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Editorial & Opinion

## Spotlight on neuroeconomics

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1,622 words

1 March 2013

Business Times Singapore

STBT

English

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More academics are getting excited about this new field that focuses on neural processes in real-world decision-making

AMERICA is embarking on a decade-long effort to map activity in the human brain: an undertaking every bit as ambitious in scope and significance as the genome project that produced the complete genetic blueprint for human life in 2003.

A comprehensive map of neural activity will shed light on how exactly the brain works, and news of the project has put the spotlight on the hot field of neuroscience. Indeed, with the brain being the ultimate black box, there has been in recent years a plethora of new interdisciplinary fields with a neuro-prefix as the business world seeks to understand human nature and behaviour change: neuroeconomics, neuromarketing, neurofinance, neuromanagement, neuroethics, even neuroaccounting, neuroleadership and neurolinguistics.

Neuroeconomics, in particular, has gained ground in the past 10 years, with some 50 research groups now around the world, primarily in several top universities in the United States and in Europe, exploring the brain processes that underlie decision-making.

Economics, after all, is about how people make choices to get what they want, when they cannot get everything they want. Standard economic theory expects human beings to make rational decisions that maximise their utility (or personal satisfaction or well-being), but examples abound in daily life where people pick a less than optimal course of action, acting seemingly "irrationally". What gives?

In fact, three different groups - economists, psychologists and biologists - have been studying how human beings make decisions over the last couple of hundred years, said neuroeconomist Paul Glimcher.

"What was striking 20 years ago was that these three disciplines were completely isolated from one another. They made different kinds of measurements, they had different theories, there was just no contact whatsoever. And I think the original idea of neuroeconomics was - well, if we could merge these three different groups, so that economists can leverage what we know about biology or psychology, the resulting discipline which would span across all those three would be a more powerful, more predictive, more useful theory."

Professor Glimcher was speaking to BT in mid-January after giving a talk at the Civil Service College on understanding behaviour through neuroscience, psychology and economics. He's a Julius Silver Professor of Neural Science and Professor of Economics and Psychology at New York University (NYU), and director of its Centre for Neuroeconomics.

"Our assumption is that understanding the structure of the machine that makes choices will allow us to improve the models we have of that machine," he said. "And we've been at this now as a community for about 20 years; certainly, everyone would agree that by 1999, there were neuroeconomics papers. So we've been at this for a little while, and I think there already have been significant successes."

The biggest breakthrough in the last five years, he said, is that there is now a "standard model" of how decision-making takes place in the human brain.

"Twenty years ago, if you'd asked, 'how do people make choices'? I'd have had to say to you, 'no idea'. Rough outline? I couldn't even tell you if it happens in the front or back of the head! Today, I can draw you a pretty complicated wiring diagram of how all the basic parts of the brain work together. There are a lot of unanswered questions still, but we now know where in the brain choices happen, where your preferences live, how choices happen physically."

And insights from psychology and neuroscience have led to new economic models, some of which have been tested in policy settings with success, according to Prof Glimcher (himself a neuroscientist-turned-economist). "I would say it really got into gear only two or three years ago, that we saw neurobiological theory really begin to influence economic theory, and that, for me personally, is the most exciting part."

But "you know, the idea was crazy when it started", he said.

Armed with a PhD in neuroscience from the University of Pennsylvania, he was an assistant professor at NYU when he began taking economics classes with its graduate students.

"I was originally trained as a physiologist, and I was trained to understand, explore, take apart biological circuits. The thing that really interested me was choice and decision-making, and it was my

hope that one can understand those circuits. One of the things that frustrated me as a postdoctoral fellow was there was no good theory. My mentors, who were neurobiologists, said: 'There is no such theory! No one in the history of life on earth has ever thought about that problem, and you'll never succeed.'

He was then studying "monkeys making choices, foraging for juice", which, "if you think about it, is really microeconomic theory", he said. He decided he wanted to be an economist. But when he approached an NYU economics professor, he was thrown out of the professor's office.

"The last thing anyone on earth needs is a neuroscientist economist!" the professor told him.

Years later, by his 10th year at NYU, he was put up by the economics department for a faculty position - much to the chagrin of a senior economist in the faculty.

"In fact, he's a pretty good friend of mine now. But at that time he basically said: 'Over my dead body is this psychologist and neuroscientist going to become an economist in our department; that's ridiculous!'" he recalled, laughing.

It was a few more years - after "more papers came out" - before neuroeconomics became established as a discipline.

"Now I get dozens of letters a week from people who want to study neuroeconomics at NYU, and do postdoctoral fellowships. At this point, very few people would say, 'you're crazy'." And both the professors who once considered him crazy, including the one who threw him out of his office, eventually went on themselves to do neuroeconomic research, he noted.

A city like Singapore offers good opportunities to explore neuroeconomic applications in policy settings, he said.

"Economists usually use aggregating indicators like stock markets, and that's a very macro view. But more and more, people are beginning to think about individual-agent-level measurements of whole economies, and that's going to be the revolution at the macro foundations - people rush and watch how market-level phenomena emerge from the actual behaviour of half a million agents.

"And so we're really interested in those phenomena, and we're exploring that at NYU. Actually it's something that would be great to explore in Singapore, thinking about these giant urban data sets that are emerging."

With electronic road pricing, for instance, "the government knows where your cars are, and you could imagine using that data set . . . to find out, for example, well, what happens when we raise the price at

this time interval, how does it actually change car flow, what are the demographic properties of the people whose car flow changes", he said.

"All you need to be able to do is track a million vehicles and, I mean, that data set actually exists. Those data sets are emerging everywhere - in New York City, we have data on the GPS location of every taxi cab. We know when they're occupied, when they're empty, we know when people wait for cabs, when they don't, how much they tip the cab drivers. If you want to study the macroeconomic structure of the cab market, you could study it at the level of individual cab drivers, and people are starting to do that. So, that trend - trying to use these giant urban data sets, trying to link macro and micro - is starting to happen. And what we're hoping in neuroeconomics, at least at NYU, is that we'll be able to use that as a wedge to push the theories we've been developing that came out of neuroscience and are now working their way into microeconomics, back up into macro."

Stock picking is another example. "If we had access to that data, when people pick stocks, can these models predict macro-level changes in stock prices from individual-level models of agents picking stocks, based on reinforcement learning algorithms?" he cited.

"There's reason to believe it might work, but in order to push reinforcement learning models of dopamine neurons up into the macro-economy, I need to have the tool that gets me across the micro-macro border. We're just searching for that tool now."

Neuroeconomists have also looked into other everyday examples such as "the curse of choice" - how people decide when faced with, say, 500 brands of cereal at the supermarket - and how people's risk attitudes and decision-making change as they get older. NYU researchers have found, for instance, that teenagers get into unsafe situations not because they are drawn to danger or risks but, rather, because they are not informed enough about the odds of the consequences of their actions. They are "ambiguity tolerant", said Prof Glimcher. Interestingly, it was found, once they truly understand a risky situation, adolescents are, if anything, even more risk averse than adults.

"Now, I think this has really interesting policy implications, in the way we protect adolescents from themselves," he said, citing, for instance, driving age laws.

The writer is a senior correspondent with BT

Observing brain activity: Prof Glimcher says 3 different groups - economists, psychologists and biologists - have been studying how human beings make decisions over the last couple of hundred years. It is only now that it's all being studied together in an interdisciplinary way. - PHOTO: AP

Document STBT000020130228e9310000d

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