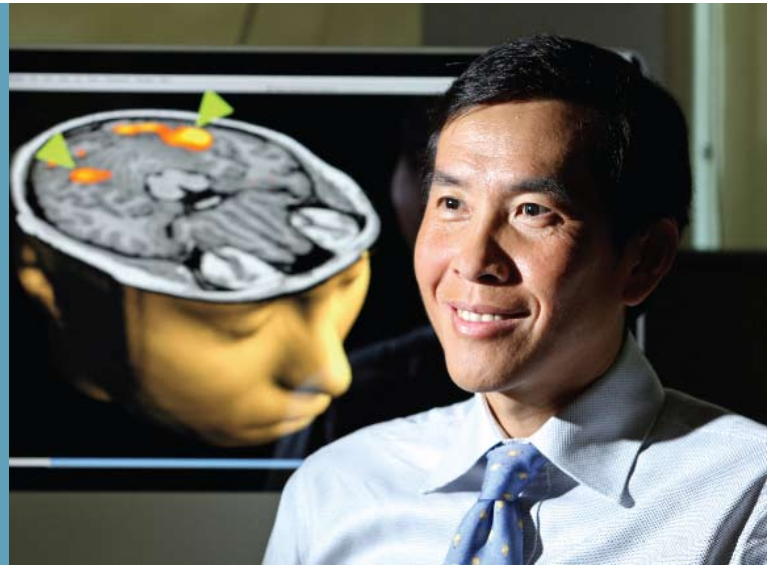


INTERVIEW

Professor Michael Chee is the recipient of this year's *National Outstanding Clinician-Scientist Award*, which recognises individuals who have made outstanding contributions to clinical and translational research in their specialty, resulting in better understanding of diseases with potential positive outcome on healthcare delivery. He was also one of the recipients of the inaugural *Singapore Translational Research Investigator (STaR) Award* in 2008, jointly offered by the National Medical Research Council and the Agency for Science, Technology and Research (A*STAR).

Prof Chee is Principal Investigator of the Cognitive Neuroscience Lab, and a member of the Neuroscience and Behavioral Disorders Programme at the Duke-NUS Graduate Medical School (GMS) Singapore. His research interest is in sleep deprivation.



Interview with **PROFESSOR MICHAEL CHEE**

By Dr Toh Han Chong, Editor

THC: Firstly, congratulations on receiving the *Outstanding Clinician-Scientist Award*. What were your feelings at the award ceremony?

MC: I felt that I had traversed a watershed. Although receiving the *STaR* award was professionally more significant, this award had a stronger emotional pull because it constituted recognition from the community that shaped the early part of my career.

While I have enjoyed considerable success in the scientific arena, it took me many years to feel confident about this within a society that has a strong tendency to peg a person's worth to his earning power. As a result, I pretty much cloaked my real persona until I had accomplished enough to make a clear statement. I devoted much of the acceptance speech to acknowledging that clinician-scientists were perhaps

finally becoming valued as opposed to merely being accommodated.

THC: During your speech, you also showed a photograph of the ACS (Anglo-Chinese School) Science and Industry Quiz team. What is the meaning and significance of that?

MC: Science has always been big part of what I am about. When I first stepped into my Primary 1 class, we were given a science book with a rocket on the cover and I thought, "Wow, we are going to learn how to build a rocket!" I was horribly disappointed that inside the book were very mundane things like how if you heat air, it will rise. Yet without a fundamental understanding of some of the phenomena we encounter daily, many of the inventions we take for granted would never have come to be.

Going back to the photo: I have very fond memories of the interschool Science and Industry Quiz and the camaraderie we enjoyed in ACS. Those memories are priceless. I showed the slide to make the point that it was one thing to win a science prize at 16, but to plug on and become a professional scientist later was a much longer journey. What I've become today was not a vocation open to Singaporeans then. It's good to know how far we have come.

THC: What happened to the other three members in your team?

MC: Cheung Tuck Wei is a very successful GP. While he's done extremely well financially, his enormous passion for medicine remains undiminished and he loves putting in long hours in his

Bukit Batok clinic. Albert Miao is Director of the Centre for Science and Mathematics at the Republic Polytechnic. Albert was into college level calculus in Secondary 1 and knew about gamma and beta functions before most graduate students. But when he went to Cambridge, he was exposed to the incredible depth of talent that existed amongst the mathematical elite. That prompted him to rethink his career goals and he chose to make a push in another direction – he ended up working in human resource management and also pursued theological studies before returning to the academic world. Jek Kian Jin defined the word polymath for me when we were in school. He is currently in California and does his own investing using a financial analytical tool he designed.

THC: Why neurology, and secondly, why cognitive neuroscience?

MC: The choice of neurology was strongly influenced by Loong Si Chin's bedside tutorials at Tan Tock Seng. You don't forget those even after 30 years. He structured the diagnostic process with elegance, finesse and impeccable logic. He was like a magician who made difficult things appear easy and this held tremendous appeal. I did consider radiology and pathology – technical disciplines that suited my personality but somehow, I picked neurology.

The road to cognitive neuroscience was a lot longer. Shortly after completing the MRCP, the “neurology stamp-collector” mindset that I harboured earlier changed and I felt a strong need to engage in a field that went beyond classifying clinical phenomena and one that provided avenues for disease changing therapy. This led me to pursue sub-specialisation in epilepsy and clinical neurophysiology.

In the early '90s, there was a strong surge of interest in surgery as a treatment for epilepsy. Digital EEG systems, video monitoring and magnetic resonance imaging greatly aided candidate selection. Being part of a team that could transform persons with intractable temporal lobe epilepsy from literal wrecks to seizure-free individuals was tremendously satisfying. My two years at Cleveland Clinic also enabled me to enter the world of brain imaging and neuroscience.

What I've become today was not a vocation open to Singaporeans then. It's good to know how far we have come.

Upon my return to Singapore, I experienced modest success in translating what I learned into clinical benefit but it soon became apparent that I was marching to the beat of a different drum and the road less travelled is not usually a smooth one. I started getting restive about pursuing my original passion for a career as an investigator but much as I loved reading and learning, I realised that without wet lab skills, I had limited capacity to study the disease models that I was reading about. This caused me to poke around functional magnetic resonance imaging or fMRI as it is better known as. I was sufficiently enthralled by it that in 1995, I decided it was time to look at a career change. I attended a three-day fMRI course

in Boston and decided to return the following year, for a predominantly self-funded fellowship. Robert Savoy, the course director stuck his neck out for me and got me a slot in the MGH-NMR (Massachusetts General Hospital Nuclear Magnetic Resonance) Centre against the better judgment of the centre's director.

I was fortunate to pick up the ropes at the time the field was evolving. Functional brain imaging allowed me to harness the motley skills I had in computing, signal processing, and neurology. I mustered the little experience in language research garnered while I was an epilepsy fellow in Cleveland to pursue a study that compared auditory and visual word processing. This worked out well and I was much encouraged. I had a chance to interact with Randy Buckner who was to become a Howard Hughes Investigator and a leading scientist in memory research.

When I returned to Singapore, I started working on bilingualism because language was pretty much all I knew about cognitive neuroscience then. I also realised we had a tremendous opportunity to study the bilingual brain here in Singapore. Thankfully, this endeavour proved to be very successful. The first paper I published pointed out that the brain regions involved in the processing of English and Chinese were largely shared. This was against the prevailing thought and when others replicated our findings, we became very well known.

The team I started off with was tiny and comprised of undergraduates and fresh graduates. But they were bright and committed and together we made our mark. Quite a few of that first batch are now completing their PhDs – Soon Chun Siong, Joshua Goh and Lee Hwee Ling and a couple more in the subsequent generations – Vinod

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Venkatraman and Julian Lim are making their mark in top US programmes. Back then though, pretty much no one would have given us odds on succeeding. But we did. I had found my calling, and it was in cognitive neuroscience.

THC: When you wake up in the mornings, what excites you the most about your work?

MC: Being able to get a handle on what might underlie cognitive failures in the setting of sleep deprivation as well as ageing.

Although the work on the bilingual brain was very successful, I decided to change track because I wanted to be involved in an area that had stronger translational value.

My interest in sleep deprivation research arose as a result of lamenting about the effects of overwork and jet-lag. When an eager beaver Choo Wei Chieh (now in private practice) asked me about a project he could work on, I persuaded him to examine working memory in the context of sleep deprivation. We published our first paper in 2004 and it was well received. I've since grown this area of research and we are now one of the most respected labs in the world working on this topic.

As a society, we can accept that people have different strengths and weaknesses. However, there is a tendency to consider someone who cannot pull an all-nighter a lazy or incapable person.

Vulnerability to the cognitive effects of sleep deprivation shows considerable inter-individual variation. My lab seeks to examine the basis for these differences by identifying where the weak spots are. We started investigating something called working memory but came to realise that a critical failing lies in the volunteer's ability to maintain 'vigilant attention' or 'sustained attention'. Our ability to respond to

Arthur Schopenhauer, the great German philosopher once said, "All truth passes through three stages. First, it is ridiculed. Second, it is violently opposed. Third, it is accepted as being self-evident." Pioneers have to be able to dig in and to continue in the face of doubt and discouragement.

infrequent but highly salient signals, such as an animal crossing a dimly lit highway at night, can be severely impaired when we are sleep-deprived and we want to know why.

THC: Does it make sense to overstretch physicians or people who have occupations which require all-nighters, like commercial pilots? Or shall we religiously protect their number of work-hours and their amount of sleep?

MC: Charles Czeisler at Harvard and David Dinges from University of Pennsylvania, amongst others, have led studies that can guide the planning of work schedules in healthcare, transport worker and military settings. The US ACGME (Accreditation Council for Graduate Medical Education) has guidelines regarding work-hours for doctors in training and the IOM (Institute of Medicine) has released data on the numbers of fatigue-related medical mishaps.

The challenge is how to enforce these guidelines. The situation is similar to that in preventive medicine – unglamorous but effective if applied.

I think as we move more deeply into a service-oriented, knowledge-based economy, it will become increasingly important to be able to squeeze out optimal performance from as many

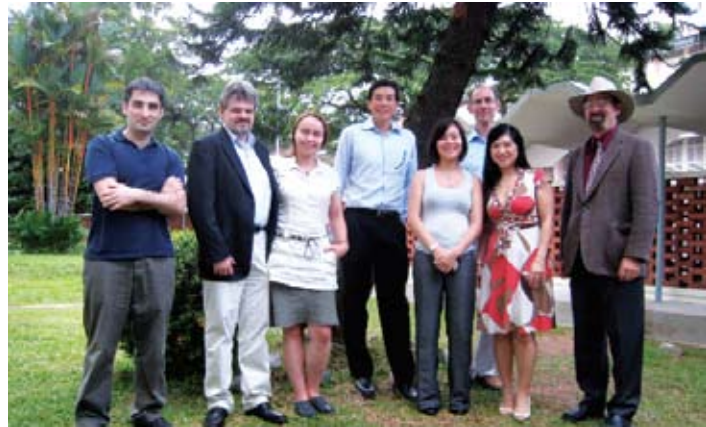
people as possible. This is where I see the work we do attain societal relevance.

THC: What does it feel like to be part of the Duke-NUS GMS academic milieu and to have this great room with a view?

MC: When I was part of the planning committee, there were moments when we thought this would never come to pass. But I must say that even as a dreamer and an academic at heart, being part of this school has exceeded expectations. The leadership and faculty that have come on board are technically excellent, enthusiastic and willing to assimilate into Singaporean culture. I like the way the place is handled with a light touch and provides one with the resources to enable one to focus on the academic mission. Having worked in isolation for years, I quite enjoy the academic fraternity the new school provides. The students are inquisitive as well as thoughtful and cause me to be optimistic about academic medicine in Singapore.

THC: And about Singapore's biomedical strategy, what are your thoughts moving forward? How do we get into a zone where we can say we are successful in biomedical research?

MC: Singapore has so far been fortunate in terms of research



Clockwise from top

The 1975 ACS S&I Quiz team at the studio on Caldecott Hill: (L-R) Goh Yeow Tee, Cheung Tuck Wei, Jek Kian Jin, Albert Miao, Michael Chee and Mervin Beng.

Cognitive Neuroscience Lab members and visitors: (L-R) Vitali Zagorodnov (NTU), Rainer and Claudia Goebel (U Maastricht), Michael Chee, Cindy Goh (CNL), Pierre Maquet (U Liege, Belgium), Lisa Chuah (CNL) and Robert Savoy (Rowland Institute).

Out hiking on a clear day in Olympic National Park, USA.



financing. Our main challenge is people. You can have a nice building, good governance and so on but in the end, it's people who get the job done. Having rooted some talented top-tier folks, the next step is to raise the level of the research middle-ware – grad students, post-docs and research support staff. Our leaders must believe that if you bring on a good team and they have the right motivation and drive, they will do things that will exceed your expectations.

THC: A lot of your friends are in private practice now. Some are residing in nice luxurious homes, living the high life and driving some very nice cars. Any regrets that you didn't go there?

MC: Well, I wouldn't say my life's uncomfortable! But I never had aspirations for the bigger trappings

that higher levels of wealth could procure.

THC: At the award ceremony, the Minister of Health affectionately made mention of the fact that throughout your journey in medicine and science, and his interactions with you, there have been occasions where you've always held your views and been very dogged and opinionated.

MC: Minister Khaw recognised that I could be an asset but at the time he chose to support me, he had no idea I was going to succeed. The odds were against it. Most people in my situation would have crashed and burned, but fortunately, I didn't. I was very blessed to have a supportive wife to help me weather the eventful transition from clinician to clinician-scientist. Arthur Schopenhauer, the great German

philosopher once said, "All truth passes through three stages. First, it is ridiculed. Second, it is violently opposed. Third, it is accepted as being self-evident." Pioneers have to be able to dig in and to continue in the face of doubt and discouragement. I like to think that I've developed better persuasive skills over the years but you know, you can't always get people to agree with you all the time.

And yes, Minister also pointed out my penchant for Apple Macintosh computers. Apple is much more mainstream today but back then, Macs were used by a minority – the people who "think different" ... "because the people who are crazy enough to think they can change the world, are the ones who do". I can't say it better than the original ad so go to <http://www.youtube.com/watch?v=4oAB83Z1yDE>

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THC: You think Singapore society and the Singapore establishment are a little bit more tolerant of embracing outliers today?

MC: The short answer is yes – the crazy people who can change the world.

THC: We are moving more from a state-driven manufacturing economy to focus on an innovation-driven economy. Are you optimistic about innovation in this country, building new enterprises, ideas and globally competitive products?

MC: I like to be optimistic. We certainly have big challenges to face up to. Every time you step out of Singapore into the bigger realm, whether it's Korea, Japan, the United States or Europe, you recognise just how incredibly talented and driven people can be. But I think that a lot of the right things have been done here. We have a pretty forward-looking leadership that recognises the need to encourage innovation in order to ensure our survival. Now, whether or not we successfully execute, that's something that no one can say for sure.

THC: Who have been tremendous influences in your life and work?

MC: There are many people I admire and it doesn't help to give a laundry list. I'm an enthusiastic student of history and spend hours delving into biographies and examining what motivated people to live the way they did. I also make it a point to examine their failings.

One anecdote I'll share though, is Michael Jordan talking about being a very complete player sometime in the early 1990's. People always remember him sticking those hoops at critical moments. But he was also an excellent defender and he talked about how he really worked on that. Ditto Roger Federer, the great Swiss tennis

player. A lot of the magic in being a champion is being able to handle all sorts of situations, and to be able to defend as well as to attack. When most people talk about heroes, they focus on their attacking plays and give less attention to a champion's defensive capabilities. You have to have both of course. Resilience and cognitive flexibility under fire are qualities that any successful person must have.

THC: So what do you do to relax outside science?

MC: I play a fair bit of tennis. It hones the mind and keeps you physically in shape. When I was younger, I've always wondered why chess players work out pretty hard. I know now that it's because you can't think and attack scientific questions if you're not in good shape. So I enjoy physical pursuits and I also jog and sometimes swim. I love hiking when I travel. I contribute a little to supporting Christian outreach efforts. In terms of reading, I've read about some of the people you have interviewed. As I said earlier, I love trolling biographies. Mathematicians are a group that I'm quite fond of.

THC: Which mathematicians would stand out?

MC: Euler, Gauss and Newton were the biggies. But there was also a young, less familiar Frenchman from the 19th century named Évariste Galois. He died at the tender age of 20 in a gun duel during the French Revolution. But in his short life, he contributed something called the theory of finite fields. That proved relevant to how error-correcting codes in digital music were devised.

I am also fascinated by the founding fathers of statistics: Thomas Galton, Karl Pearson and Charles Spearman. These men were deeply interested in the premise underlying heritability of 'desirable' traits and the first two are

associated with the field of eugenics. At some level this fits into my passion for improving performance and outcomes in my cognitive neuroscience work.

THC: One question which we always like to ask people in science and research is this whole culture of patents. What are your thoughts?

MC: Being publicly funded, I am always conscious of the need to get some returns for the public. This return is certainly economic, but there are indirect benefits that are important that often are not considered. If you bring laurels to the country, they serve to attract talented people to work here and can generate a positive buzz. Talent enamours people and we need to get Singaporeans to believe this if we want to be the 'Boston of the East'. I remember reading once that Michael Jordan at his peak was like a \$10 billion economic engine. And all he did was to shoot hoops.

With regard to patents, I certainly feel there is a need to defend intellectual property but the depth you go about doing this has to vary from case to case. There is the case of a well-known image processing software called 'Statistical Parametric Mapping' (SPM) developed by University College London. It involved enormous effort over many years but it's put up free on the web. The benefit from its existence accrues from running courses and attracting the best people all over the world in this field to London. Some of them stay and contribute ideas that eventually spin money. A contrasting model is a package named 'Brain Voyager'. Rainer Goebel, a German researcher was developing the same type of analysis software and he was asked by his boss to commercialise his tools. He did and it's a very successful operation. You may ask how free and paid software can co-exist but they do.



CNL Lab: Lab members of the Cognitive Neuroscience Laboratory at Duke-NUS Graduate Medical School enjoying a celebration.

So we should not be trapped in a system where decision makers merely look at the books and tell highly-skilled and dedicated persons that they are not earning their keep. Remember the Galois story? Well, I can tell you many more but we don't have space. Scientific ideas take time to mature and to generate revenue and the pay-line is unpredictable. That's the way life is.

THC: What are your thoughts on the strategy of bringing reputable foreign talents into Singapore to jump-start our biomedical industry? There have been debates on both sides, with one side saying it's costly and may not be value for money, and the other side saying that you need the 'whales' to bring in the halo effect.

MC: A number of these luminaries have made a positive difference. We have to accept that if you bring in 10 people, there will be some misfires. At the end of the day, if by bringing in the 'whales', you achieve a net gain, that's positive. You can bicker about the small details but considering an economy worth billions, I feel the investment is worth it.

Our partnership with Johns Hopkins did not work out. It's a great institution and they have vast talent but it didn't work out. Our engagement

with Duke, in contrast, has worked out very well so far.

Locals should also be more proactive in engaging the 'whales'. These are highly accomplished people who have a wealth of life experience. Expecting expats to transform Singapore by themselves is not realistic. We need to cooperate. It's a two-way street. As you rightly point out, 'whales' can bring in the halo but sustained results have to come from folks, be they indigenous or newly rooted, who are willing and able to deliver.

THC: Tell us something very few people know about Michael Chee.

MC: I'll chase a good idea, a cause or a principle I believe in with total commitment and with ferocity that can be scary but outside this, I'm shy and hate the limelight. I'm fond of nature and animals and feel strongly for green issues.

THC: What kind of ecosystem do we need to bring back some of the best and the brightest Singaporeans from overseas?

MC: We could be here all day but two things come to mind:

First, I would encourage the leadership to chill out and believe that they are on the right track in setting the conditions for creative individuals

to contribute to the country. Yerkes and Dodson suggested back in 1906 that performance increases with arousal but up to a point and then things go south. I think this is particularly relevant for creative endeavours. In the effort to get good results, we sometimes try too hard to over-engineer things and to fill up all the 'right' check-boxes. This can be a big turn-off. Driven people don't need someone to tell them to work harder and that the economy needs them to perform.

Secondly, I think it's important to recognise that while the best scientists blur the boundary between work and hobby, the running of larger labs requires support infrastructure that could be improved on. In an effort to keep costs low, we have our investigators business manage, rattle back and forth between regulatory authorities and so on. In the end, this can result in disenchantment and attrition of the highly skilled persons who cost a lot to train. These folks frequently trade higher pay for the opportunity to chase questions and it makes sense to enable them to do what nature and nurture have best equipped them to do. By all means, expect performance, but make it worth the while.

THC: It's been a great interview.

Thanks, Mike. SMA