

From left to right:

Dr. Wesley Zheng Guangyuan
Scientist, Institute of Materials
Research and Engineering (IMRE)

Dr. Quek Boon Kiat
Capability Group Manager,
Scientist, Institute of High
Performance Computing (IHPC)

Dr. Cheston Tan Yin Chet
Scientist, Institute for Infocomm
Research (I²R)



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Dr. Quek Boon Kiat and
Dr. Cheston Tan Yin Chet

Worldly Inspirations

The world is your oyster, so the saying goes. A*STAR provides many scholarship opportunities, allowing our scientists a chance to spread their wings. Find out what Dr. Wesley Zheng, Dr. Quek Boon Kiat, and Dr. Cheston Tan have learnt from the industry's greatest minds.

Curiosity and Optimism

To study the speed of neurotransmission in the body, Dr. Wesley Zheng once immersed his hand in ice-cold water. He waited till it went numb before placing some electrodes on his palm, and then used a hammer to tap his funny bone along the elbow.

Wesley's anything-goes character has served him well when he was at Stanford University, California, USA. The A*STAR National Science Scholarship (PhD) gave him the chance to brush shoulders with the world's most talented minds. He describes his Stanford days as the "best time of his life". The sense of optimism

“When you're young and do not yet have family commitments, that is the time to really go out and pursue your ideas.”

- Dr. Wesley Zheng



and intellectual curiosity that permeate Stanford — where any start-up can be the next Facebook or Google — have also rubbed off on him.

In Silicon Valley, those who have a string of failed businesses are given the title of “serial entrepreneurs”. This air of positivity is very refreshing for Wesley. Many of his friends have gone on to start their own companies, some while pursuing their PhD. “There is this innate desire to create something that benefits society,” Wesley says. “And it’s the same thing we want to do here at A*STAR.”

Making an Impact

Wesley aims to change the world with his research on lithium-sulphur (Li-S) batteries. Their predecessors are lithium-ion (Li-ion) batteries, found in products such as mobile phones. “Li-ion batteries have been around for 20 years, and hence have reached the theoretical limits of their potential,” says Wesley. “I wanted to

discover how to improve electrode materials and enhance a battery’s cycle life as well as performance.”

High-energy density and long cycle life are the hallmarks of the new Li-S batteries. Recent experiments have demonstrated that Li-S batteries can boast up to 1,500 charge and discharge cycles. Very soon, the impact of Wesley’s research may well be felt in all parts of the world. “The commercialisation of these batteries is very near. Businesses are already looking at ways to use them in electric cars and solar panels,” adds Wesley.



DID YOU KNOW

Li-S Batteries Power Up the World



**Provide 5X more
theoretical energy
density than Li-ion
batteries**



**Are a low-cost option
as compared with
Li-ion batteries**



**Li-S batteries were
used on the Zephyr,
earning a world
record of over 336
hours of continuous
unmanned flight.**

Source: Sion Power’s Lithium-Sulfur Batteries Power World Record Flight. *Business Wire*.

Inspired by Humans

The first 40 minutes of the Wall-E movie have very little dialogue. “Yet somehow, we are able to relate to the self-awareness of the robots,” says Dr. Quek Boon Kiat, a Capability Group Manager and Scientist at Institute of High Performance Computing (IHPC). “That’s because the behaviours of these robots actually mirror human emotions.” The movie struck a chord with Boon Kiat, who is a robotics aficionado. In fact, his work turns fantasy into reality. “For my PhD, I was involved in building autonomous robots that could monitor their own progress.” In short, he builds robots that can survive on their own in harsh environments such as deserts.

Creating Human-like Robots

“I knew that in order to make some form of breakthrough, I needed to draw inspiration from how human beings behave and think.” This thinking motivated Boon Kiat to switch from the field of robotics to cognitive science and psychology. Making this transition was easy, he says. “How we model a robot’s emotions and actions draws



on the same mathematical foundation we use to model relationships between psychological constructs.”

Thanks to A*STAR’s two-year post-doctoral scholarship programme, Boon Kiat was able to learn from leading computational psychologists like William Revelle and Andrew Ortony at Northwestern University, Chicago, USA. There, he developed an agent-based model that could mimic human performance on a psychological experiment known as the Implicit Association Test. “The model was able to simulate the pressing of left or right buttons and categorise different items. It also

“As science becomes increasingly multidisciplinary, those with a variety of backgrounds and knowledge are the ones who can think of unusual ideas to solve problems.”

- Dr. Quek Boon Kiat

made the same errors that humans would make when the nature of the task became more complicated.”

Buoyed by his experience, Boon Kiat is now developing more complex algorithms that can make human-like inferences about people's characteristics. They can be used in areas such as human resource management, consumer behaviour understanding and social media analysis.



SCIENCE THAT KNOWS YOU BETTER THAN YOURSELF

Many of us enjoy doing the occasional personality quiz. What if there is a way to use the psychometric data, amongst others, to benefit society? Boon Kiat and his team hope to develop computational models that can eventually understand human behaviours, preferences and choices.

The team developed a proof-of-concept system that could help volunteers understand themselves better and recommend volunteering activities that suited their personalities. This system is being piloted with the help of a few volunteer welfare organisations.

“Having a problem that you want to solve will focus your research efforts. Read newspapers, magazines as well as scientific journals and identify important global issues.”

- Dr. Cheston Tan

Understanding the Human Mind

“What makes human beings so smart?” This question has intrigued Dr. Cheston Tan, and it inspired him to think about how to recreate human intelligence. “We’re not the strongest species nor are we the fastest. Yet our intelligence has enabled us to not only survive, but also shape our world.”

At the Institute for Infocomm Research (I²R), Cheston uses artificial intelligence (AI) techniques to create concise and meaningful summaries of daily experiences. Replaying these summaries to dementia patients can potentially help them to enhance their memories.

For his research, Cheston draws on the knowledge he acquired at Massachusetts Institute of Technology, Cambridge, USA. He worked in the Department of Brain and Cognitive Sciences, where he had a chance to collaborate with neuroscientists, psychologists and computer scientists. “Working with such a diverse team has made me a flexible thinker. I now approach problems with an open mindset.”



Mentors and Opportunities

His biggest lesson came from Prof. Tomaso Poggio, whom he met while pursuing his A*STAR National Science Scholarship (PhD). “Tomaso is one of my scientific heroes, and from him I learnt the importance of identifying problems that science can solve, from world hunger to energy and transport challenges.” Now, Cheston offers similar advice to aspiring researchers: do not just aim for incremental science. “The PhD journey is a very special time in that your mentors are on deck to help you. Take this time to work on risky projects that tackle huge obstacles.”

Cheston believes in making full use of his time, not just at work but during recreation as well. While in the USA, he took the opportunity to travel regularly. Beach vacations, skiing, snowboarding and even marathon training formed part of his eclectic interests. He urges those who have the opportunity to pursue overseas studies to do the same. “Explore new areas and meet new people. Start building your own network of connections.”

Everyday Applications of AI



Choose the best vacation photographs from a collection and produce an album.



Curate Facebook and Instagram posts and create a meaningful collage of photographs, which can then be given as a memento.



Select specific clips from a movie to cut a movie trailer.

Cheston works with artificial intelligence systems that can understand and summarise details of pictures. These systems are able to handle huge volumes of data, which help us automate processes, enhance productivity and save time.