as part of this collaboration.

This includes a study on reducing the radiation dose for paediatric applications. Children are more susceptible than adults to the harm done by the ionising radiation that is part and parcel of such X-ray technology. In another study, they are hoping to develop a technique for determining bone-mineral density by measuring the amount of X-ray absorption in the hand, an application that could be applied to the diagnosis of osteoporosis, for example. They have even incorporated cutting-edge gaming technology, building a 3D reconstruction of the body surface using the Xbox Kinect camera system, to help doctors better target their scans to areas of concern and so limit patients' exposure to radiation.

So inspired was Associate Professor Douglas by these industry partnerships that she signed up for an Executive MBA at UCT's Graduate School of Business. Her award-winning thesis – she graduated with distinction and received an Old Mutual Gold Medal for outstanding achievement – was on the relevance of the university's biomedical engineering programme to health care in South Africa. Her take-home message was that changes were called for – both in curriculum and mindset.

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"We need to orient ourselves not only towards doing good research," she says, "but also towards building our medical device industry in such a way that these activities mutually reinforce each other – not only through the industry being able to develop the products of our research, but also through its employment of our graduates."

Justice for all

If his colleagues – such as Associate Professor Douglas – are interested in finding ways to improve health or save lives, Professor Alan Morris is concerned with justice for those who could not be saved.

For many years now, Professor Morris, who leads the Department of Human Biology's applied anatomy and biological anthropology section, is regularly called upon by the Western Province's forensic pathology laboratories as a 'specialist's specialist' – dealing specifically with the analysis of bone remains.

Originally conducted as a collegial arrangement, when the case numbers started increasing, the state recognised Professor Morris' laboratory as a specialist facility. More than merely penning an addendum to the forensic pathologist's report, Professor Morris and colleague Dr Jacqui Friedling can now sign off their own reports.

One hiccup, however, was that the group's facilities did not quite measure up to the medico-legal requirements. Most notably, they lacked the space to store specimens and keep separate administrative records.

In 2011, Professor Morris was finally able to shore up capacity in his section; funding from the university

Associate Professor Ernesta Meintjes, who holds the DST/NRF SARChI Chair in Brain Imaging at UCT.

allowing the group to convert an old physiology teaching laboratory into an upgraded forensic anthropology laboratory.

"As soon as you deal with forensics, you need to have appropriate and adequate storage space as well as proper systems," he says.

As he explained in his 2011 book, *Missing and Murdered: A Personal Adventure in Forensic Anthropology,* Professor Morris trained as a skeletal biologist, but has always had a fascination for really cold 'cold cases' – he has published on the origins of anatomically modern humans and the Later Stone Age and Iron Age populations of Southern Africa. The book allowed Professor Morris to reach a wide audience with this recounting of his work. He covered a series of modern cases in the title, including muti murders and political killings.

The appeal of writing a book in popular science is that, while still needing to be meticulous in the checking and re-checking of facts, he does not have to get stuck on it. "You can get on with the story," he says.

In time, Professor Morris will probably have a few more stories to recount. As will his colleagues in the Department of Human Biology, as they press on in their research of the human body and its shortcomings, and explore new technologies and ways to identify and circumvent those failings.

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And as the head of the Department of Human Biology, Professor Lauriston Kellaway, explains, the diversity in disciplines brings with it new opportunities. Already divisions, units, and centres are partnering up, bringing their range of skills to one table.

"The drive is not so much to 'weave' the groups together," says Professor Kellaway, "but to recognise and acknowledge the spread of expertise of the various groups within the Department of Human Biology and to encourage collaborations both intra- and extra-departmentally, involving many disciplines."