Human Cognition Initiative at NTU

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An Overview of NTU
• 1955: Founded as Nanyang University (Nantah; 1955 – 1979)
• 1981: Establishment of Nanyang Technological Institute (NTI)
• 1991: Establishment of Nanyang Technological University (NTU)
• 1991 – 2001: Focused on education of engineers & business graduates for Singapore market
• 2001 – 2006: Establishment of several new disciplines
  – School of Biological Sciences (2001)
  – School of Humanities & Social Sciences (2004)
  – School of Physical & Mathematical Sciences (2005)
  – School of Art, Design & Media (2005)
• 2006 – 2011: Heavy investments in research & recruitments
• 2010: Establishment of Lee Kong Chian School of Medicine in collaboration with Imperial College London (first intake in AY2013)
• 2014: Establishment of Asian School of The Environment
About NTU

The NTU Academic Structure

• World’s biggest Engineering college
• Research-intensive and interdisciplinary
NTU Leadership

President
Bertil Andersson

Provost
Freddy Boey

Lam Khin Yong
Chief of Staff & Vice President (Research)

Er Meng Hwa
Vice President (International Affairs)

Lee Sing Kong
Vice President (Education Strategies)
NTU Yunnan Garden Residential Campus

50% of Students and 30% of Full Time Faculty living on campus
The new medical school: LKCMedicine
NTU’s Figures at a Glance

At a Glance

100 nationalities on campus
400 university partners in academics and research
258 partner universities in 97 countries offer student attachment programmes
710 undergraduates have an overseas opportunity during their studies
18 joint/dual PhD degree programmes with overseas universities
43 overseas alumni associations
54 first intake at joint medical school with Imperial College London

TOP 50 fastest-rising Asian university in global top 50 of QS World University Rankings 2014
1st globally and only Singapore university in 2014 QS ranking of young elite universities
9th in Engineering and Technology in QS World University Rankings 2014
61st in Times Higher Education World University Rankings 2014, jumping 108 places over 2011
5th most-cited university in Engineering by Essential Science Indicators of Thomson Reuters

TOP 15 most beautiful university campus (Travel + Leisure magazine)
14 new physical developments over the next two years, including 2 large learning hubs
90 research institutes and centres
5,000 new hostell places by 2015

179,800 alumni across 127 countries
23,500 undergraduates
9,000 graduate students
4,000 faculty and researchers from 75 countries
97% of the class of 2012 received a job offer within four months of graduation

S$487.7 million in competitive research grants won in FY2012/13
1st globally for industry income and innovation

S$1.2 billion in funding for sustainability research since 2005
41 patents granted in FY2012/13
938 technology disclosures received since 2007
NTU’s International Profile

- 70% of international faculty & research staff (from >75 nationalities)

- Extensive international graduate student recruitment (≈ 52% Masters & ≈ 79% PhD international students)

- International academic partnerships with top universities based on mutual academic esteem

- Working with global industry partners

- International leadership
NTU Seeks to cover both worlds (Academic Excellence and Societal Relevance)

Nature Publishing Index

Times Higher Education global ranking

Global Top 100 & 12th in Asia Pacific

No. 1 in the World for Industrial Collaboration
Asian Research Impact Trends – Singapore’s Universities Top in Asia

Source: Thomson Reuters 2014
Research on human cognition – human cognition initiative
Why should a technological university have human cognition research?

Technological universities have an increasingly strong interest in cognitive neuroscience.

Medical schools have an increasingly strong interest in cognitive neuroscience.

Only in the US more than 200 PhD programmes!
NTU already has a strong - but dispersed - initial background in cognitive neuroscience

The new medical school and its partners are strongly motivated

Some further platforms, supporting cognitive neuroscience research

Medical Imaging and Signal Analysis, NITHM & School of Electrical Engineering

NTU Complexity Programme and ParaLimes

BioInformatics Research, School of Computer Engineering

Nanyang Institute of Technology in Health and Medicine (NITHM)

NTU – Parmenides Center on Cognostics (future plan)
www.parmenides-foundation.org
Overview of the Clinical Brain Lab

S.H. Annabel Chen, PhD
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- Cerebellum involvement in Higher Cognition
  - Applications to Alcoholism, Schizophrenia, OCD, Dyslexia and Autism
- Aging in Asia Pacific Countries
  - Aging networks and cognitive training
- Developing Research in Learning and Emotion
Both Convergent and Divergent regions were identified.
A sub-network consisting of the left Middle Frontal Gyrus and the right Fusiform Gyrus was proposed to be specific to Chinese character processing.
Overview of the Applied Cognitive Development Lab

Kerry Lee
kerry.lee@nie.edu.sg

Cognitive underpinnings of math proficiency

Study 1: Individual differences in algebraic problem solving

Study 2: Influence of executive functioning

Study 3: Development of working memory, executive functioning & math abilities

Intervention study

Teachers’ perception of different algebraic strategies

Pupils’ understanding of model solutions

Algebraic strategies

Visual-spatial short term vs. working memory

Working memory, test anxiety, and math performance

The impact of executive interference

fMRI study of strategic differences I & II

Behavioral & fMRI study of the role of inhibitory functions in the acquisition of more advanced strategies

Teachers’ perception of different algebraic strategies

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Algebraic strategies

Visual-spatial short term vs. working memory

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fMRI study of strategic differences I & II

Behavioral & fMRI study of the role of inhibitory functions in the acquisition of more advanced strategies

Overview of the Applied Cognitive Development Lab

Kerry Lee
kerry.lee@nie.edu.sg
Using fMRI to examine curricular issues

- **Two algebraic problem solving methods** are taught in Singapore schools
  - *Symbolic algebra* is taught in secondary school
  - The *model method* is taught in primary school
- Considerable time and effort are expanded on teaching the model method in the primary years
  - Is it worthwhile?
Similar brain areas were activated by the two approaches, but the symbolic method activated areas associated with the use of attentional resources, suggesting that it is better suited for older children with greater access to such resources. Consequently, to facilitate students’ transition from primary to secondary algebra (i.e., the teaching of symbolic algebra) the linkages between the various problem solving methods need to be made explicit. This will better allow students to leverage on their prior knowledge regarding the model method.

Lee et al., Brain Res, 2007; Lee et al., Brit J Educ Psychol, 2010
Future Directions

Optimising Learning

• Understanding optimization
• Social and emotional skills
• Executive functions
• Understanding and usage of knowledge
• Psychological wellbeing
• Cultural nature of learning
• Creativity and student dispositions
1. The mechanisms of cultural mixing
2. Research Capabilities and Expertise: Analyzing complex social bio-cognitive systems

- Sociocultural dynamics
- Group dynamics
- Genetics
- Neuroscience
- Cognitive science
3. Future Cities: Human Cognition and Built Environment

Underground Spaces

Mega-Cities
Overview of the LKCMedicine Translational Neuroscience Programme

Pathological ageing – neurodegenerative diseases:
- Neuropsychology – cognitive tests
- Neuroimaging (morphological, functional, molecular)
- Blood born and peripheral biomarkers

Neurological disorders (with strong emphasis on TBI)
- Neuropsychology – cognitive / behavioural analysis
- Neuroimaging (morphological, functional, molecular)
- Blood born and peripheral biomarkers

Mental disorders
- Neuropsychology – behavioural / cognitive markers
- Neuroimaging (morphological, functional, molecular)
- Proxy / blood born biomarkers
Neuroimaging at NTU: the future

The human neuroimaging triad:
MRI: morphology + function (fMRI, DTI, ...)
PET: molecular - biochemical
MEG: electrophysiology

Human neuroimaging in Singapore:
MRI: CIRC + Duke-NUS + NTU
PET: CIRC
MEG: NTU
A vision on cognitive neuroscience at NTU

Research Groups and Themes:
- LKCMedicine
- National Institute of Education
- School of Humanities
- Business School
- Cognitive complexity – NTU Cognostics Center
- ...

Education and training (MA, PhD)

Technology Platforms:
- Imaging (PET, MRI, MEG)
- Image and Signal Analysis
- Bioinformatics / biomathematics
- Cognitive and behavioural genomics
- Cognostics
- .......

National and international cooperation
THANK YOU