12 Professor Rhodri Cusack
Thomas Mitchell Professor of Cognitive Neuroscience

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"If you wait till the child is two and a half years old, when the first problems with language might manifest, you will have missed opportunities for early intervention. If we understand what normal development should look like from birth, we'll be able to detect much earlier when things are going wrong, and intervene earlier."

Professor Rhodri Cusack, newly appointed Thomas Mitchell Professor of Cognitive Neuroscience in the School of Psychology, is talking about his research in the frontier field of infant neuroscience.

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Babies can't of course talk to tell you what's wrong, and until six months they can't even sit up. Thanks to pioneering studies of infant behaviour we know something about how they should be developing but a real breakthrough is now being made with neuroimaging. This is the bedrock of Professor Cusack's research: "With MRI [magnetic resonance imaging] we can study brain networks of babies from birth. We scan them asleep and awake. If they're awake we keep them interested with toys, sounds, images and we study what's happening in their brains when they respond to things."

This has all kinds of exciting potential for application—from neonatal care for preterm babies to government childcare programmes. "In the US, for instance, they have a programme, Early Headstart, which provides day care for the first two years of life. It's received massive investment since it was launched in the 1960s, but the results in terms of child development aren't always as good as was hoped. What should we be doing to get this right? How do we stimulate infants so that they're learning to their optimum? We want to replace assumptions about what infants need with scientific evidence."

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As an example, he points to language: "It's established that the more you talk to your baby, the better their vocabulary in pre-school; this in turn predicts how well they will learn and perform in exams, and that predicts their job success, so it's incredibly important to be talking to your newborn."

He is new to Trinity, having arrived in May 2017 from the University of Western Ontario in Canada. His teaching commitments won't start until September 2018, giving him time to settle into the Trinity College Institute of Neuroscience (TCIN), which he describes as "a lovely place to work" and to apply for grants, and establish contacts with the Children's Research Centre and with St James's hospital: "My research is very interdisciplinary—I work with neonatologists, psychologists, computer scientists, and bioengineers, while in terms of understanding how the MRI scanner works, there's a physics element."

His own background is suitably multidisciplinary: "After school in the Brecon Beacons in Wales, where I grew up, I read physics and natural sciences in Cambridge, but when it came to doing a PhD I moved into psychology because it's a relatively new discipline—it's an exciting dynamic field where you can make ground-breaking discoveries that change our understanding of the world and of ourselves."

His PhD on the psychology of hearing was in the University of Birmingham and he then returned to Cambridge for fourteen years. "I was doing research into people with brain injuries. This was the period when imaging was really taking off, a tremendously exciting time. Its potential for revealing the algorithms of the brain was just becoming apparent, and this new discipline required both psychology and physics."

From Cambridge, he moved to the University of Western Ontario, and that's where he developed his interest in infant cognition. "It was through serendipity, and meeting the right enthusiastic person, like so many good things in life. I was using imaging with adults. But, about seven years ago, there was a grant call for neuroscience with clinical applications. I had met a neonatologist during my interview process,

and I called him to ask about the potential of scanning for infants. It's a frontier area; I was incredibly excited about the potential to address the question that has probably occurred to almost everyone that has looked in a baby's eyes—what is going on in that tiny mind? And, every advance in knowledge had so many clinical applications. He was enthusiastic and we put together a proposal, which was funded.

"Right now, in terms of technology things are developing so rapidly. We can acquire images of brain function five times faster than we did a few years ago, and we can measure all sorts of things with increasingly fine detail." One of the most exciting potential fields of application is in Artificial Intelligence (AI). "I can remember twenty years ago, people being incredibly excited about AI. But at that time computers couldn't do very much. Now they are starting to do things like humans—for instance they can drive cars and recognise things. So there's renewed belief in how the two field—machine and human intelligence—can learn from each other. And the latest thinking is that machines can learn in the way that babies do. Demis Hassabis, the head of Google DeepMind, has said that he believes that studying cognitive neuroscience is the way forward for bio-inspired artificial intelligence."

Ultimately then, he could be collaborating with industry leaders in AI, as well as with the health sciences and policy-makers in childcare. For the moment, he is establishing his lab and settling into Dublin. "My wife, Dr Lorina Naci, also works in neuroscience, but in ageing and dementia—yes, between us we span the full life-cycle!—she's also found work in Trinity, with the Global Brain Health Institute, which is great. We're loving Dublin as a city, living by the sea, cycling into work. And I've found a squash club, and am working my way up the league."

He's delighted it's such a family-friendly city: "We had a baby three years ago. Yes, my research did shape the way that I interacted with him. It changed the way I was as a parent. I made sure to talk a lot! And it's amazing how much they pick up."

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