INTERNATIONAL SCIENCE OF LEARNING CONFERENCE

RESEARCH TO REALITY

SEPTEMBER 18, 19 & 20, 2017

BRISBANE CONVENTION & EXHIBITION CENTRE
SOUTHBANK | BRISBANE | AUSTRALIA

HANDBOOK

HOSTED BY

SLRC SCIENCE OF LEARNING RESEARCH CENTRE

Australian Government
Australian Research Council

A SPECIAL RESEARCH INITIATIVE OF THE AUSTRALIAN RESEARCH COUNCIL

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WELCOME

On behalf of the Science of Learning Research Centre (SLRC), I am pleased to welcome you to the 2017 International Science of Learning Conference – *Research to Reality* and to welcome you to Brisbane.

The 2017 International Science of Learning Conference – *Research to Reality* brings together cognitive and brain researchers, education researchers, and neuroscientists to present and ***share*** their latest research findings into the science of learning, to ***discuss*** what these findings mean across the respective disciplines from cognitive and brain research to education, and to consider the ***challenge*** of how these findings may be applied in learning and education.

We have an exciting speaking program with a mix of keynote speakers, symposia, oral and poster presentations, along with the all-important networking events. We acknowledge and welcome our international partners, the National Science Foundation USA and the International Bureau of Education UNESCO. We also thank all those presenting their work - you all are playing a valuable part in the success of the conference.

With more than 250 people attending, and over 50 speakers, we hope this conference will stimulate new collaborations and open new horizons.

Professor Ross Cunnington
Deputy Director, Science of Learning Research Centre
Conference Chair

CONTENTS

REGISTRATION DESK

International Science of Learning Conference 2017

Onsite Registration Desk
Boulevard Level, BCEC on Grey
Brisbane Convention &
Exhibition Centre
Grey Street
SOUTH BANK QLD 4101

Phone: 0450 006 224 – Amy Mailander, Conference & Event Co-Ordinator
0404 488 910 – Susan Harris, Conference Manager
Fax: +61 7 3112 3900
Email: sol2017@absoluteevents.com.au

For information and assistance at any time during the Conference, please see the Absolute Events & Marketing staff at the Registration Desk.

Absolute Events & Marketing
EXCEEDING EXPECTATIONS

SCIENCE OF LEARNING RESEARCH CENTRE

Victoria Anderson,
Chief Operating Officer
Phone: 0437 360 878
Email: slrc@uq.edu.au
Web: www.slrc.org.au

SLRC SCIENCE OF LEARNING RESEARCH CENTRE

PROGRAM

DAY 1

MONDAY 18 SEPTEMBER

SCIENCE OF LEARNING: RESEARCH TO REALITY		
8.00am	Registration Desk open	
PLENARY SESSION		
9.00am – 9.30am	**Room:** Boulevard Auditorium **Chair:** Professor Ross Cunnington, The University of Queensland and Science of Learning Research Centre (SLRC)	
	CONFERENCE OPENING **Welcome To Country – Aunty Carol Currie** Professor Peter Høj, Vice-Chancellor and President, The University of Queensland Professor Pankaj Sah, Director, Science Learning Research Centre, The University of Queensland	
9.30am – 10.30am	**How Does Learning Influence The Capacity Limits Of Attention?** Associate Professor Paul Dux, School of Psychology, The University of Queensland and SLRC	
10.30am – 11.00am	**Morning Tea** (Boulevard Auditorium Foyer)	
CONCURRENT SESSIONS		
11.00am – 1.00pm	**Symposium 1 –** **The Role of Confusion in Learning**	**Symposium 2 –** **Language Learning: Neuroscientific and Psychological Perspectives**
	Room: Boulevard Auditorium **Chairs:** Professor Gregor Kennedy, The University of Melbourne and SLRC; and Professor Lori Lockyer, University of Technology Sydney and SLRC	**Room: B1 & B2 (Combined)** **Chair:** Associate Professor Susan Bridges, The University of Hong Kong
	Speakers • Dr Amael Arguel, Macquarie University and SLRC • Dr Jason Lodge, The University of Melbourne and SLRC • Dr Kelly Trezise, The University of Melbourne and SLRC • Professor Rob Hester, The University of Melbourne and SLRC	**Speakers** • Dr Nandini Chatterjee Singh, UNESCO New Delhi • Professor Akaysha Tang, The University of Hong Kong • Dr Francesco Foroni, Australian Catholic University • Dr Johan Mårtensson, Lund University, Sweden • Professor Brendan Weekes, The University of Hong Kong
1.00pm – 2.00pm	**Lunch** (Boulevard Auditorium Foyer)	
PLENARY SESSION		
2.00pm – 3.00pm	**Room:** Boulevard Auditorium **Chair:** Professor Ross Cunnington, The University of Queensland and Science of Learning Research Centre (SLRC)	
	Foundations Of A Science Of Learning: From Birth To School Age Professor Andrew Meltzoff, Co-Director, Institute for Learning and Brain Sciences, University of Washington, USA	
3.00pm – 3.20pm	**Afternoon Tea** (Boulevard Auditorium Foyer)	
CONCURRENT SESSIONS		
3.20pm – 5.00pm	**Talk Session 1 –** **Maths Cognition, Reasoning, and Confusion**	**Talk Session 2 –** **Social and Cultural Factors in Learning**
	Room: Boulevard Auditorium **Chair:** Professor Rob Hester, The University of Melbourne and SLRC	**Room: B1 & B2 (Combined)** **Chair:** Professor Akshay Anand, Postgraduate Institute of Medical Education and Research, Chandigarh
	Speakers • Professor Jason Mattingley, The University of Queensland and SLRC • Dr Sarah Gray, The University of Melbourne • Dr Maryam Ziaei, The University of Queensland and SLRC • Dr Joseph Ferguson, Deakin University and SLRC	**Speakers** • Dr Man Ching Esther Chan, The University of Melbourne and SLRC • Prof Russell Tytler, Deakin University and SLRC • Matti Wilks, The University of Queensland • Luke Rowe, The University of Melbourne and SLRC • Sarah Bentley, The University of Queensland
5.00pm – 7.00pm	**Poster Presentations and Reception** (Boulevard Auditorium Foyer) *Light food and drinks served from 6.00pm*	
7.30pm – 10.00pm	**Student and Early Career Researcher Social Night** (Offsite)	

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DAY 2

TUESDAY 19 SEPTEMBER

SCIENCE OF LEARNING: RESEARCH TO REALITY		
8.00am	Registration Desk open	
PLENARY SESSION		
9.00am –11.00am	**Room:** Boulevard Auditorium **Chair:** Professor Ross Cunnington, The University of Queensland and Science of Learning Research Centre (SLRC)	
	International Highlights From Science Of Learning Research Programs *A focus on science of learning research programs that are being undertaken around the world.* • Professor Nancy Law, The University of Hong Kong • Professor Roberto Lent, Brazilian Network of Science for Education • Dr Melina Uncapher, University of California, San Francisco • Dr Johan Mårtensson, Lund University, Sweden	
11.00am – 11.20am	**Morning Tea** (Boulevard Auditorium Foyer)	
CONCURRENT SESSIONS		
11.20am – 1.00pm	**Symposium 3 –** **Advances in Measurement Technology**	**Symposium 4 –** **The State of the Learner: Metacognition and Social Synchrony**
	Room: Boulevard Auditorium **Chairs:** Dr Melina Uncapher, University of California, San Francisco and Dr John Iversen University of California San Diego	**Room: B1 & B2 (Combined)** **Chair:** Associate Professor Paul Dux, The University of Queensland and SLRC
	Speakers • Dr John Iversen, University of California San Diego • Dr Tzyy-Ping Jung, University of California San Diego • Dr Pasha Antonenko, University of Florida • Dr Catherine Jordan, University of Minnesota • Dr Ido Davidesco, New York University • Dr Melina Uncapher, University of California San Francisco	**Speakers** • Dr Natasha Matthews, The University of Queensland and SLRC • Professor Annemaree Carroll, The University of Queensland and SLRC • Dr David Painter, The University of Queensland and SLRC • Stephanie McMahon, The University of Queensland and SLRC
1.00pm – 2.00pm	**Lunch** (Boulevard Auditorium Foyer)	
PLENARY SESSION		
2.00pm – 3.30pm	**Room:** Boulevard Auditorium **Chair:** Professor David Clarke, The University of Melbourne and SLRC	
	Panel Discussion – Making A Difference To Learning With Science Of Learning Research *Discussion with panel representatives from research, education policy, government, and funding organisations on how can research on the science of learning really make a difference to learning.*	
	Panel members: • Stacie Hansel, Executive Director, School Autonomy and Improvement, State Schools, Queensland Department of Education and Training • Professor Pankaj Sah, Director, SLRC and The University of Queensland • Professor Andrew Meltzoff, University of Washington • Em.Prof. Barry McGaw AO, The University of Melbourne	
3.30pm – 3.50pm	**Afternoon Tea** (Boulevard Auditorium Foyer)	
CONCURRENT SESSIONS		
3.50pm – 5.30pm	**Talk Session 3 –** **Higher Education and Digital Learning**	**Talk Session 4 –** **Memory, Attention, and Feedback**
	Room: Boulevard Auditorium **Chair:** Professor Lori Lockyer, University of Technology Sydney and SLRC	**Room: B1 & B2 (Combined)** **Chair:** Dr Maryam Ziaei, The University of Queensland and SLRC
	Speakers • Professor Annemaree Carroll, The University of Queensland and SLRC • Associate Professor Blake McKimmie, The University of Queensland • Iwona Czaplinski, Queensland University of Technology • Associate Professor Sandra Milligan, The University of Melbourne and SLRC • Dr Luke van de Laan, University of Southern Queensland	**Speakers** • Dr Karen Murphy, Griffith University • Abbey Nydam, The University of Queensland • Dr Oliver Baumann, The University of Queensland • Jack Leggett, The University of Queensland • Luke Mandouit, The University of Melbourne and SLRC
7.00pm – 10.00pm	**Conference Dinner** (Sky Room, Brisbane Convention and Exhibition Centre)	

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PROGRAM

DAY 3

WEDNESDAY 20 SEPTEMBER

PUBLIC FORUM: SCIENCE OF LEARNING FOR EDUCATION AND POLICY	
8.00am	Registration Desk open
	PLENARY SESSION
9.00am – 9.05am	**Room:** Boulevard Auditorium **Chair:** Professor Ross Cunnington, The University of Queensland and Science of Learning Research Centre (SLRC)
	PUBLIC FORUM WELCOME AND OPENING
9.05am – 10.05am	**Keynote Speaker** **What Can We Learn From The Science Of Learning?** Professor John Hattie, Director, Melbourne Education Research Institute, The University of Melbourne and SLRC
10.05am – 10.45am	**Research Presentation** **SLRC Network of Schools** Stephanie MacMahon, The University of Queensland and SLRC, and Andrew Jones, SLRC Educator-in-residence, The University of Melbourne (on secondment from Victorian Department of Education and Training)
10.45am – 11.20am	**Morning Tea** (Boulevard Auditorium Foyer)
	PLENARY SESSION
11.20am – 11.45am	**Room:** Boulevard Auditorium
	Keynote Speaker **Senator the Hon. Simon Birmingham** Minister for Education and Training
11.45am – 12.15pm	**Research Presentations** **Research to Reality: Scaling Research, Retaining Impact** *Showcase of projects being implemented in schools on a large scale. Each presentation will include presenters from the research teams and from partner schools.* **Feedback for Learning, Brisbane Metropolitan Region** Dr Cameron Brooks, The University of Queensland and SLRC, and Rochelle Burton, SLRC Educator-in-residence, The University of Queensland (on secondment from Queensland Department of Education and Training)
12.15pm – 1.15pm	**Lunch** (Boulevard Auditorium Foyer)
	PLENARY SESSION
1.15pm – 2.45pm	**Room:** Boulevard Auditorium **Chair:** Professor Merrilyn Goos, The University of Queensland and SLRC
	Panel Discussion **Why The Science Of Learning? Education And Policy Perspectives** *Panel discussion including educators, policy makers, and international researchers.*
2.45pm – 3.45pm	**Research Presentations** **Research to Reality: Scaling Research, Retaining Impact** *Showcase of projects being implemented in schools on a large scale. Each presentation will include presenters from the research teams and from partner schools.* **Enhancing Metacognition, Empowering Learners, Port Augusta Region** Professor Martin Westwell, Flinders University and SLRC **Teacher Wellbeing Project, A Queensland Study** Professor Annemaree Carroll, The University of Queensland and SLRC, and Dr Julie Bower, The University of Queensland and SLRC
3.45pm	**CONCLUDING COMMENTS AND CONFERENCE CLOSE**

DISCLAIMER: *Information in this handbook is correct at the time of printing. The Organisers reserve the right to alter details as needed.*



SOCIAL PROGRAM

WELCOME RECEPTION

Enjoy this all-important networking event as a time to catch up with your colleagues and meet new contacts, and view the poster presentations.

When: Monday 18 September – 6.00pm - 7.00pm
Where: Boulevard Auditorium Foyer
Cost: Included for conference delegates

CONFERENCE DINNER

The Conference Dinner is a wonderful way of experiencing the best networking in a special environment with sensational views of Brisbane.

When: Tuesday 19 September
7.00pm Pre-Dinner Drinks, 7.30pm - 10.00pm Dinner
Where: Sky Room, Sky Level
Cost: $130 per ticket
Dress: Smart casual
Includes: 3 course dinner and beverage package (includes beer, wine, soft drink)

Haven't got a ticket?

If you wish to attend but have not pre-booked a ticket, a very limited number of tickets may be available until 5.00pm on Monday 18 September. Please see the Registration Desk staff with your request.

SOUTH BANK CONCIERGE – VIP DISCOUNT PROGRAM

The International Science of Learning Conference is working closely with the South Bank Concierge Program and delegates can enjoy 10% discount off many outlets at South Bank.

A VIP card is included in your name tag pocket.

There is nothing better than getting out to experience the local surrounds of a new city and South Bank, only a short stroll away from the Brisbane Exhibition and Convention Centre, is brimming with incredible conference exclusives awaiting delegates.

By using the South Bank Concierge program, delegates can unlock incredible conference exclusives throughout the South Bank precinct. Not only will you receive 10% off at participating retailers, you can also book event tickets, plan your itinerary and access special offers, plus so much more.

Visit www.southbankconcierge.com.au to unlock incredible conference exclusives as an International Science of Learning Conference attendee.

GENERAL INFORMATION

ATMS

An ATM is located on the ground level of BCEC on Grey.

BUSINESS CENTRE

The Brisbane Convention & Exhibition Centre (BCEC) reception desk offers business services such as photocopying and faxing. Unfortunately the Conference registration desk is unable to offer these services.

CAR PARKING

BCEC has undercover parking for 1,500 vehicles, with direct lift access to the Centre's convention and exhibition facilities. For faster exit the Centre has an automated parking system which allows you to enter and exit the car park using your credit card.

CATERING

All Conference catering will be served to registered Conference delegates on the Boulevard foyer.

CHAIRPERSONS

Chairpersons should check in at the Registration Desk for any program changes.

DISCLAIMER

All information is correct at time of printing but the Organisers reserve the right to alter the details as needed. For up-to-date information, view the program updates displayed onsite at the Conference.

DRESS CODE

Smart casual attire is appropriate for all sessions and social functions. As the session rooms may get a bit cool at times, we recommend you bring a jumper with you.

EXHIBITOR/PRODUCT DISCLAIMER

Neither the Conference Organisers nor the Organising Committee endorse or take responsibility for any services or products displayed or promoted at this conference.

LIABILITY

Neither the Conference Organiser nor the Conference Committee accepts any responsibility for loss or damage, theft, injuries/accidents or any other relevant matters. Delegates should make their own arrangements with respect to personal insurance.

LUGGAGE STORAGE

There will be limited luggage storage available at the BCEC Information Desk on the Ground Floor of BCEC on Grey foyer. Please do not take luggage into session rooms or leave unattended as BCEC Security staff will remove it. Please also be aware that any luggage stored is at your own responsibility and the Committee nor the BCEC will take responsibility.

MESSAGES

A delegate message board is located near the Registration Desk. If required, callers can leave a message with Registration Desk staff on phone 0450 006 224 or 0404 488 910, fax 07 3112 3900 or email sol2017@absoluteevents.com.au. These messages will be available for collection from the message board. Under no circumstances will sessions be interrupted to deliver messages.


NAME BADGES

Delegates are required to wear their name badge at all times as they allow access to all sessions and catering. Those not wearing name badges will be asked to see Registration Desk staff for re-issue.

NO SMOKING POLICY

Delegates should be aware that smoking is banned within the BCEC. Designated smoking areas are clearly signed. Please be aware that, due to heavy fines, food and beverage is not allowed to be consumed in these designated smoking areas.

PAYMENT POLICY

It is Conference policy that all registrations must be paid prior to admittance to the Conference and/or networking function(s). Any outstanding payments will need to be made onsite by secure credit card payment.

PERSON WITH DISABILITIES

Should you require these services, please advise the Conference Organisers and we will do all we can to make your attendance as comfortable as possible. BCEC is a fully accessible venue.

REGISTRATION DESK

The Registration Desk will be located on the Boulevard Level of BCEC on Grey and will be open during the following times:

- Monday 18 September 8.00am – 5.00pm
- Tuesday 19 September 8.00am – 5.00pm
- Wednesday 20 September 8.00am – 4.00pm

Please collect your name badge as soon as possible after your arrival.

Please contact staff at this desk with any queries. For enquiries outside of these times, please contact the Registration Management Team:

- 0404 488 910 – Susan Harris, Conference Manager
- 0450 006 224 – Amy Mailander, Conference & Event Co-Ordinator

SPEAKERS' PREPARATION AREA

The Speakers' Preparation Area is located in the Boulevard Auditorium Foyer and will be open during the following times:

- Monday 18 September 8.00am – 4.00pm
- Tuesday 19 September 8.00am – 4.00pm
- Wednesday 20 September 8.00am – 1.30pm

All speakers are required to register at the Registration Desk, then check in with the Speakers' Preparation Area **at least two hours before their session**, or as early as possible. This will ensure presentations can be opened and pre-loaded onto the central Conference computer system.

If you emailed your presentation prior to the Conference, please still check in to ensure that you don't have any changes.

An audio visual technician will be available to assist with presentations and will advise any speakers of further instructions.

Speakers and Chairpersons are required to be in their presentation room **10 minutes prior** to the commencement of their session.

SPECIAL DIETARY REQUIREMENTS

Any delegates who requested a food allergy/special dietary requirement will have a sticker on the name tag pocket and the venue has been advised of your request. Please identify yourself to the wait staff person at the Special Dietary Requirements Area. While the Conference Organisers will aim to cater to any special dietary meals advised onsite, please be aware that, due to the late notification, it may not be possible.

VENUE

BCEC on Grey
Brisbane Convention & Exhibition Centre
Grey Street
SOUTH BANK QLD 4101
Phone: 07 3308 3000

KEYNOTE SPEAKERS

ASSOCIATE PROFESSOR PAUL DUX

The University of Queensland and Science of Learning Research Centre

Topic

How Does Learning Influence The Capacity Limits Of Attention?

BIOGRAPHY

Associate Professor Paul E Dux is a psychologist and neuroscientist in the School of Psychology at The University of Queensland. He leads a group that studies the cognitive and neural underpinnings of human information-processing capacity limitations in health and disease. Specific interests are the mechanisms of attention and the efficacy of cognitive training and how it changes the brain to improve performance. Dux has published widely, received several early career research awards and attracted funding from both the ARC and NHMRC.

PROFESSOR JOHN HATTIE

Melbourne Education Research Institute, The University of Melbourne and Science of Learning Research Centre

TOPIC

What Can We Learn From The Science Of Learning?

BIOGRAPHY

Professor John Hattie is Director of the Melbourne Educational Research Institute at the University of Melbourne. His areas of interest are measurement models and their applications to educational problems, and models of teaching and learning. Professor Hattie is a Theme Leader in the Australian Research Council's national Science of Learning Research Centre and was appointed as Chair of the Australian Institute for Teaching and School Leadership in 2014.

PROFESSOR ANDREW MELTZOFF

Co-Director, Institute for Learning and Brain Sciences, University of Washington, USA

TOPIC

Foundations Of A Science Of Learning: From Birth To School Age

BIOGRAPHY

Professor Andrew Meltzoff holds the Job and Gertrud Tamaki Endowed Chair and is the Co-Director of the Institute for Learning & Brain Sciences, University of Washington. He is a pioneer in the study of infant and child development and has demonstrated the power of role models and social learning for young children's development.

His studies on elementary school children's cultural stereotypes about STEM (science, technology, engineering, and mathematics) have far-reaching implications for the science of learning. This research work shows that non-academic factors profoundly influence STEM learning. It is helping to bring together psychological science and educational practice at national and international levels.

INTERNATIONAL PLENARY SPEAKERS

INTERNATIONAL HIGHLIGHTS FROM SCIENCE OF LEARNING RESEARCH PROGRAMS

PROFESSOR NANCY LAW

University of Hong Kong

BIOGRAPHY

Professor Nancy Law is a professor in the Division of Information Technology in Education, Faculty of Education at the University of Hong Kong. She served as the Founding Director for the Centre for Information Technology in Education (CITE) for 15 years from 1998. Her key research focus is on studying technology-enhanced pedagogical innovations for learning at student, teacher and school levels for scalable change at institutional and system levels. She is currently leading a major interdisciplinary research project on learning and assessment of digital citizenship from childhood to early adulthood.

PROFESSOR ROBERTO LENT

Brazilian Network of Science for Education

BIOGRAPHY

Roberto Lent is Professor of Neuroscience at the Institute of Biomedical Sciences, Federal University of Rio de Janeiro, Brazil. He conducts studies on neuroplasticity, neurodevelopment and evolution of the nervous system, employing different techniques, from cell biology to neuroimaging. He is a Full Member of the Brazilian Academy of Sciences, and General Coordinator of the Brazilian Network of Science for Education, constituted by scientists of all disciplines to foster translational research applied to learning and other educational matters.

DR JOHAN MÅRTENSSON

Lund University, Sweden

BIOGRAPHY

Dr Johan Mårtensson is a Researcher at the Department of Clinical Sciences at Lund University, a position that straddles the Division of Logopedics, Phoniatrics, and Audiology, the Humanities Laboratory and the National 7T facility. Johan's background is in neuropsychology, with focus on multi modal MRI and longitudinal studies into brain change; a topic that has taken him from Lund to the Max Planck for Human Development in Berlin and back. Johan is a member and representative of the research community Cognition, Communication and Learning (CCL) which is a multidisciplinary and cross-faculty research environment which brings together 40 researchers, post docs and PhD students from Cognitive Science, Psychology, Linguistics, Neurophysiology and Logopedics, Phoniatrics and Audiology.

DR MELINA UNCAPHER

University of California, San Francisco

BIOGRAPHY

Dr Melina Uncapher is an Assistant Professor in the Department of Neurology at University of California, San Francisco, and is Director of the Education Program at the new Neuroscape Center at UCSF. Dr Uncapher's research focus is on understanding how attention affects learning, and how this knowledge can be used to solve real-world problems. Dr Uncapher is Executive Director of the Institute for Applied Neuroscience, a science-for-good nonprofit that partners with educators and students to solve education challenges using practical tools based on the science of learning.

SYMPOSIA

SYMPOSIUM 1 – THE ROLE OF CONFUSION IN LEARNING

OVERVIEW

Led by Professors Gregor Kennedy, Lori Lockyer, Rob Hester and Ottmar Lipp the SLRC has been engaged in a program of research investigating the foundations of learner confusion as it manifests in digital learning environments. The Symposium will draw together a range of papers that reflect the diversity of conceptual and methodological approaches to the core issue of identifying and understanding the role of student confusion in the learning process. The Symposium papers will consider how patterns of learning interactions impact on emotions like confusion (Arguel), how these emotions can promote conceptual change (Pachman), how misconception, overconfidence and confusion relate to conceptual change (Lodge), how different 'types' of confusion can be manifest in learning environments (Trezise), and how students' errors and the feedback they receive can impact on performance (Hester).

SYMPOSIUM CHAIRS

- Professor Gregor Kennedy, The University of Melbourne.
- Professor Lori Lockyer, University of Technology Sydney and Macquarie University

SYMPOSIUM SPEAKERS

- Dr Amael Arguel, Department of Educational Studies, Macquarie University
- Dr Jason Lodge, Melbourne Centre for the Study of Higher Education, The University of Melbourne
- Dr Kelly Trezise, Melbourne Centre for the Study of Higher Education, The University of Melbourne
- Professor Rob Hester, School of Psychological Sciences, The University of Melbourne

SPEAKER AND PRESENTATION OUTLINE

Professor Gregor Kennedy is Pro Vice-Chancellor (Teaching and Learning) and Director of the Melbourne Centre for the Study of Higher Education at the University of Melbourne. As a Professor of Education he oversees a vibrant team in the area of educational technology research and development.

Professor Lori Lockyer is Dean of the Graduate Research School at University of Technology Sydney and Honorary Professor in the Department of Educational Studies at Macquarie University. In her role as Honorary Professor, Lori leads the Macquarie node of the Science of Learning Research Centre.

Dr Amael Arguel is a psychological scientist, based at Macquarie University, specialised in learning from new technologies. As a Research Fellow at SLRC, his researches focus on the use of behavioural and physiological data for building predictive models of the occurrence of confusion in digital learning environments. Amael's talk will consider how learner interactions within digital environments can be used to detect emotional states such as confusion. He will report on a study involving mathematical puzzle resolution in which he investigates the relationship between patterns of interactions and levels of self-reported emotions.

Dr Jason Lodge is a senior lecturer in the Melbourne Centre for the Study of Higher Education and a senior research fellow in the ARC-SRI Science of Learning Research Centre. Jason's research focuses on the application of the learning sciences to higher education and the ways in which technology is influencing learning in universities. Jason's talk will focus on the numerous ways in which misconceptions occur and the ways in which the process of overcoming them can be confusing, particularly when they feel confident in what they think they know. In this presentation, he will discuss a series of studies looking at the emotions students experience as their conceptual understanding changes.

Dr Kelly Tezise is a Research Fellow in the Melbourne Centre for the Study of Higher Education and in the Melbourne School of Psychological Sciences at the University of Melbourne. She is primarily interested in identifying individual differences in patterns of learning. Her work integrates educational, cognitive, and developmental psychology, and use a variety of analytical methods to examine processes that contribute to learning. Kelly's talk will focus on how different types of confusion (e.g. conceptual, perceptual) occur and are manifest in digital learning environments.

Professor Rob Hester is a cognitive neuroscientist who uses event-related functional MRI to study human feedback processing, in both healthy adults and clinical samples. The work of his team in the SLRC examines how feedback in learning environments influences subsequent adaptive behaviour, including the interaction between confidence, feedback and learning. Rob's talk will focus on learning from errors and consider the interaction between confidence and feedback and its impact on adaptive performance change.

SYMPOSIUM 2 – LANGUAGE LEARNING: NEUROSCIENTIFIC AND PSYCHOLOGICAL PERSPECTIVES

This Symposium will present research on language learning, with an emphasis on neuroscientific and psychological methods. Data from different populations of language learners (adults, bilingual speakers, children, dyslexia, translators) will be presented and will address a range of issues from natural and statistical learning to the impact of the linguistic environment on language learning. Special attention will be given to new technologies. The speakers come from a range of research backgrounds to bring different perspectives on the problem "From Research to Reality."

SYMPOSIUM CHAIR

Associate Professor Susan Bridges, University of Hong Kong

SYMPOSIUM SPEAKERS

- Dr Nandini Chatterjee Singh, National Project Officer, UNESCO Mahatma Gandhi Institute of Education for Peace and Sustainable Development, New Delhi, India
- Professor Akaysha Tang, Laboratory of Neuroscience for Education (NfE Lab), Faculty of Education, University of Hong Kong
- Dr Francesco Foroni, School of Psychology, Australian Catholic University, NSW, Australia
- Dr Johan Mårtensson, Humanities Laboratory and Logopedics, Phoniatrics and Audiology, University of Lund
- Professor Brendan Weekes, Laboratory for Communication Science, University of Hong Kong

SPEAKER AND PRESENTATION OUTLINE

Dr Nandini Chatterjee Singh is a cognitive neuroscientist formerly at the National Brain Research Centre (NBRC) in India and now working at UNESCO MGIEP. Her areas of research are language, literacy and music. Her laboratory at NBRC is focused on using different brain imaging methods to understand the neural pathways underlying reading in different writing systems. She has also been actively associated with understanding the role of emotion in music especially North Indian Classical ragas. At MGIEP, her work is focused on building a new evidence based curriculum for school children embedded in critical inquiry, mindfulness, empathy and compassion.

SYMPOSIA

Singh's talk will focus on children who are bi-literate i.e. that they are instructed simultaneously in two languages that belong to distinct writing systems. In the first part of talk, she will discuss research on reading circuits in the brain and results showing that reading in bi-literates depends on access to phonological representations of a language. In the second part of her talk, she will discuss implications for dyslexia. It is critical that dyslexia is assessed in all languages for bi-literates. Given the absence of appropriate standardized screening and assessment tools in the languages of India, diagnosis of dyslexia has been incomplete or even unavailable. To address this lacuna, the Dyslexia Assessment for Languages of India (DALI) was developed. DALI contains standardized screening tools for school teachers and assessment tools for psychologists, in three Indian Languages namely Hindi, Marathi, Kannada and English to identify dyslexia. I will discuss the different tests available in DALI, its standardization and validation.

Professor Akaysha Tang is the inaugural director of the newly established Laboratory of Neuroscience for Education (NfE), the Faculty of Education at the University of Hong Kong. The NfE Lab aims to bridge neuroscience and education by bringing neuroscience of learning from the laboratory into the real world of classrooms and homes and from animal models to humans by developing EEG-based source imaging tools that offer improved signal to noise ratios and conceptually analogous mechanistic measures of learning. Her animal research at the University of New Mexico offered the first demonstration in animal models that repeated brief exposures to unfamiliar environment can lead to long lasting enhancement of cognitive, social, emotional, and neural development cross life span and these enhancements cannot be accounted for by maternal care but modulated by the mother's ability to regulate her own stress. Her work on hdEEG source imagining offered the first demonstration that single-trial visual event-related potentials can be observed at the single-subject level despite continuous eye movement in the context of a video game. Tang also served as the Program Director for the Cognitive Neuroscience Program (2012-2014) and China Program (2015-2016), National Science Foundation, USA.

Understanding neural mechanisms underlying learning outside of the laboratory is challenging due to (1) high measurement noise level in the natural environment; (2) high expense of brain imaging facilitates; (3) low feasibility for frequent and large population studies; (4) high demand for learner performance. Using language learning as a case for illustration, this talk will highlight recent technical advances in EEG-based source imaging that may potentially transform the landscape of language learning study, and more broadly, natural learning in general.

Dr Francesco Foroni obtained his Master's and Ph.D. degrees from the University of Oregon (USA). Subsequently was a Post-Doctoral Fellow at the VU University Amsterdam (the Netherlands). Between 2010 and 2012 he was appointed as Research Fellow and Lecturer at Utrecht University (the Netherlands). Between 2012 and 2016 he worked as Senior Research Fellow and Adjunct Professor at SISSA (Trieste, Italy). In 2016 he joined the Australian Catholic University as a Senior Lecturer in the School of Psychology. Dr. Foroni conducts research on the interplay between affective and cognitive processes: He investigates, for instance, how people process emotion information and how these processes influence perception and judgements. One line of research investigates how proprioceptive information about our own body (e.g., somatic reactions like muscle feedback) are at the base of emotion information processing and how it guides our judgments and evaluative processes.

Foroni will start by presenting the idea of different learning histories between the native language (L1) and the non-native language (L2) suggesting how they differ in affective grounding. He will argue that these learning histories should result in differences in the processing of emotional information (evidence using EMG on reading and memory processes for emotion language). He will discuss the hypothesis that this should have direct implications in the way information are processed in L1 vs L2 and will briefly discuss some preliminary evidence from the literature that suggests that this is the case.

Dr Johan Mårtensson has a PhD in experimental psychology from the University of Lund. In 2013, he held a Post-doctoral position in the Center of Lifespan Psychology (Mechanisms and Sequential Progression of Plasticity) at the Max Planck Institute for Human Development in Berlin Germany. He returned to Lund in February 2014 as a Researcher Department of Psychology (CCL) until taking a position in the Department of Logopedics, Phoniatrics and Audiology. He is interested in how the brain changes and adapts to learning. His work is predominately longitudinal and combines cognitive test batteries along with Magnetic Resonance Imaging. A continued theme and interest is brain change during language learning, with an ongoing study into the effects of game based intervention on children with reading difficulties.

While we know little about the neural correlates of statistical learning although some of the variance may be traced to individual differences in white matter density (Flöel et al. 2009; Frost et al. 2015). In this talk I will describe an investigation of auditory and visual statistical learning tasks related to white matter microstructure. A whole-brain search in major white matter connections using tract based spatial statistics revealed a correlation between visual statistical learning and white matter microstructure (Radial Diffusivity) in forceps minor (bilaterally), corpus callosum and areas adjacent to the left striatum and left hippocampus. These findings indicate that brain areas involved in learning and reward systems show differential white matter microstructure that is related to individual differences in statistical visual learning.

Professor Brendan Weekes trained as a clinical psychologist in Australia. He then worked at the University of Birmingham after completing a PhD at Macquarie University returning briefly to the Australian National University then relocating to the UK. Weekes has been a consultant to local and international organisations including the British Academy; British Dyslexia Association; Chinese Academy of Science; EU Directorate; International Dyslexia Association (US); Japan Society UK; Leverhulme Trust UK; Ministry of Health, Singapore; Nuffield Trust UK; Royal Society; UK Universities in China; Wellcome Trust and an Advisor to international agencies (Australian Research Council; Department of International Foreign Development (UK); Dutch Academy of Science; Erasmus Mundi (EU); NSF (US); Norwegian Government). Weekes joined HKU in 2010 to focus his research on multilingual language processing. Weekes was appointed Associate Dean for Higher Research Degrees in the Faculty of Education from 2011-2014. As Director of the Laboratory for Communication Science, Weekes secured new funding for the acquisition and maintenance of advanced technologies (EEG, TMS, Ultrasound). Weekes has a role with the National Science Foundation as an invited consultant to the Partnerships for International Research and Education (Penn State) and the Initiative on the Ethics of Emerging Technologies (UQ, UCSD). Weekes was seconded to the Universities Grants Committee in Hong Kong (2013-2014) as a local member of the RAE committee for the Health Science (Medicine) Panel. He is a Professorial Fellow in the School of Psychological Science at the University of Melbourne and a Honorary (Guest) Professor in the School of Foreign Studies at the University of Science and Technology, Beijing.

Weekes will report on emerging technologies in the Science of Learning with an emphasis on language learning in environments where the non-native language is the medium of instruction. He will argue that neuroscience models of learning require greater alignment with established theories in education, linguistics and psychology and present evidence of how new technologies can help to bridge this gap. Illustrations of how these technologies impact on pedagogy will be considered as well as the ethical issues that arise when testing in the classroom setting.

SYMPOSIA

SYMPOSIUM 3 – ADVANCES IN MEASUREMENT TECHNOLOGY: PROMISE AND PERSPECTIVE

SYMPOSIUM CHAIRS:

- Dr John Iversen, University of California San Diego
- Dr Melina Uncapher, University of California San Francisco

SYMPOSIUM SPEAKERS:

- Dr John Iversen, University of California San Diego
- Dr Tzyy-Ping Jung, University of California San Diego
- Dr Pasha Antonenko, University of Florida
- Dr Catherine Jordan, University of Minnesota
- Dr Ido Davidesco, New York University
- Dr Melina Uncapher, University of California San Francisco

OVERVIEW

The coming ubiquity of wearable sensors has the potential to impact the study of learning. One way this might be possible is in enabling ongoing measurement of the state of individual learners in the classroom setting, using methodologies such as electroencephalography (EEG) to measure brain state, as well as using new technology to unobtrusively measure biological and behavioral states. Another benefit of the liberation of research from the laboratory include the ability to study many learners in parallel, and begin to examine their interactions during the learning process. This symposium will present a range of perspectives on the intersection of measurement technology and learning in the classroom. Six symposium speakers from a range of disciplines will give brief talks introducing their views and methods and the session will finish with a group discussion. The speakers in this symposium are part of a delegation funded by the United States National Science Foundation's Science of Learning Program.

SPEAKER AND PRESENTATION OUTLINE

Dr John Iversen is Assistant Research Scientist in the Institute of Neural Computation, and Associate Director of the Swartz Center for Computational Neuroscience. A cognitive neuroscientist, he uses measurements of brain activity to understand brain mechanisms of learning, language, and music perception and production. He directs the SIMPHONY project, a five-year longitudinal study of the impact of music training on child brain and behavioral development. He will introduce the symposium and describe the NSF-funded Group Brain Dynamics in Learning Network, which is developing new technologies and methods for the use of EEG in the classroom.

Dr Tzyy-Ping Jung is Co-Director of the Centre for Advanced Neurological Engineering and Associate Director of the Swartz Center for Computational Neuroscience. He leads a multi-national research group focusing on several areas: 1) exploring neurophysiological processes of e-learning/training, 2) translating knowledge from neurophysiological studies into enabling brain-computer interaction technology for user-centric adaptive education and training, and 3) developing adaptive neuromodulation techniques with BCI feedback to enhance learner's performance. He will discuss latest developments in assessing multi-modal signals in real-world environments.

Dr Pasha Antonenko is Associate Professor in the School of Teaching Learning in the College of Education and is Director of the Educational Neuroscience Lab. His work focuses on a) developing, implementing, and studying frameworks and technologies to encourage and scaffold meaningful learning and 21st century skills, and b) psychophysiological assessment of cognitive processing to optimize the design of technology-enhanced learning environments. He will discuss research on the use of EEG to explore cognitive dynamics during authentic learning tasks.

Dr Catherine Jordan is Associate Professor in the Division of General Pediatrics and Adolescent Health. She directs the large, interdisciplinary Science of Nature-Based Learning Collaborative Research Network, which aims to understand possible mechanisms explaining how time spent in nature influences children's classroom learning and behavior through a focus on stress-reduction, attention, behavior regulation and motivation. Her talk will provide a brief overview of nature's impact on human learning and development and then present example studies illustrating a range of measurement techniques to provide a sense of the diverse approaches to investigating this topic.

Dr Ido Davidesco is Assistant Professor in the Collaborative Teaching and Learning Department and the founder of the New York University Neuroscience and Education Collaborative. He is developing and testing a neuroscience curriculum in which students design and conduct small-scale EEG experiments in the classroom. His presentation will describe EEG studies in high school classrooms that suggest students' brain-to-brain synchrony predicts classroom engagement and social dynamics.

Dr Melina Uncapher is Assistant Professor, Neurology, and Director of Education for Neuroscape. She studies the relationship between executive functioning and math and reading learning, and is developing the effect of executive function training on academic outcomes. She co-leads a recent large-scale initiative to foster research-practice partnerships (RPPs) in a new way, centered around the novel field of Learning Engineering. Her talk will present mobile assessment and intervention technology developed by her group, and moderate the panel discussion.

SYMPOSIUM 4 – THE STATE OF THE LEARNER: METACOGNITION AND SOCIAL SYNCHRONY

OVERVIEW

In this Symposium we will highlight two programs of research within the SLRC that demonstrate how common research questions can be addressed from both cognitive neuroscience and education perspectives. Our first example is meta-cognition – here Matthews will discuss lab-based cognitive neuroscience investigations on brain markers of readiness for learning. Carroll will expand on this to discuss a novel education-psychology based meta-cognitive training program that we are employing to determine if brain-markers of readiness for learning can be enhanced by this training. Our second example is learner synchrony. Painter will discuss a lab-based cognitive neuroscience investigation of how neural synchrony, measured in the brain of pairs of learners, increases as the pairs learn to collaborate on a task together. MacMahon will discuss learner synchrony from an education perspective, and describe how social synchrony can be measured in the classroom and how teachers can improve feelings of connection.

SYMPOSIUM CHAIR

- Associate Professor Paul Dux, The University of Queensland and SLRC

SYMPOSIUM SPEAKERS

- Dr Natasha Matthews, School of Psychology, The University of Queensland
- Professor Annemaree Carroll, School of Education, The University of Queensland
- Dr David Painter, School of Psychology, The University of Queensland
- Stephanie MacMahon, School of Education, The University of Queensland

SPEAKER AND PRESENTATION OUTLINE

Dr Natasha Matthews is a cognitive neuroscientist and research fellow in the SLRC. Our brain does not process all arriving information equally. Instead, our current brain state provides an important constraint on how we react to information. Fluctuations in brain states can be tracked by measuring oscillations in ongoing neural activity using electroencephalography (EEG). In particular, variations in pre-trial alpha oscillations have been associated with modulations in our sensitivity to incoming sensory information. Here we investigated

how fluctuations in pre-trial alpha influence our ability to encode numerical information and to engage in complex reasoning using that information. Participants where presented with two fractions, separated by a brief delay, and asked to indicate which of the two fractions represented the greater proportion. Across two conditions fractional quantities were represented either pictorially (as dot clouds) or symbolically (using standard fraction notation). Behavioural results demonstrated a fractional distance effect, whereby participants took longer to make the proportion judgment, the closer the numerical distance between the two fractions. This fractional distance effect was also present in event-related potentials (ERPs) recordings, which showed greater p3 amplitude for fraction pairs that had a small numerical distance between them. This effect was largest for fractions presented as dot clouds. There was also a significant correlation between pre-trial alpha amplitude and the amplitude of the p3 distance effect, suggesting that fluctuations in our readiness to receive information has important consequences for high level reasoning.

Professor Annemaree Carroll is Professor of Education, and a Chief Investigator in the SLRC. Meta-cognition describes the ability of a learner to reflect on their own thoughts and behaviour. Metacognition is the skill that allows a student who has learnt a strategy in a particular context to retrieve and employ that strategy in a new context. In particular, learning to control the focus of attention has important implications for learning across many settings. We have developed an education-psychology intervention program designed to train 12-14 year olds to manage and control the focus of their attention. We combine this training program with neuroscience methods for studying readiness for learning (as outlined in the proceeding talk) to determine the mechanisms by which improved meta-cognitive control of attention may improve cognitive performance. We combine these measures with clinical and behavioural ratings of attentional focus.

Dr David Painter is a cognitive neuroscientist and research fellow in the SLRC. In everyday life, it is often necessary for individuals to coordinate their actions with others to achieve common goals. Relatively little is known about the neural processes underlying such joint actions. Here we tested whether joint actions might involve coupling, or synchronisation, of brain states between co-actors. Pairs of participants used joysticks to manoeuvre a computer cursor to one of eight visual targets while we recorded neural activity using electroencephalography. In separate, randomly interleaved trials, participants were cued to perform the movement task either individually or jointly. Critically, throughout the experiment, participants were physically separated and thus not able to observe one another's movements directly. The cursor and visual targets flickered at unique frequencies, thus evoking unique steady-state visual evoked potentials. To test for evidence of neural synchrony, we employed a combination of time-frequency analyses, cross-correlations and deep neural network machine learning techniques. Cursor movements were faster and more direct under joint control than individual control. Additionally, joystick displacements were more highly correlated during joint control than individual control, indicating behavioural coupling. Moreover, neural activity between participants within each pair was more correlated under joint control than individual control conditions, consistent with neural synchronization. For the joint control condition, neural coupling was stronger for movements that successfully hit the target than for those that missed. Remarkably, neural coupling under joint control was even present immediately after the cue, but before movement onset, suggesting synchronization was initiated during the early stages of motor planning.

Stephanie MacMahon is a PhD candidate in the School of Education and a student in the SLRC. The classroom is a highly social environment with participants innately synchronizing their behaviours, thoughts and feelings with like others as a means of establishing connection (Farmer et al., 2016). Experiencing a sense of connection in the classroom is the outcome of shared actions, thoughts and feelings as groups work towards a shared goal, and has been shown to be an important aspect of effective teaching and learning. This sense of connection, or social synchrony, can occur spontaneously, but it can also be engineered (Wheatley, T., Kang, O., Parkinson, C. & Looser, C.E., 2012). However, the development and maintenance of connected environments is often left to chance or considered an outcome of experience, with many teachers – particularly novice teachers – not prepared for the challenges of engineering a socially synchronized learning environment. Through an exploration of the experience of socially connected learning environments, a Social Synchrony Matrix has been developed and trialled to support teacher awareness, knowledge and practice surrounding the establishment of social synchrony in the classroom.

ORAL PRESENTATIONS

TALK SESSION 1 - MATHS COGNITION, REASONING, AND CONFUSION

PRODUCTIVE STRUGGLE, CONFUSION AND REASONING IN INQUIRY SCIENCE

AFFILIATIONS

Dr Joseph Ferguson, Deakin University; Professor Russell Tytler, Deakin University; Dr George Aranda, Deakin University; Dr Radhika Gorur, Deakin University

ABSTRACT

Traditionally confusion is considered to be a negative experience in the classroom. However much research in cognitive science, drawing on research exploring impasse-driven learning and desirable difficulties, has demonstrated that confusion can be beneficial for learning. We seek to add another dimension to this exploration of the potentially productive nature of confusion by investigating how this might play out in the context of inquiry in the science classroom and how confusion might relate to reasoning. This has led us to focus not so much on confusion itself, but rather the productive struggle associated with such confusion. This project specifically explored inquiry based science learning in a collaborative environment. Over 6 lessons in distinct topics, year 7 students undertook a series of inquiry challenges involving reasoning through constructing representations. The lessons were conducted in the Science of Learning Research Classroom with multi tracked video and audio facilities that allowed capture and analysis of the talk and gesture of each student group. For our analysis we adopted a sociocultural perspective in which we made use of Peirce's work on doubt and the fixation of belief and Burbule's exploration of aporia. We also made use of Kapur's work on productive failure, which we suggest bridges the gap between cognitive and sociocultural approaches. By adopting such a perspective, we focus on the productive nature of the struggle that students can engage in when confronted with confusion, as opposed to primarily focusing on the confusion itself. We analysed episodes of confusion where the students were unsure of the concepts, nature of the task or resources that were central to solving the challenge. We identified a variety of resources students drew on, and pathways through which students engaged with the challenge, remained in a confused state or withdrew from the challenge. In our paper we present a model that identifies pathways by which confusion can stimulate productive struggle and productive outcomes for students and teachers, as well as when it does not.

Student responses to confusion in our model include: reasoning in multimodal ways; seeking further input from teachers and peers; shifting attention to different examples and previous examples; continuing with the current line of inquiry; and inactivity (withdrawing engagement from the task). These different responses are not mutually exclusive and often operate at different scales (e.g. students may seek the help of teachers as a part of their reasoning). Not all responses to confusion are productive, and what might be productive on one occasion may not be on another occasion. In other words, struggle can be productive but may not always be productive. We are particularly interested in the productive role that struggle may play in fostering students' reasoning. We argue that some degree of confusion is an inherent aspect of productive inquiry processes because it can generate productive struggle, through which students explore and construct problem spaces in complex and chaotic ways, engage in a variety of reasoning processes (deductive, inductive and abductive), and develop flexible solution strategies that can be transferred to novel problem scenarios. This struggle is not productive simply by virtue of it leading to a problem solution or to the acquisition of particular knowledge, although this may take place. Rather we agree with Kapur that this struggle sets students up for future learning by virtue of their deeper engagement with the problem space. Productive struggle provides students with the opportunity to begin their induction into the discursive practise of science – specifically the ability to creatively problem solve in the pursuit of discoveries. However, if students do not have access to the appropriate resources provided by the task or the teacher (inquiry must be guided), lack the required experience and knowledge (it is important for students to be resilient and comfortable with not knowing), and/or the confusion they encounter is not conceptually focused (confusion about the requirements was not generally productive) then confusion remains unproductive and students' struggle is a negative experience. Learning in this case is unlikely. We explore in this paper the conditions under which this struggle can lead to engagement with reasoning and learning and begin to outline the key features of such a process. This has implications for the design and implementation of inquiry based science learning.

ORAL PRESENTATIONS

TOWARDS A NEURO-COGNITIVE MODEL OF EARLY MATH COGNITION

AFFILIATIONS

Dr Sarah Gray, The University of Melbourne; Associate Professor Robert Reeve, The University of Melbourne

ABSTRACT

Background: Different neuro-cognitive models have been proposed to account for the origins and development of math cognition. These models include both domain-specific and domains-general factors. Core number abilities (identifying small sets of objects without counting and comparing different magnitudes) are evident early in life, and predict preschoolers' math competence (Gray & Reeve, 2014, 2016). Executive functions (Clark, Sheffield, Wiebe, & Espy, 2012) and vocabulary abilities (LeFevre et al., 2010) have also been linked to emerging math competence. A coherent model of early math cognition requires disentangling the role of these different factors in emerging math competence. Further, the nature of early math cognition itself is not well understood. It is becoming increasingly evident that early math competence is not a unitary construct, but comprises different abilities that emerge at different rates and/or sequences across children (Dowker, 2008). It is possible different cognitive markers are associated with different early math abilities. This study investigated the degree to which core number abilities, executive functions and vocabulary abilities predict different aspects of preschoolers' math competence. Understanding the cognitive markers of different early math abilities would help specify a neuro-cognitive model for identifying early math difficulties and possibly intervention strategies.

Methods: One hundred-twenty-five children (40- to 64-months old) completed core number (dot enumeration, magnitude comparison), working memory, response inhibition, and receptive vocabulary tasks, as well as nine math tasks (count recitation, object counting, constrained counting, naming numbers, number line marking, non-symbolic addition, non-symbolic subtraction, puppet addition, addition story problems). These math tasks were select because, individually, they are regarded as indices of early math ability.

Results: Confirmatory factor analysis of the math tasks identified three latent factors: counting, number relations, and arithmetic ability factors [$\chi 2$ (24, N = 125) = 25.49, p = .38; RMSEA = .022; CFI = .995; TLI = .002]. Structural equation modelling examining associations between these factors and the domain-specific and domain-general cognitive markers showed that, after accounting for all other factors, dot enumeration was associated with all three of the math factors. Magnitude comparison was associated with counting; and response inhibition and vocabulary abilities were associated with the arithmetic factor. The model was a good fit to the data [$\chi 2(72, N = 125) = 92.30$, p = .054; RMSEA = .047; CFI = .983; TLI = .930].

Conclusions: It is evident that emerging math competence comprises distinct math factors. It is also evident that different combinations of core number, executive function and language markers are differentially associated with different aspects of preschoolers' math competence. Overall, the patterns of findings suggest a more complex neuro-cognitive model of early numerical cognition is required than is commonly proposed. Further research is required to unpack the implications of this more complex model. Specifically, longitudinal research is needed to understand the significance of early cognitive markers for predicting later differences, delays or deficits in math achievement. This will have implications for understanding how best to support early math learning and for identifying children at risk of later math difficulties.

DECODING NEURAL REPRESENTATIONS OF FRACTIONAL QUANTITY IN THE HUMAN BRAIN

AFFILIATIONS

Professor Jason Mattingley, The University of Queensland; Dr Natasha Matthews, The University of Queensland; Ms Anica Newman, The University of Queensland; A/Prof Paul Dux, The University of Queensland

ABSTRACT

Understanding fractions is a core aspect of mathematical learning, yet relatively little is known about how the brain represents fractional quantities. A simple fraction consists of an integer numerator positioned above a line, and a non-zero denominator beneath (e.g., ¾). The numerator indicates the number of equal parts, and the denominator how many parts make up a whole. When children first learn about fractions, they are often shown pictorial examples (e.g., a cake or pizza divided into several equally sized pieces), on the assumption that such examples will help to develop the general concept of fractional quantities, and thus enhance understanding of simple fractions expressed as integers. It remains unknown, however, whether the brain represents fractional quantities as a common code, or whether separate representations are established for fractions in their numerical and pictorial forms. To examine this issue,

we recorded brain activity using electroencephalography (EEG) while young adult volunteers undertook a task that required them to compare the relative magnitudes of fractions presented in numerical or pictorial format. On each trial of the experimental task, participants were presented with two fractions, separated by a brief delay, and asked to indicate as quickly as possible which one represented the larger proportion. In separate trials, the fractions were presented either numerically, using integers displayed in conventional fraction notation, or pictorially as 'dot clouds' in which the numerator and denominator were instead depicted as different coloured dots. Participants were slower to make judgements about the relative proportions of the pairs of items within each trial as the magnitude of the difference between them became smaller, a phenomenon known as the 'fractional distance effect'. This effect is thought to reflect the fact that fraction magnitude is represented as a mental number line, along which fraction representations are ordered by magnitude. Analyses using a linear classifier were then undertaken to determine whether patterns of EEG activity elicited by pictorial fractions could be used to predict activity associated with numerical fractions, and vice versa. When trained on pictorial fractions, the classifier reliably discriminated between patterns of brain activity elicited by both pictorial and numerical forms. By contrast, when trained on numerical forms, the classifier reliably discriminated activity elicited by numerical but not pictorial forms. The findings suggest that fractions presented pictorially can be generalised into a numerical code, but that the reverse relationship – conversion of numerical fractions into an abstract pictorial code – does not occur spontaneously during relative magnitude judgements.

NEURAL CORRELATES OF BELIEF LOAD IN LOGICAL REASONING

AFFILIATIONS

Dr Maryam Ziaei, Centre for Advanced Imaging, The University of Queensland; Dr Mohammadreza Bonyadi, Centre for Advanced Imaging, The University of Queensland; Professor David Reutens, Centre for Advanced Imaging, The University of Queensland

ABSTRACT

Prior knowledge and beliefs influence our daily reasoning and may lead to drawing unwarranted conclusions and undesirable outcomes. However, the underlying neural correlates of interaction between belief and logic are relatively unknown. The aim of this study is thus to examine the neural networks that are modulated by the belief load of the premise or conclusion in different stages of reasoning using a syllogistic reasoning task. Thirty-one healthy volunteers (18-29 years old) participated in an fMRI study and responded to a series of syllogistic arguments while the belief load of the premises and conclusions was manipulated. Behaviourally, we found that participants were more likely to endorse believable premises, irrespective of the conclusions' content. Our fMRI results showed that unbelievable, but not believable, premises recruited cognitive control regions. While believable premises led to the central executive being engaged in later stages of reasoning (conclusion), unbelievable premises led to the engagement of brain areas such as the amygdala, suggesting that incongruency between one's beliefs and the problem's premises enlists the emotional regions of the brain. Two distinct brain networks were modulated by the belief load of premises and contributed to response accuracy. We have delineated the brain networks connected to the amygdala that hinder logical reasoning performance. This study provides novel insights into the importance of the contents of the premises – rather than the conclusions – contents during a syllogistic reasoning task. It has important implications for real life situations in which the ability to objectively reason is heavily influenced by strongly held prior assumptions. Based on these findings, training programs can be designed to improve students' abilities in logical reasoning.

TALK SESSION 2 - SOCIAL AND CULTURAL FACTORS IN LEARNING

LEARNING, FROM A SOCIAL PERSPECTIVE

AFFILIATIONS

Ms Sarah V Bentley, The University of Queensland; Katharine H Greenaway, The University of Queensland; Alex Haslam, The University of Queensland

ABSTRACT

Lev Vygotsky, proponent of a sociocultural approach to cognitive development, stated that "it is through others that we become ourselves". Vygotsky's ideas are still highly influential today, and have raised awareness of the importance of the dynamic between the learner and the teacher. Piaget, another cognitive developmental theorist, advocated peer group learning as the deepest and least constrained route to knowledge transmission, and Bandura's social learning theory highlighted the importance of a sense of identification between the learner and their learning environment. So, what are the cognitive mechanisms behind these famous theories of learning in which social context is so influential? We used a well-known cognitive paradigm within a tried

and tested social context manipulation to explore this question. In two experiments, we measured the impact of a sense of social connection to others on implicit levels of encoding and memory. We know that to encode material deeply—the ultimate form of learning—a student needs to integrate and assimilate incoming information in a way that sticks. And research has shown that the best way of doing this is to involve the self-concept in the encoding process—a cognitive schema known to be 'sticky' through both its elaborative and organisational qualities. This phenomenon, known as the self-reference effect, has been reproduced many times and in many different settings. But how, and under what conditions, does the self expand to incorporate incoming information from sources different from the self? To capture this, we took measures of both self-referential encoding and other-referential encoding within situations of social exclusion and social inclusion. Other-referential encoding describes the process of encoding information in relation to other people, rather than to the self, and typically, research shows that self-referential encoding generates superior levels of recall that other-referential encoding. In contrast, we hypothesised that when people feel a sense of connection to others—through social inclusion—that other-referential encoding would occur to a similar degree as self-referential encoding. As expected, when participants in both studies underwent a minimal social interaction in which they were socially excluded by another person, levels of other-referential encoding were significantly lower than self-referential encoding; thus reproducing the standard self-referential effect. However, when people were made to feel socially included, implicit levels of other referential encoding were no different than levels of self-referential encoding. Our results demonstrate the dynamic role of context in encoding and memory processes, and provide emerging evidence for the mechanics of learning in situ. When a person feels psychologically aligned with those around them, their self-related cognitive schema appears to expand to incorporate others in a way that facilitates the integration and retention of incoming information.

ENTANGLED MODES OF SOCIAL INTERACTION IN STUDENT COLLABORATIVE PROBLEM SOLVING IN MATHEMATICS

AFFILIATIONS

Dr Man Ching Esther Chan, The University of Melbourne; Ms May Ee Vivien Wan, The University of Melbourne; Prof David Clarke, The University of Melbourne

ABSTRACT

In Australia, teachers are expected to have intimate knowledge of the content of their subject area and how to teach it (AITSL, 2011). With the increasing emphasis on collaborative work in the Australian curriculum (ACARA, 2013), mathematics teachers are required not only to support and scaffold the mathematics activities of their students but also to facilitate effective collaboration between students. Greater understanding is required of collaboration as educational process and product, if teachers are to orchestrate optimal conditions for its development. This paper reports a study conducted in a laboratory classroom with the capability to record classroom social interactions in great detail using advanced video technology. The laboratory classroom offers possibilities for structured, rigorous, fine-grained investigation of the social aspects of classroom practice. The data from an intact class of Year 7 students (26 students) provide the focus of this report where the students attempted purposefully designed mathematical tasks individually, in pairs, and in groups of four to six students. The reported analysis addresses the question: What are the foci of the students' social interactions during pair collaborative problem solving of the mathematical task? The analysis suggests that meaning negotiation in mathematics classrooms can be usefully distinguished as occurring in three modes, each characterised by a specific negotiative focus: mathematical, sociomathematical, or social. The paper reports the proportion of time student pairs were spending on these three negotiative foci and discusses the implications of this for teacher scaffolding of student collaborative problem solving activities in mathematics.

REFERENCES:

ACARA [Australian Curriculum Assessment and Reporting Authority]. (2013). General capabilities in the Australian curriculum. Retrieved from http://www.australiancurriculum.edu.au/generalcapabilities/general%20capabilities.pdf

AITSL [Australian Institute for Teaching and School Leadership]. (2011). Australian professional standards for teachers. Melbourne, Victoria, Australia: Author. Retrieved from http://www.teacherstandards.aitsl.edu.au/static/docs/Australian_Professional_Standard_for_Teachers_FINAL.pdf

EXPLORING INTELLIGENCE IN HUMAN GROUPS

AFFILIATIONS

Mr Luke Rowe, The University of Melbourne; Professor John Hattie, The University of Melbourne; Professor Robert Hester, The University of Melbourne

ABSTRACT

Psychometrics is a field often linked to the development of theories, methods, and practices used to measure psychological aspects of 'individual differences.' Seldom, however, do psychometricians use their expertise to measure psychological aspects of 'group differences.' For example, do groups vary in their mental abilities (i.e., intelligence) in ways that are similar to individuals? If so, are psychometricians well placed to measure these psychological differences at the group-level? We answer in the affirmative, and support this position by providing evidence from three separate correlational studies that focus on measuring intelligence in groups; a term we refer to as 'Collective Intelligence.' The first study, comprising 29 groups from an Australian university setting, explores the notion of Collective Intelligence in human groups. Findings revealed a two-factor model of Collective Intelligence that is largely independent of the intelligence possessed by individual members, and combined to explain 63% of total variance in groups' performance on a battery intellectually challenging group tasks. The second study involved 20 groups, also from an Australian university setting, and sought to explore a novel method for measuring Collective Intelligence and individual member contributions thereof. Results from group and individual-level analysis further validated the previously mentioned two-factor model of collective intelligence; and also laid the theoretical foundations for a novel, closely related construct: The 'Individual Contribution Factor' or ICFx. This factor, representing an individual's ability to contribute to a group's Collective Intelligence, was shown to be unrelated to individual (i.e., IQ) or emotional (i.e., EQ) intelligence; despite sharing many features prima facie. The third study followed the previous study by assessing the predictive validity of the ICFx across a variety of tasks sampled from a well-established group-task taxonomy. The predictive validity of the ICFx was partially supported by the findings. We discuss specific theoretical and practical implications, while touching on the broader ramifications for those interested in measuring 'group differences' as they pertain to collective psychological constructs.

THE ROLE OF DRAWING IN REASONING AND LEARNING IN SCIENCE

AFFILIATIONS

Professor Russell Tytler, Deakin University; Dr Joseph Ferguson, Deakin University; Dr George Aranda, Deakin University; Dr Radhika Gorur, Deakin University

ABSTRACT

Drawing has been advocated as supportive of student learning in science within both cognitive science and sociocultural literatures. It's role in students' visualising is consistent with insights from neuroscience into the complex and multi-modal nature of perceiving and thinking. We have previously drawn on these traditions to identify five reasons to justify a renewed focus on drawing; to enhance engagement, to learn to represent, to reason, as a learning strategy, and to communicate. However, recent reviews of the literature on drawing show contradictory results as to the learning benefits.

We argue that drawing should not be viewed as simply a learning aid, as it tends to be characterised in the cognitive science experimental literature, but needs to be seen as a fundamental aspect of inquiry science processes. Accounts of how scientists produce knowledge now recognise the fundamental role of visuo-spatial representations in the imaginative practice of discovery. Studies by scholars such as Latour, Gooding and Nersessian show how epistemic practices in the sciences involve reasoning about relationships between multiple, multi-modal representations, material instruments and phenomena. We have been investigating a guided inquiry approach to learning and reasoning in science that draws on these insights. We argue that constructing representations productively constrains reasoned exploration and explanations of scientific phenomena. In researching this approach, our perspective draws on pragmatist accounts (Peirce) of the situated and contextual nature of problem-solving and knowledge generation. In this account representations actively mediate and shape reasoning, in contrast to traditional accounts where representations are cast as illustrative and communicative devices. Following Vygotsky and Magnani, we characterise representations as tools or epistemic mediators of thinking and knowing. We will present analyses of video sequences at the Science of Learning Classroom at the University of Melbourne, where groups of students respond to an open task by material exploration, representational work including modeling and drawing, and talking, to reason about phenomena. Our aim is to investigate a) the ways in which drawing can operate to support

reasoning and learning, and b) the conditions under which drawing is effective in promoting quality learning. The study involved video capture of lessons in the specially designed classroom with wall and ceiling mounted video cameras with zoom and tilt capacity, and radio microphones on each desk. We generated a continuous visual and audio record of the interactions of each of 12 groups, for each of six lessons on the topics of levers, flower structure and function, energy transformation in toys, and Earth's astronomical cycles . The analysis in each case was micro-ethnographic, with the research team actively and iteratively viewing the data, purposefully selecting episodes that represent a variety of ways in which student drawing supported, or was ineffective in supporting, reasoning and learning.

Findings: The analysis revealed a) a variety of ways in which drawing contributes to reasoning and learning, and b) key task features that affected the ways in which drawing contributed, or failed to contribute, to learning. First, in relation to the ways in which drawing can support reasoning and learning, we are able to generate analyses that show:

- Drawing is particularly powerful in combination with other modes such as 3D models, experimenting with equipment, gesture and talk
- Drawing acts to frame/constrain student attention to relevant details of phenomena
- The affordance of drawings lies in their visual and spatial specificity, which constrains student attention and enables self- checking of perceptions and subsequent refinement of perspective or interpretation
- Drawing exposes visuo-spatial aspects of student conceptions that can encourage self-checking, and through making thinking accessible to other group members, or teachers, provides opportunities for evaluation of ideas and negotiation of shared meaning

Second, in relation to the conditions under which drawing was (or was not) effective, a key distinction could be made concerning whether drawing played a generative role in the reasoning process, or a communicative role where students represented what had been learnt by other means. In tasks where students had been introduced to appropriate representational resources, drawing could be generative and creative. Where the task was conceptually difficult, without appropriate support, students could revert to ineffective abstracted verbal explanations with drawings not adding to their understanding.

Conclusion: The study has demonstrated the important roles that drawing can play in inquiry approaches to conceptual learning in science. It has revealed a number of ways in which drawings were generative of ideas, consistent with sociocultural pragmatist views of the active role played by representation in reasoning and learning. It has identified conditions needed for drawing of this type to be effective, and shown the challenges involved and the possibility of superficial and ineffective use of drawing if students do not have appropriate representational resources and supports. The study demonstrates that, with this variety of roles of drawing, we need to be very clear about the role played by drawing in studies of the contribution of drawing to learning. We argue that these sociocultural perspectives on drawing which foreground its role as a foundational discursive practice in scientific discovery processes allows for a richer and more nuanced view of its role in learning. Further, this focus on drawing as 'language' adds value, and complexity to the task of translating 'learning' across the domains of neuroscience, cognitive science, and sociocultural theorising.

SOCIAL LEARNING AND THE PROPENSITY FOR RITUALISTIC BEHAVIOR AMONG SOUTH AFRICAN BUSHMAN CHILDREN

AFFILIATIONS

A/Prof Mark Nielsen, The University of Queensland; Dr Rohan Kapitany, Oxford University; Prof Keyan Tomaselli, University of Johannesburg

Presented by: Matti Wilks, The University of Queensland

ABSTRACT

Though their relative prominence may differ, religious behaviour invariably features rituals, with some authors maintaining that ritual is critical in the maintenance of religion (Rappaport, 1999; Turner, 1967). Rituals are important as they help distinguish devoted in-group members from imposters or interlopers and, especially when costly (in terms of time, energy or physical endurance), can reliably indicate commitment to in-group beliefs. We regard rituals as a coherent series of actions characterized by formality, repetition, redundancy, stereotypy, and causal opacity, in which performance is more important than outcome, and little variability is permitted in the action's execution. Based on this we have argued that young children's strong, early-emerging sensitivity for ritualistic behavior can be found by evaluating their social learning proclivities, especially their readiness to copy visibly, causally irrelevant actions (Nielsen, Kapitany, & Elkins, 2015). In this presentation

we will present new data collected with children living in remote Bushman communities in Southern Africa. Fifty-five children, aged between 3 and 6 years and from 3 distinct cultural groups across two distinct geographical locations, were presented with two tasks involving novel boxes that could be opened by lifting up a hinged lid. An adult showed the children how to open each box (presentation order fully counterbalanced) involving a 3-action sequence incorporating a redundant (causally opaque) action (Action 1; e.g., wiping a stick across the top of the box 3 times), a causally related action (Action 2; e.g., placing the stick under a handle and lifting the door open), and an additional opaque redundant action (Action 3; e.g., tapping the side of the box). Children were presented with this sequence of actions in four different conditions. In two conditions a sticker inside the box was retrieved and shown to the child (Condition 1: sticker retrieved after all actions were modelled and Condition 2: sticker retrieved after Action 2 but before Action 3 - thus determining the likelihood of replication for goal-demoted actions). In two further conditions the functional goal of the demonstration was demoted further by either not retrieving the sticker (Condition 3 – where the sticker inside was visible but not touched during demonstration) or not having a sticker inside at all (Condition 4).

The redundant actions were reproduced at similar rates across Conditions 1 and 2, and across Conditions 3 and 4. However, in the latter two conditions the actions were performed twice as frequently as the former two. This highlights how causally opaque and goal demoted actions can lead children to take 'the ritual stance', whereby they attribute a rationale of cultural convention for demonstrated actions rather than one based on the laws of physical causation (Legare & Souza, 2012, 2014). Demonstrating this phenomenon in groups of children that differ across a host of social and cultural dimensions from Western, middle-class children (upon which the vast majority of developmental research is based) support arguments that this is not a culturally specific phenomenon while highlighting the ease with which young children can adopt religious ideas in the form of ritual. These data take on added importance when placed in the context of recent calls for data collection in psychology, and developmental psychology in particular, to be less homogenized and less concentrated on WEIRD (Western, Educated, Industrialized, Rich and Democratic) participants (Nielsen, Haun, Kartner & Legare, 2017). That is, they provide insight from a rarely-sampled population that is far removed, culturally and socio-economically, from the participants that are most commonly represented in psychological research.

TALK SESSION 3 - HIGHER EDUCATION AND DIGITAL LEARNING

APPLYING THE SCIENCE OF LEARNING TO HIGHER EDUCATION: A VIEW FROM THE EXPERTS

AFFILIATIONS

Prof Annemaree Carroll, School of Education, The University of Queensland; Dr Jason Lodge, Melbourne Centre for the Study of Higher Education, The University of Melbourne; Mr Rupert Bagraith, School of Education, The University of Queensland; Mrs Anita Nugent, Dr Kelly Matthews, Professor Sah Pankaj, The University of Queensland

ABSTRACT

As technologies and new approaches to learning impact on the ways in which students in higher education go about learning, it raises some questions about how best to facilitate student learning at university. Unlike K-12 contexts, university students are expected to manage their own learning to a large extent. In combination with a move away from didactic lectures and tutorials, this creates challenges for teachers in higher education who are often not comprehensively versed in theory and evidence underpinning student learning. In an attempt to understand what is the most critical evidence to convey to these teachers, world-leading experts in learning in universities were interviewed. Twenty-four experts from 10 countries across the disciplines of Education, Psychology and Cognitive Neuroscience were asked a series of questions pertaining to higher education teaching and learning including their views on good quality learning and recent research developments that may influence how students learn in the higher education sector. Using an integrated thematic analysis approach where a mixture of semantic and latent themes was identified, an interactive iterative process revealed seven distinct principles related to higher education learning. These were: Deep and meaningful learning; Contextualised and related learning; Higher order thinking and metacognition; Failure and confusion; Learning as becoming; Interactive learning; and Emotions and learning. This presentation will provide an overview of the study findings and will explore how the principles can be translated for effective university teaching in the 21st century.

ORAL PRESENTATIONS

DESIGNING FOR PERSONALISED LEARNING: INSIGHTS FROM A PILOT OF INTENSIVE MODE OF DELIVERY (IMD) IN A SCIENCE UNIT.

AFFILIATIONS

Ms Iwona Czaplinski, Queensland University of Technology, Science and Engineering Faculty; Dr Christine Devine, Queensland University of Technology, Science and Engineering Faculty

ABSTRACT

The digital learning environment offers unique opportunities for enhanced accessibility, engagement and flexible, personalised learning. However, recognising and acting upon these opportunities requires learners to be suitably equipped with the appropriate skills and competences for adapting to and succeeding in this learning environment. Moreover, individual human factors such as limitations of cognitive capacity (Sweller, Ayres, & Kalyuga, 2011) or various degrees of development of metacognitive and motivational skills (Hattie & Donoghue, 2016) influence the ways learners interact with the environment and impact on the acquisition of knowledge. Consequently, the issue of "how" to create an educational environment that will embrace learner diversity, enhance agency and enable personalisation of learning remains. Specifically, what factors influence learning design that supports individuals to become autonomous, expert learners (i.e. strategic, motivated, resourceful)? (Meyer, Rose & Gordon, 2014). The research presented here discusses a recent initiative undertaken by an interdisciplinary team composed of academics and educationalists which aimed to improve the learner experience and promote student engagement by flipping learning and intensifying face-to-face delivery, while emphasising collaboration and the development of individual learning skills. In the longer term, the initiative serves as a model to investigate the potential posed by a non-standard delivery mode to promote flexible, personalised learning. Animal Biology is a core third-year unit for students enrolled in the Biology major of the Bachelor of Science. The redesign team took a holistic perspective, one that goes beyond the procedural and timetabling constraints imposed by traditional unit delivery. The new teaching model was based loosely on an IMD, featuring modularisation of the unit content and a significant online component serving as a structural frame supporting learning design. The online platform reflected the organisation of the unit and contained four online modules, each providing learning resources to students. All four modules followed similar design principles: multiple means of representation providing unit content (e.g. videos, images, readings, and recommended websites), practical activities encouraging retrieval and consolidation (e.g. formative questions at the end of the videos, quizzes), and a dedicated online space for peer collaboration. Each online module was followed by an on-campus intensive day of face-to-face delivery involving lectorials, workshops and laboratory practicals, culminating in an assessment task. The intensive days promoted learning through inquiry and were conducted within collaborative learning environments and the laboratory. Students were provided with multiple opportunities to learn through a combination of demonstration, dissection, construction, experimentation and computer simulation.

A specific evaluation strategy was developed to establish the effectiveness and impact of the new mode of delivery, including a series of questions investigating students' engagement with the proposed model, their metacognitive awareness and motivational attitudes. The results of the study demonstrate the importance of making students aware of their metacognitive skills and specifically developing their learning skills.

The study identified metacognitive skills as critical for enabling personalisation of learning. More precisely, it appears that development of metacognitive learning strategies such as self-regulation and self-direction (strategic neural network) and motivational strategies (affective neural network) such as self-efficacy are crucial for personalised learning to be effective as it promote individuals' agentic attitudes towards learning, and therefore, expertise in learning. In addition, analysis of the data obtained from this pilot identify three interdependent aspects of learning design that warrant further investigation for enhanced iterations of the model: pedagogy, social agents (teaching team and students), and institution. First, at the level of task design, there is a need to investigate which learning activities not only stimulate cognition, but also positively affect strategic and affective neural networks. Second, how should we support teaching staff in developing their pedagogical approaches to enable the stimulation of the above-mentioned networks? How do we assist students adapt to the proposed pedagogy and encourage them to be receptive to opportunities for developing their learning skills, consciously selecting and taking them up?

Finally, to what extent is change at the institutional level necessary to support the proposed pedagogy? For example, introducing alternative teaching periods, flexible assessment arrangements and reconsidering curriculum. Further, should metacognitive skills be

taught explicitly within already overcrowded HE curricula? Research indicates that many learners, including university students, either lack self-regulation and/or self-direction, or have not developed these skills to the level required for becoming agentic, independent learners (Czaplinski & Mallet, 2016). The findings of the study have already informed the second iteration of the unit, allowing modifications in learning design with explicit focus on self-management and independence. Combined, these skills lead to expertise and equip students with the ability to adapt to change. The initiative described here represents a considered and strategic attempt to investigate factors impacting on the development and adoption of flexible, personalised learning processes in the higher education sector. In the longer-term, it aims at developing an experience-based, research-underpinned model for personalised learning.

REFERENCES:

Downes, S. (2016). Personal learning environments and technologies. Presentation in Berlin, Germany, 30th of November 2016. Retrieved 7th of June 2017 from: http://www.downes.ca/presentation/464

Czaplinski, I. & Mallet, D.G. (2016) Preparing future graduates to become lifelong, expert learners: Lessons and considerations from a blended learning engineering mathematics unit. In The Australian Conference on Science and Mathematics Education, 28-30 September 2016, The University of Queensland, Brisbane.

Hattie, J. A. C. & Donoghue, G. M. (2016). Learning strategies: A synthesis and conceptual model. Npj Science of Learning, 1, Npj Science of Learning, 2016, Vol.1.

Meyer, A., Rose, D.H., & Gordon, D. (2014) Universal design for learning: Theory and practice,

Sweller, J., Ayres, P., & Kalyuga, S. (2011). Cognitive load theory. New York: Springer.

FLIPPING GREAT: USING HYBRID LEARNING TO IMPROVE LEARNING AND ENGAGEMENT IN THE CLASSROOM

AFFILIATIONS

A/Prof Blake McKimmie, The University of Queensland; A/Prof Barbara Masser, The University of Queensland; A/Prof Mark Horswill, The University of Queensland

ABSTRACT

It is frequently claimed that the lecture is dead and that flipped, blended, or hybrid models of teaching are the new way forward. The format of the class per se is not what necessarily drives improvements in student learning and engagement however. How the class implements activities and assessment known to improve study behaviour and learning is what is important. We present data from two classes, taught in both flipped and traditional format, that included assessment tasks designed to promote spaced learning (learning spread out over time), repeated testing before and after content, and peer learning. Students showed increased engagement with the class, and improved learning both on individual assessment items and in terms of myths associated with the content areas they were learning about. While these methods of assessing students are easy to integrate in a flipped classroom due to the flexibility afforded by online lectures, they can also be used with traditional lecture format classes.

ASSESSMENT AND MEASUREMENT IN THE DIGITAL ERA

AFFILIATIONS

Associate Professor Sandra Milligan, The University of Melbourne

ABSTRACT

The technologies of the digital era provide both challenges and opportunities for educational assessment and measurement. For example, assessment analytics is an emergent field, built around the need to use new kinds of digital information about learning, and new analysis techniques and new measurement models. Application of techniques such as textual analysis, machine learning and data mining, combined with 'big data' from scaled learning platforms are extending educators' capabilities to improving learning, providing more and better quality feedback to learners and teachers. In addition, the digital era is generating changes in how teaching and learning is organised, in what counts as valued learning, and what the community wants to know about learners' attainments. Assessment practices are changing, underpinned by the idea that assessment of complex constructs is best thought of as the search for diverse evidence that enables an on-balance judgment of where on a progression of learning a learner can be placed. This paper describes several case studies which illustrate the sorts of opportunities that are now emerging, and describes the emergent trends in assessment, measurement, and credentialing of learning.

ORAL PRESENTATIONS

THE INNOVATIVE AUSTRALIAN UNIVERSITY; THE ROLE OF 3RD GENERATION POSTGRADUATE RESEARCH PROGRAMMES

AFFILIATIONS

Dr Luke Van Der Laan, University of Southern Queensland; Dr Jenny Ostini, University of Southern Queensland; Dr Lee Fergusson, University of Southern Queensland; Timothy Allred, University of Southern Queensland

ABSTRACT

There is overwhelming consensus that the time is right to reimagine higher education especially in the postgraduate research domain. Yet, universities are very slow to change with many exhibiting a monolithic group-think, defensiveness and resistance to change. This limits their ability to re-define the mission of their institutions through the awards they offer thus missing out on opportunities to optimise their value in times that demand greater higher education engagement. Postgraduate education has always been important to universities primarily in the area of research and / or contributing to professional practice. The emergence of professional postgraduate awards presented universities with a unique challenge: how to translate the advanced practice needs of professionals in the modern era, into postgraduate programs. The result to date has mostly focused on deepening (often dated) theoretical knowledge within a discipline area and applying this in a minor research component as a smaller proportion of the full award.

Universities should recognise that the governmental and workforce demands for higher education collaboration has doubled domestically. Yet governments and industry are increasingly frustrated by the lack of alignment with universities. As recently as 2015 the 'rise of professional doctorates' seems to indicate an increased need for postgraduate professional awards but little has changed in terms of the format, delivery and outcomes of the majority of these awards. This is a highly relevant issue that a) indicates the limited extent to which Australian higher education has responded to the shift and b) illustrates how higher education can contribute to the increasing demand for university / private sector collaboration and the generation of relevant original knowledge in professional practice. Universities should recognise the enormous potential of research undertaken by professionals that are in their mid- to senior-career. Driven by increasing lifelong learning aspirations, self-directed career development and a credential-driven employment environment, non-academic professionals are increasingly turning to higher education a) to validate and contribute knowledge informally gained in practice; and b) engage in contemporary non-traditional academic offerings that contribute to their professional development.

Traditional offerings, while still critical, fail to formally recognise the significant levels of multi-disciplinary professional knowledge of practicing professionals wishing to engage in higher education. Within current university offerings, the notion of more contemporary forms of multi-disciplinary postgraduate research aimed at recognising this unique need and opportunity, is limited and rare. A key premise of this paper is that current postgraduate research offerings in Australia are generally still embedded in traditional paradigms related to disciplinary knowledge acquisition (rather than professional practice research impact) and that their host institutions have been slow to adjust to rapid change and the priorities typifying the 21st century. A response to this 'lack of fit' between practice, further professional educational needs and the higher education sector, may lie in what are being termed '3rd generation' postgraduate programmes. This paper explores the notion of '3rd generation' postgraduate studies and how they may address these issues. It describes an evidenced form of such a program and defines its underlying principles, delivery, community, assessment and rationale. The paper also outlines what tensions may emerge in universities in adopting such programmes.

TALK SESSION 4 - MEMORY, ATTENTION, AND FEEDBACK

INCREASED STIMULUS COMPETITION DURING ENCODING RESULTS IN FEWER BUT EQUALLY ROBUST MEMORY TRACES

AFFILIATIONS

Dr Oliver Baumann, The University of Queensland

ABSTRACT

Forgetting can be accounted for by time-indexed decay as well as competition-based interference processes. While conventionally seen as competing theories of forgetting processes, Altmann and colleagues (2002, 2012) argued for a functional interaction between decay and interference. They revealed that, in short-term memory, time-based forgetting occurred at a faster rate under conditions of high proactive interference compared to conditions of low proactive interference. However, it is unknown whether interactive effects between decay-based forgetting and interference-based forgetting exist

in long-term memory. We employed a delayed memory recognition paradigm for visual scenes, measuring recognition accuracy at two time-points, immediately after learning and after one week, while interference was indexed by the number of images in a semantic category. In contrast to the findings in working-memory, our study showed that decay rate was not modulated by the level of interference during encoding. This indicates that while the encoding of several similar items results in the formation of fewer memory traces, these traces are as robust as those of unique single items. Our findings provide new insights into the mechanism of forgetting and could inform neurobiological models of forgetting.

RETRIEVAL PRACTICE BENEFITS IN THE CLASSROOM EVEN AFTER LOW RATES OF RETRIEVAL SUCCESS

AFFILIATIONS

Mr Jack Leggett, The University of Queensland; Dr Jennifer Burt, The University of Queensland; Dr Annemaree Carroll, The University of Queensland

ABSTRACT

Revision activities are often more effective when they involve memory retrieval. However, under realistic educational conditions, this advantage may depend on a high rate of retrieval success, such that students who are less capable with the material being revised may be better off revising without using retrieval. In our study, year 9 geography students listen to factual information, then revised some of it with a reading activity, some with a retrieval practice and feedback activity, and left some unrevised. We manipulated the presence of hints during revision—a factor that can affect the rate of retrieval success during practice and that is relatively easy for teachers to control. On a test of the material one week later, most students showed a benefit of retrieval practice, even those who had a low rate of retrieval success during revision. There was also some evidence that hints improved learning when they made retrieval practice easier. Our findings suggest that retrieval practice is advantageous for students of all ability levels as long as instructors ensure both prior exposure to material and attention to feedback. Implications for future applied research are discussed.

HOT & COLD FEEDBACK: HOW INSIGHTS FROM THE LEARNER CAN ENHANCE OUR FEEDBACK PRACTICES

AFFILIATIONS

Mr Luke Mandouit, The University of Melbourne

ABSTRACT

The influence of teacher feedback on student achievement is well established, but with wide variance in the levels of effectiveness between different forms of feedback acknowledged. In addition to this, the subjective nature of how each student responds to teacher feedback adds another layer of complexity to the feedback discussion. With most prior research completed through the lens of researcher and teacher, these studies investigate the influence of feedback from the learner's perspective, and aim to develop a deeper understanding of students' cognitive and emotional responses to teacher feedback. In providing their perspective, 103 student participants from years 10 – 12 were presented with a range of feedback samples, and asked: what they thought teachers were communicating; how this information would shape their future performance; and, how effective this feedback was through their own eyes as learners. Following this, interviews were conducted with a small number of these participants with themes identified in the first study discussed and elaborated on. Results from these studies support previous research in that different forms of feedback vary in their effectiveness and influence on the learner, and give new insights from the perspective of the student. This presentation will present an overview of these research studies, discussing: what information students consider useful to improving learning outcomes when receiving teacher feedback; and, proposing a model that represents the student's emotional and behavioural response to teacher feedback.

ORAL PRESENTATIONS

IS THERE A LINK BETWEEN STUDENTS' OFF-TASK MULTITASKING WITH MEDIA WITHIN EDUCATIONAL CONTEXTS AND THEIR ATTENTION AND MEMORY SKILLS?

AFFILIATIONS

Dr Karen Murphy, Menzies Health Institute Queensland and School of Applied Psychology, Griffith University, Gold Coast

ABSTRACT

Within University learning environments many students use internet capable technologies for off-task activities and this is referred to as multitasking with media (MwM) (also known as cyberslacking or cyberloafing). Unless two tasks are simple and well practiced, people show diminished attention and performance capabilities whilst multitasking due to cognitive limitations. Within educational contexts this explains why more MwM is linked to poorer academic performance. This study examined the link between MwM behaviours and student's everyday attention and memory skills. University students completed a survey measuring their MwM within academic contexts (lectures, tutorials, exam study, assignment writing and lecture capture viewing), and everyday attentional focus, mental errors and memory failures. Across all academic contexts, higher levels of MwM were associated with more mental errors, and more attentional focus and memory problems in everyday life. Higher levels of MwM were associated with higher levels of mind wandering for all academic contexts. Students undertook more overall MwM during assignment writing and exam study than when attending classes or reviewing recorded lectures. During exam study and assignment writing, students' MwM involved messaging, social media and listening to music. The impact of these MwM behaviours would be to shift between various cognitive processes and increase cognitive load, thereby reducing the effectiveness of these learning environments.

CATHODAL ELECTRICAL STIMULATION OF FRONTOPARIETAL CORTEX DISRUPTS INCIDENTAL STATISTICAL LEARNING FOR VISUAL CONFIGURAL INFORMATION

AFFILIATIONS

Ms Abbey Nydam, The University of Queensland, School of Psychology; Dr Paul Dux, The University of Queensland, School of Psychology; Dr David Sewell, The University of Queensland, School of Psychology

ABSTRACT

Much of what we come to know and learn about our environment is acquired incidentally; meaning without instruction or explicit awareness. In the laboratory, incidental learning can be studied using an adapted visual search task known as Contextual Cueing. Here, observers have to locate a target object within a visual context. Unbeknown to observers, some contexts are repeated over time, and people come to respond faster for targets appearing in repeated versus non-repeated contexts. While this behaviour is indicative of learning, people are typically unable to recognize or report the contexts they have learned, meaning the learning is implicit. This form of learning was believed to rely on deep, sub-cortical brain structures, such as the hippocampus; and was distinguished from explicit, goal-directed behaviours that involved the pre-frontal cortex. However, recent correlational evidence from imaging studies suggested that frontal and parietal brain areas may also be involved. My research employs a causal investigative technique, known as non-invasive brain stimulation, which allows one to temporarily alter neural activity a target brain area and record how it affects performance on a task. Using this technique, we found that learning during Contextual Cueing was disrupted by stimulation targeting both frontal and parietal regions. This indicates that frontoparietal regions are directly involved in the emergence of incidental learning that acts on visual contextual information. These findings help inform theoretical accounts of generalized learning mechanisms in the brain.

POSTER PRESENTATIONS

(Listed alphabetically by surname of the presenter)

DECISION-MAKING UNDER UNCERTAINTY: AN EEG STUDY FROM PARENTS AND YOUNG CHILDREN DURING COLLABORATIVE SOCIAL INTERACTION

AFFILIATIONS

Ms Julia Anna Adrian, University of California San Diego

ABSTRACT

Our actions are often motivated by the expectation of certain outcomes. We investigated the effect of reward expectancy and its violation during social interactions. The cortical oscillatory correlates of collaborative actions of parents and their children were measured using high-density EEG. Parent-child dyads (mean child age: 4.6 years) played a turn taking game with high and low reward outcomes after every turn. After participants had learned the rules of the game, the reward contingency was randomly reversed in 20% of trials, thereby eliciting prediction errors. Independent component analysis (ICA) was used to determine and exclude non-brain components. Children and parents both exhibited strong P3a and P3b positivity in response to their own high vs. low reward outcomes. Interestingly, during parents' observation of their child's action, the P3a was effected by the parent's expectation of high or low reward, but not by the actual outcome. This event-related effect might be an indication of parents' increased attention to the consequences of their children's actions. The effect of expectancy violation on children's event-related potential varies highly between individuals. Finally, preliminary results suggest that parent-child dyads exhibit patterns more closely related to each other than to other participants of the same cohort.

LEARNING OUTCOMES OF AYUSH YOGA PROTOCOL BY ROLE MODELLING OF INDIAN PM AT 2ND INTERNATIONAL YOGA DAY AT CHANDIGARH: PHYSIOLOGICAL AND BIOCHEMICAL BENEFITS

Professor Akshay Anand, Post Graduate Institute of Medical Education and Research, Chandigarh; Professor Natasha Sayal, Neuroscience Research Lab, Department of Neurology; Manju Mohanty, Department of Neurosurgery; Ashish Bhalla Department of Internal Medicine, Post Graduate Institute of Medical Education and Research, Chandigarh (India)

ABSTRACT

Background: Increased burden of obesity and associated ailments have been reported progressively with passage of time due to poor lifestyle and food habits. Even though Yoga is being increasingly documented for its homeostatic effects and being actively practised since time immemorial in India, yet it was not so popular and easy to learn until UN approved June 21 as the International Yoga Day and the Indian PM role modeled for Yoga on the eve on 1st, 2nd and 3rd International Yoga Day (IYD)-2016. 2nd IYD was held in the city of Chandigarh in India. About 30,000 individuals came forward to practice Govt's Yoga protocol standardised for this purpose. They were excited at the prospect of performing Yoga with Prime Minister. We used the opportunity to analyse the compliance, regularity and the effects of yoga in prevention and protection on healthy participants and trainers. Methods: About 86 healthy participants (naïve) were recruited who had not performed any exercise and yoga in past 6 months but wanted to learn Yoga in order to perform it with Indian PM. About 81 trainers were also recruited in the study. Naïve participants not only quickly learnt and performed standard AYUSH Yoga Protocol under the supervision of Yoga instructor but also practised the same for 1-3 months with regularity hitherto unreported before. Various physiological (POR, Weight, BMI and Systole-Diastole), neurocognitive and biochemical (TC, TG, HDL, LDL, VLDL, ratio, Glucose levels) parameters were simultaneously analysed before and after yoga intervention with the help of Chandigarh administration. Institute ethical clearance was obtained. Results: The 86 healthy volunteers comprised of male (n=34) and female (n=52) while the trainer group consisted of males (n=54) and females (n=27). The age range of the naïve participants was 18-55 years and for trainer group, it was 18-72 years. The data was compared between naïve pre and post yoga intervention for 1, 3 months, and further compared with trainer data to test the longitudinal effects of yoga. We found significant changes in Percent Oxygen rate (POR), Basal Metabolic Index (BMI) and weight after performing yoga protocol. Similarly, results also showed altered levels of HDL, TG, VLDL, ratio (HDL to total cholesterol). Moreover, neurocognitive analysis showed that executive functioning was significantly improved after yogic practice in naïve healthy participants. Conclusion: Our study shows role modeling of Yoga by National leader enhances adoption of lifestyle changes. The protective effect of Ayush yoga protocol in healthy and trainer groups show that charismatic leadership is required to adopt a healthy lifestyle. This data and leadership of role modelling can be usefully employed in integrating Yoga in Indian Hospitals for cost effective health management.

POSTER PRESENTATIONS

MERGING ADVANCES IN MOLECULAR NEUROSCIENCES WITH STRATEGIES IN EDUCATING CHILDREN WITH AUTISM SPECTRUM DISORDER (ASD)

Mr Jason Abbas Aramideh, The Brain and Mind Centre, Sydney Medical School, University of Sydney

ABSTRACT

Autism Spectrum Disorder (ASD) is primarily characterised by persistent deficits in social communication and social interaction, and restrictive and repetitive patterns of behaviour, interests or activities. Advances in molecular neurosciences have provided new insight into the causes of autism, such as prenatal neurogenesis, over-production of synapses and consequent abnormal connectivity of neurons, synaptic pruning deficits, to even abnormal neuronal cell activity and dopamine transporter issues. These findings implicate several new molecular agents into autism research such as the emergent role of microglial cells, genetic abnormalities in CELF6 or FOXP2, as well as genes responsible for dopamine and serotonin excess and deficiencies. There has not been any investigation, to date, on how these findings can help advise future educational strategies on learning for neurodiverse children, particularly those with ASD. This is largely due to ASD being categorised according to behavioural observation rather than through the molecular neurosciences. In this study, we surveyed the various strategies and methods employed by educational facilities in accommodating learning in students with ASD to examine how additions to such strategies can be made to better accommodate recent advances in ASD research. Given the advances in molecular neuroscientific findings on ASD such as dopamine and serotonin disruption and genetic mutations in synaptic pruning, current teaching strategies and techniques implemented require appropriate review considering these recent trends. In addition, we also suggest for the development of a science of learning advisory committee in Australia's education department to shape and mould future planning of teaching neurodiverse children with special needs.

CONFUSION AND LEARNING WITH INSTRUCTIONAL VIDEOS

Dr Amael Arguel, Macquarie University; Dr Mariya Pachman, Macquarie University; Professor Lori Lockyer, University of Technology Sydney

ABSTRACT

Learning from online videos on a variety of topics has become popular with the proliferation of online video-sharing platforms, such as YouTube or Dailymotion. The benefits of videos on learning are significant, especially when learning dynamic contents such as procedures (Berney & Bétrancourt, 2016; Lee & Lehto, 2013). Whether instructional videos offer numerous advantages, they can however lead learners to experience difficulties because of the transience of information (Ng, Kalyuga, & Sweller, 2013) and, in turn, contribute to causing confusion and missing learning opportunities (Lehman, D'Mello, & Graesser, 2012). The implementation in instructional videos of features designed to provide possibilities of controlling the pace of videos (e.g., play/pause button, manipulable progression cursor, etc.) could efficiently reduce the unwanted cognitive load caused by the transience of the information (Tabbers & de Koeijer, 2010). In addition, providing interactive controls is also likely to promote engagement, hence to be beneficial for learning (Kennedy, 2004). The aim of our study is to explore the effects of interactive videos on the levels of cognitive load and learning performance. We also aim to assess how interaction behaviours could be predictor of the level of confusion and to observe the relationship between measured levels of confusion and cognitive load. In a laboratory-based study, 51 university students were tested on a task that involved learning from instructional videos. The videos were extracted from the YouTube channel "Engineerguy" and presented the functioning of everyday technical objects. Four 5-min videos were selected and presented under two conditions: (a) interactivity, in which participants had the possibility to pause the videos and manipulate a navigation bar, and (b) non-control, with videos not being interactive, like a television program. Each video depicted in details the technical operation of devices such as a coffee maker or a smoke detector. Before each video, a short text describing a breakdown scenario about the device was given and participants were asked to provide an explanation about the most likely cause of the problem. Before and after each video, self-reported level of confusion was measured on a 100-point scale and level of cognitive load was assessed with a 9-point scale (Paas, 1992) after each video. The solutions given

before and after the videos to the breakdown problems as well as multiple-choice transfer questions were used to assess learning performance. All the interactions from participants with the control features of interactive videos were recorded. Our hypotheses focus on an improvement of learning with controllable videos, in comparison with non-controllable videos, as well as a decrease of measured cognitive load. It is also expected to observe a positive correlation between self-reported levels of confusion and cognitive load as well as possible specific patterns of behaviour that participants can produce when learning from interactive videos.

All data have been recently collected and analyses are in progress. Results of the study and implications will be presented and discussed at the conference. Some guidelines for the design of digital learning environments involving instructional videos will also be indicated.

REFERENCES:

Berney, S., & Bétrancourt, M. (2016). Does animation enhance learning? A meta-analysis. Computer & Education, 101, 150-167.

Kennedy, G. E. (2004). Promoting cognition in multimedia interactivity research. Journal of Interactive Learning Research, 15(1), 43-61.

Lehman, B., D'Mello, S., & Graesser, A. (2011). Confusion and complex learning during interactions with computer learning environments. The Internet and Higher Education, 15(3), 184-194.

Lee, D. Y., & Lehto, M. R. (2013). User acceptance of YouTube for procedural Learning: An extension of the Technology Acceptance Model. Computers & Education, 61, 193.208.

Ng, H. K., Kalyuga, S., & Sweller, J. (2013). Reducing transience during animation: a cognitive load perspective. Educational Psychology, 33(7), 755-772.

Paas, F. G. (1992). Training strategies for attaining transfer of problem-solving skill in statistics: A cognitive-load approach. Journal of Educational Psychology, 84(4), 429-434.

Tabbers, H. K., & de Koeijer, B. (2010). Learner control in animated multimedia instructions. Instructional Science, 38(5), 441-453.

DESIGNING TOOLS TO SCAFFOLD COLLABORATIVE LEARNING WITHIN MOOCS - A UQX PERSPECTIVE

Dr Aneesha Bakharia, The University of Queensland, UQx, ITaLI; Ms Linda MacDonald, UQx, ITaLI, The University of Queensland; Ms Anna Morris, UQx, ITaLI, The University of Queensland; Ms Wendy Chalmers UQx, ITaLI, The University of Queensland; Ms Carrie Finn, UQx, ITaLI, The University of Queensland; Mr Ankith Konda, UQx, ITaLI, The University of Queensland; Dr Sai Sun UQx, ITaLI, The University of Queensland

ABSTRACT

UQx has created 30 Massive Open Online Courses (MOOCs) for the edX platform covering a diverse range of topics. UQx courses combine video, simulation, social polling, visualisation and collaborative learning to deliver engaging learner experiences. We have developed a range of domain specific and generic open source custom tools to extend the social polling and collaborative tools available within the edX platform. In this presentation, the tools UQx has built to encourage decision making, enhance learner sense of community, improve critical thinking and reflection, scaffold assessment, facilitate the co-creation of knowledge and encourage citizen science will be discussed. The main focus of the presentation, however, will be on the importance of scaffolding collaborative learning activities within MOOCs and the tools that UQx is currently developing to facilitate that scaffolding. Currently, the discussion forum is the tool most used within MOOCs to foster collaborative learning; however, only between 5-10% of learners actively participate in a course discussion forum (Hill, 2013). Learners who actively contribute to the course forum are more likely to complete the course and achieve higher grades (Corrin, de Barba & Bakharia, 2017). In order to create structured collaborative activities and scaffold learner contribution, UQx is incorporating concepts from Computer Supported Collaborative Learning (CSCL) and the Knowledge Community and Inquiry (KCI) model in new tool development. To take learner collaboration a step further, a multi-perspective elaboration (e.g., SWOT analysis) and concept mapping tool are currently under development and have been designed to promote learner knowledge construction, curation, critical thinking and argumentation. The design principles that underpin future tool development and course learning design will also be discussed.

REFERENCES:

Corrin, L., de Barba, P.G., Bakharia, A. (2017) Using learning analytics to explore help-seeking learner profiles in moocs. In: Proceedings of the Seventh International Learning Analytics & Knowledge Conference. pp. 424-428. ACM

Hill, P. (2013) Mooc discussion forums: barrier to engagement? http://mfeldstein.com/mooc-discussion-forums-barriers-engagement/ [Viewed: 30 June 2017]

POSTER PRESENTATIONS

DISRUPTING TO DRIVING: TEACHERS' CONCEPTIONS OF STUDENT ENGAGEMENT

Ms Amy Berry, SLRC, The University of Melbourne

ABSTRACT

Student engagement is commonly associated with a variety of desirable outcomes, including academic achievement. For this reason, promoting student engagement in the classroom has become an expected part of being a teacher. Despite considerable research, a lack of conceptual clarity and consensus continues to plague the field. It is generally agreed that engagement is a multidimensional construct, although the exact nature of these dimensions is debated. The nature of the relationship between disengagement and engagement is a further source of contention within the research community. While many have argued that engagement can be conceptualised as varying in intensity or level of involvement on the part of the student, the existing tools for measuring student engagement rarely allow us to distinguish between qualitatively different forms of engagement that occur in the real world of the classroom. While it is widely accepted that teachers have the ability to influence the engagement of their students, much of the research has focused on attempts to measure student engagement, with far less attention given to exploring the strategies that can be used to promote it within the classroom. Given the lack of clarity in relation to what student engagement is and how it is best promoted in the classroom, this research seeks to understand how teachers conceptualise and operationalise student engagement in the context of their daily classroom experience. An initial interview study with 15 upper-primary teachers found most described two aspects to their role of engaging students, one being 'getting students engaged' and the other being 'keeping them engaged'. In addition, they described six qualitatively different forms of engagement and disengagement that are best represented on the same continuum. Disengagement and engagement were perceived to have both active and passive forms. Subsequent studies will seek to further develop this model as a basis for describing teachers' daily engagement interactions in the classroom.

"THIS IS A HELL FROM WHICH I SEE NO ESCAPE": CONTEMPLATIONS ON A FLIPPED CLASSROOM TRIAL

Dr Joanne E Brown, The University of Queensland; Associate Professor Winnifred R Louis, The University of Queensland; Ms Jennifer English, The University of Queensland

ABSTRACT

This presentation reflects upon implementation of a flipped classroom attempt which failed to engage low achieving students in a tertiary psychological statistics course. We identify the logistical challenges and barriers to success, including: 1) the insensitivity of low achievers to low-stakes assessment, 2) our unwillingness to assign high-stakes quiz and exam assessment due to the endemic nature of test anxiety within the course population, 3) high student numbers not being conducive to the successful performance of group activities, 4) audio-visual equipment difficulties in the flipped class teaching space, and 4) despite additional support, an insufficient ratio of tutors-to-students to supervise and assist flipped class activities. We close by reflecting on our employment and execution of new strategies for the course.

MAKING AN IMPACT WITH RESEARCH: ADDRESSING MATHEMATICS ANXIETY IN PRIMARY TEACHING

Dr Sarah Buckley, Australian Council for Educational Research; Dr Kate Reid, Australian Council for Educational Research; Professor Merrilyn Goos, The University of Queensland; Professor Ottmar Lipp, Curtin University

ABSTRACT

Maths anxiety is a significant challenge to effective maths teaching. Research suggests that students who are maths anxious are likely to have difficulties learning maths and therefore require extra help in the classroom. In addition to being experienced by students, maths anxiety is also reported by many teachers, particularly those in primary schools. Teachers who experience maths anxiety are likely to be less effective and less confident maths teachers. Research also suggests that students of maths anxious teachers are more likely to achieve at lower levels and have negative attitudes about maths. This presentation will describe a program of research within the Science of Learning Research Centre (SLRC) designed to investigate maths anxiety.

Our initial research aimed to explore the experience of maths anxiety among pre-service primary teachers, and sought to develop and trial strategies to assist them to better understand and address anxiety in themselves and/or their students. The next stage of our research will extend the focus of our initial study to classroom teachers and will trial an extended professional learning program designed to address maths anxiety. This research program illustrates two key principles of the SLRC. Firstly, adopting a multidisciplinary perspective – using education, psychology and neuroscience – as argued by Buckley, Reid, Goos, Lipp and Thomson (2016) affords a better understanding of the processes underpinning learning. Secondly, it is possible to use this multidisciplinary research to develop resources that will enhance educational outcomes in the classroom.

EVIDENCE-BASED COACHING: BUILDING CAPACITY, IMPROVING STUDENT OUTCOMES

Ms Rochelle Burton, SLRC, The University of Queensland

ABSTRACT

Teachers believe that current professional development models and practices do not always align with classroom requirements (Ischinger, 2009). Therefore, there is a need to ensure that effective professional development is made available that produces impact through improvement of student learning outcomes. Evidence-based coaching practices are rapidly growing within schools as a form of professional learning that are seen as supportive and individualised, with a focus on professional growth for teachers and improvement of student outcomes (Denton & Hasbrouck, 2009). This research aims to measure the influence of an evidence-based coaching model on primary teacher self-efficacy and investigate how changes in teacher practice impacts and improves student learning outcomes. The research design will utilise a mixed methods approach. Qualitative measures will be implemented through field observations of coaching participants, the collection of teacher pre-coaching questionnaires and recording of post-coaching teacher interviews. Student perception data, collected through the use of questionnaires and focus group discussions, will highlight how and to what degree these practices impact on student learning. Pre- and post- quantitative analysis of student writing samples will be used to measure the impact of the coaching on student learning outcomes. It is anticipated that the evidence-based coaching will instigate a change in teacher practice which will positively impact student learning outcomes.

ACHIEVEMENT EMOTIONS AND THEIR INFLUENCES ON THE COLLABORATIVE PROBLEM-SOLVING PERFORMANCE OF ADOLESCENTS

Mr Jesus Camacho-Morles, SLRC, The University of Melbourne, Dr Gavin Slemp, Melbourne University; Associate Professor Lindsay Oades, Melbourne University

ABSTRACT

Collaborative Problem Solving (CPS) is an activity that involves working with others to solve common challenges and achieve shared goals. Despite being recently named as one of the essential skills to be successful in the 21st-century workplace, little is known about the precursors and moderators of CPS skills in education. In particular, research addressing the complex interaction between adolescent emotional experiences and CPS performance remains unknown. This study took some of the first steps in exploring these relationships. Participants were 100 adolescent dyads (N = 200) whose work was to complete a series of five computer-based CPS tasks. The Achievement-Emotions Questionnaire (Pekrun et al., 2011) was used to monitor participants' achievement emotions during the CPS tasks. We report on the relative frequency of positive and negative emotions during CPS activities, as well as the relation between enjoyment, anger, and boredom to CPS performance when numeracy and gender are controlled. Implications of the study for intervening in an educational context to improve learning, performance, and student collaboration are discussed.

TRAINING THE MIRROR SYSTEM NOT TO IMITATE

Ms Megan Campbell, SLRC, The University of Queensland, Professor Ross Cunnington, The Queensland Brain Institute and the School of Psychology, The University of Queensland

ABSTRACT

The mirror neuron system is a network defined by neural responses to both action execution and action observation. These two processes are inter-twined and support all of human interactions. Whether these mirror properties are innate or acquired, is still a subject of debate. Associative Sequence Learning (ASL, Catmur, Walsh, & Heyes, 2009; Heyes, 2010) suggests mirroring properties are formed through learned associations - strengthening connections between certain sensory inputs and motor outputs.

POSTER PRESENTATIONS

We aimed to test the experience-based hypothesis of 'mirror' associations. Specifically, whether counter-imitation training differentially benefits task-relevant counter-imitation over the automatic imitation effects of observing task-irrelevant actions. If sensorimotor associations are completely malleable to experience, training to always oppose an observed action ought to affect both incidentally imitating a task-irrelevant action stimulus, as well as task-relevant intentional imitation. 78 participants attended 5 sessions across 5 consecutive days. Pre- and post-training session involving Stimulus-Response Compatibility (SRC) tasks, manipulated 3 factors: Response preparation (pre-defined or stimulus-relative) and Stimulus-Response Compatibility (matched or mismatched), task-type (action or spatial stimuli). Participants were grouped into 3 separate training conditions: 1) Counter-Imitation Training (CIT): mismatch the video-stimulus; 2) Imitation Training (ImT): match video-stimulus; and 3) Spatial Incompatibility Training (SIT): press opposite button to arrow-stimulus (a control for training response-inhibition). We found CIT reduced reaction times for mismatched over matched responses (mismatch cost), while the mismatch cost increased for the IMT group. This inverse training effect suggests mirroring is malleable, in line with Heyes' ASL account. However, the effects were specific to intentionally counter-imitating so simple SRC effects were still present after training.

PATTERNS OF COMMUNICATION: DYADIC INTERACTIVITY DURING COLLABORATIVE PROBLEM SOLVING IN MATHEMATICS

Dr Man Ching Esther Chan, SLRC, The University of Melbourne

ABSTRACT

The optimisation of classroom learning is a major focus in government policies and research efforts within Australia (e.g. COAG, 2012) and overseas (e.g. OECD, 2013). The sociocultural view of learning (Vygotsky, 1978), in particular, generated high interest in the role that a more able other (e.g. a teacher or a peer) might play in facilitating the learning of individual children. Contemporary theories such as Distributed Cognition (Hutchins, 1995, 2006) and the Social Brain hypothesis (Dunbar, 1998) continued the expansion of the notion of cognition from strictly an individualistic process to a collective process. In order to understand classroom learning, researchers therefore need to take into account the social interactions that occur as part of the classroom setting. This paper reports a study that utilised the laboratory classroom research facility located at the University of Melbourne. Classroom activities were purposefully orchestrated to make visible the socially enacted learning processes within a classroom setting. An interactivity analysis (Sfard & Kieran, 2001) was carried out based on the dyadic interactions between a pair of Year 7 students as they attempted an open-ended mathematical problem solving task. The fine-grained multimodal analysis highlighted different patterns of interaction between the students, such as instances where one person consistently ignores or responds (reacts) to the other person's utterances or frequently initiates new topics. In addition to its function as an analytical tool, the graphic display of interactive patterns, such as those identified in this study, can be used to inform teacher instructional interventions and even to catalyse student self-reflection.

REFERENCES:

COAG [Council of Australian Governments]. (2012). National education agreement. Barton, ACT: Author.

Dunbar, R. I. M. (1998). The social brain hypothesis. Evolutionary Anthropology, 6(5), 178-190. doi:10.1002/(sici)1520-

6505(1998)6:5<178::aid-evan5>3.0.co;2-8

Hutchins, E. (1995). Cognition in the wild. Cambridge, MA: The MIT Press.

Hutchins, E. (2006). The distributed cognition perspective on human interaction. In N. J. Enfield & S. C. Levinson (Eds.), Roots of human sociality: Culture, cognition and interaction (pp. 375-398). New York: Berg.

OECD. (2013). PISA 2012 results: What makes schools successful? Resources, policies and practices. Vol. IV. Paris: Author.

Sfard, A., & Kieran, C. (2001). Cognition as communication: Rethinking learning-by-talking through multi-faceted analysis of students' mathematical interactions. Mind, Culture, and Activity, 8(1), 42-76. doi:10.1207/s15327884mca0801_04

Vygotsky, L. S. (1978). Mind in society: The development of higher psychological processes. Cambridge, MA: Harvard University Press.

BRAIN-TO-BRAIN SYNCHRONY IN THE CLASSROOM: UTILIZING PORTABLE EEG IN SCHOOLS TO INTEGRATE RESEARCH AND EDUCATION

Ido Davidesco, New York University; Suzanne Dikker, Utrecht University; Lu Wan, University of Florida; Mingzhou Ding, University of Florida; David Poeppel, Max-Planck-Institute

ABSTRACT

How does the human brain support the complex dynamic interactions in a classroom? We used portable electroencephalogram (EEG) to simultaneously record brain activity from a class of 12 high school students over the course of a semester during regular classroom

activities. A novel analysis technique to assess group-based neural coherence demonstrated that the extent to which brain activity is synchronized across students predicts both student class engagement and social dynamics. This suggests that brain-to-brain synchrony is a possible neural marker for dynamic social interactions, likely driven by shared attention mechanisms. As part of this study, we developed an interactive neuroscience education program in which students became the researchers: they developed an EEG experiment, collected and analyzed data and presented their results.

INTRODUCING NEUROGAMING TECHNOLOGY TO NEUROSCIENCE EDUCATION: CREATING A PORTABLE UNDERGRADUATE TEACHING LABORATORY

Dr Bianca de Wit, Department of Cognitive Science, Macquarie University & ARC Centre of Excellence in Cognition and its Disorders (CCD); Dr David Kaplan, Department of Cognitive Science, Macquarie University & ARC Centre of Excellence in Cognition and its Disorders (CCD) & Perception in Action Research Centre (PARC)

ABSTRACT

Adopting active research-driven approaches in the undergraduate curriculum are known to greatly enrich student learning, yet relatively few undergraduate students are given the opportunity to participate in research activities or gain meaningful laboratory experience. This is especially true for neuroscience education due to the prohibitive costs and technical demands of the research equipment that is required. Our innovative project circumvents these factors and leverages commercial EEG-based neurogaming technology to integrate valuable research experience in the undergraduate cognitive and brain sciences curriculum at Macquarie University in Sydney. Specifically, using this technologically we created an affordable, scalable, and portable teaching laboratory that gives undergraduate students the opportunity to participate in hands-on, exploratory research activities designed to augment their understanding of key neuroscience concepts and provide a unique real-time glimpse at the workings of the human brain. Results demonstrated that students enjoyed the lab sessions. Furthermore, students indicated that the lab sessions augmented their understanding of the course material specifically and their knowledge about EEG and cognitive neuroscience research in general.

EXPLORING THE EFFECTS OF STIMULATING THE FRONTOPARIETAL ATTENTION NETWORK WITH HIGH-DEFINITION TRANSCRANIAL DIRECT CURRENT STIMULATION (HD-TDCS) ON SPATIAL ATTENTION

Yuqi Deng, Boston University

ABSTRACT

High definition transcranial direct current stimulation (HD-tDCS) is a non-invasive brain stimulation method that allows focused stimulation of target cortical areas. It changes brain functions by changing neural excitability, and it has the potential to affect long term potentiation or long term depression. Traditional tDCS over the frontoparietal network has been shown to improve alertness and visuospatial attention. However, due to the lack of focalized stimulation and controversy in findings, there is not enough evidence to prove this causal relationship. The aim of this study is to further explore the behavioral and electrophysiological effects of HD-tDCS on different regions of the frontoparietal attention network. In this study subjects perform an active spatial attention task. An auditory stream composed of 80% repetitive and 20% infrequent complex tones is played in both left and right directions simultaneously. Spatialized sound effects are simulated with head related transfer functions (HRTF). Subjects are cued to attend to either the left or right stream and press a button when a deviant tone is detected. Each subject participates in a tDCS stimulation session and a sham control session on two separate days. We compare both sessions and study how the stimulation may affect the reaction times and attentional modulations of EEG metrics. The neural signatures for attention we will investigate in include event related potential (ERP) and brain oscillation in alpha band (8-14Hz). Both have been shown by extensive evidence to be modulated by spatial attention.

LEARNING IS NEUROLOGICAL, EDUCATION IS SOCIOCULTURAL: INTEGRATING THE SCIENCES OF LEARNING

Mr Gregory Donoghue, SLRC, The University of Melbourne

ABSTRACT

Given the seductive appeal of neuroscience, what contribution has it actually made to educational practice? I report data from a meta-analysis and systematic review of the neuroeducational, psychological, and educational literature that shows significant limitations in all three

disciplines. I argue that these limitations reflect what is absent from education , neuroeducation and Science of Learning: a valid over-arching theoretical framework. To address this, I propose a conceptual model of human learning that integrates and situates each of these disciplines such that practical, valid and meaningful translation is possible.

HOW DOES PARENTS' MATH ANXIETY RELATE TO THE QUALITY OF PARENT-CHILD TALK ABOUT NUMBER DURING PRETEND PLAY?

Dr Sarah Eason, University of Chicago

ABSTRACT

There is evidence indicating that parent math anxiety undermines involvement in children's math learning during the elementary school years. Less is known about the mechanisms through which this occurs, or whether parents' math anxiety plays a role in younger children's math learning. Parents' number talk predicts children's early math knowledge and there are variations in quantity and quality of parents' number talk, but it is not clear what factors contribute to this variability. This study examined how parent math anxiety relates to young children's engagement in number talk during play, and whether this relation is mediated by parents' own number talk. Fifty dyads of two- to four-year-olds and their parents were videotaped while playing with a kitchen playset that included wooden foods cut into pieces, a cutting board and knife, and four plates and cups. This activity was selected for offering rich opportunities for number talk without explicit numerical content so that there was potential to observe variation in number talk. Child and parent number talk was coded and parents completed a survey including items regarding their math anxiety and beliefs about the importance of math for preschoolers. We found that parents' math anxiety was a significant predictor of children's number talk, and that this relation was fully mediated by parent number talk. However, it was only parents' prompts for children to talk about number that mediated the relation between parent math anxiety and child number talk; parents' statements about number was not a mediator. Therefore, parents' math anxiety may play a role in the quality of parent-child number talk. That is, by using fewer prompts, math-anxious parents' number talk may not actively engage children in as much number talk, ultimately limiting children's learning from number talk exchanges.

ANODAL TDCS APPLIED DURING MULTITASKING TRAINING LEADS TO TRANSFERABLE PERFORMANCE GAINS

Dr Hannah Filmer, The University of Queensland; Mr Maxwell Lyons, The University of Queensland; Professor Jason Mattingley, The University of Queensland; Associate Professor Paul Dux The University of Queensland

ABSTRACT

Cognitive training can lead to performance improvements that are specific to the tasks trained. Recent research has suggested that transcranial direct current stimulation (tDCS) applied during training of a simple response-selection paradigm can broaden performance benefits to an untrained task. Here we assessed the impact of combined tDCS and training on multitasking, stimulus-response mapping specificity, response-inhibition, and spatial attention performance in a cohort of healthy adults. Participants trained over four days with concurrent tDCS – anodal, cathodal, or sham – applied to the left prefrontal cortex. Immediately prior to, 1 day after, and 2 weeks after training, performance was assessed on the trained multitasking paradigm, an untrained multitasking paradigm, a go/no-go inhibition task, and a visual search task. Training combined with anodal tDCS, compared with training plus cathodal or sham stimulation, enhanced performance for the untrained multitasking paradigm and visual search tasks. By contrast, there were no training benefits for the go/no-go task. Our findings demonstrate that anodal tDCS combined with multitasking training can extend to untrained multitasking paradigms as well as spatial attention, but with no extension to the domain of response inhibition.

THE ROLE OF MUSIC IN TEACHER WELLBEING

Dr Libby Flynn, SLRC, The University of Queensland; Professor Annemaree Carroll, School of Education, The University of Queensland; Dr Julie Bower, School of Education, The University of Queensland; Ms Emma Sanders, School of Education, Science of Learning Centre, The University of Queensland

ABSTRACT

The concept of 'readiness for learning' is largely student-centric, with focus drawn to student's development, engagement, their learning environment, stress and wellbeing. It could be argued however that all of these factors are just as imperative to consider for teacher's in relation to their readiness towards the act of learning in the classroom. Improving wellbeing, regardless

of age, is a global agenda. In recent years, the World Health Organisation (2013) announced their current action plan for mental health, listing prevention as one of the key objectives, with a specific focus on strategies that will assist in the promotion of mental wellbeing. Drawing from a recent study which aimed to improve teacher wellbeing, the following paper will unpack one component of the intervention; music therapy. Specifically, focus will be drawn to the pre and post intervention findings for the Healthy Unhealthy Music Scale (HUMS) which was originally developed as a scale to measure musical engagement as a predictor of wellbeing in adolescents (Saarikallio, Gold, & McFerran, 2015). Results will be further discussed in relation to 'real world' accounts and the potential for top-down approaches to change. Looking forward, the role of music in the classroom for emotional regulation and wellbeing purposes will be considered.

WHEN CHILDREN LEARN DIFFERENTLY FROM A DIGITAL SCREEN THAN A LIVE DEMONSTRATION

Mr Frankie Tze-Kiet Fong, The University of Queensland; Associate Professor Mark Nielsen, School of Psychology, The University of Queensland

ABSTRACT

Different cultural groups develop a vast diversity of problem solving methods that are suited to their living environment and style. Even as adults, we spend a substantial amount of effort learning processes of problem solving, and improve those processes over time. Yet, when we move to a new environment or cultural group, we may change our usual ways of doing things and trouble ourselves to learn the normative ways (which everyone uses) of the new group. If cultural diversity is to be maintained across different groups, then group-specific skills and conventions need to be transmitted to future generations with high fidelity. To date, little is known about the social and cognitive foundations of this inclination to act as those around us act. Some hints come from previous research, which has shown that children will involve high-fidelity imitation and adherence/enforcement of normativity in their learning. However, there are instances when the motivation of instrumental functionality is stronger than the social motivation to conform with our own group. Thus, the aim in this study was to examine whether children would adopt and learn a normative way of completing a functional task in a novel setting, or select a more efficient and less effortful way that is readily available. Four- to six- year old children were shown sub-optimal and optimal ways of retrieving a sticker out of two apparatuses. Children were required to lift a mini bucket from a tube, and also to push a mini container out from one side of a box. They could either build a tool (using Lego; using magnetic fragments) or use another readily available tool (a pipe cleaner; a dowel) to complete the tasks. Critically, both ways were equally functional just that one was less efficient than the other, and the sub-optimal way was always identified as normative, i.e. a socially preferred way. There were 3 conditions in Experiment 1: a) 'Everybody normative', where the experimenter told children everybody uses the sub-optimal tool; b) 'Nobody normative' (the opposite of the first condition), where the experimenter told children nobody uses the optimal tool; and c) 'Baseline', where the experimenter told children some people uses the sub-optimal tool. Results revealed no difference across conditions, as most children chose the optimal way to complete the tasks regardless of condition. One possible explanation of this finding was that children did not interpret the sub-optimal way as normative given that the experimenter (Asian) was of a different ethnic group to the majority of the participants (Australian Caucasian) and hence could be considered to be an out-group member. To test the validity of this explanation, an Australian Caucasian experimenter was used to conduct a follow up experiment. Only the 'everybody normative' condition was repeated since this was the most crucial condition. Results showed no significant effect of experimenter. That is, regardless of the experimenter's cultural background, children adopted the instrumental/functional approach to solving the task rather than the normative conventional means. Perhaps relying on verbalization was insufficient to induce a normative response. Therefore, in Experiment 2, a group condition was introduced with additional adults observing, agreeing (by nodding) with the sub-optimal and disagreeing (shaking their heads) with the optimal tool options. This was compared to an individual control condition where the model appeared on his own and hence there was no group consensus. Demonstrations were shown through video clips on a laptop computer following the same procedures as the 'everybody' condition in Experiment 1. Two minor amendments were made: a) A phrase of "but nobody here uses this one" was added when the optimal tools were shown to emphasise the normative approach taken, and b) the task materials were provided on a small tray for easier access. In contrast to Experiment 1, children chose the sub-optimal tool – however, they did so regardless of whether there was a group context or not (i.e., there was no difference across conditions). A possible explanation for this different pattern was that the video presentation also included a zoomed

in screen showing the model building the sub-optimal tool, potentially drawing attention to it. A follow up experiment where the zoomed in screen was excluded failed to validate this. Another possible explanation for this difference was the two amendments in Experiment 2 might have combined to help children identify which was the optimal way and which was normative. To test this interpretation, a live version of the individual condition was conducted. Intriguingly, children switched to using the optimal tool, just like Experiment 1, suggesting the results of Experiment 2 were not to do with changes in narrative or experimental set-up but rather were due to the medium of presentation. The finding of this study is unexpected but indicates that children are more inclined towards a normative mode of learning while watching a demonstration through a digital screen than live, where they seem to pay more attention to instrumental/functional information (which is more goal directed). Young children may thus perceive a live interaction as a pedagogical teaching activity but the same information presented on a screen as conveying conventional information. Ongoing experiments are aimed at testing this hypothesis.

USING PORTABLE TECHNOLOGY FOR POSITIONAL MAPPING OF TEACHERS AND STUDENTS

Dr Felicia Goh, SLRC, The University of Queensland, Professor Annemaree Carroll, The University of Queensland; Professor Robyn Gillies, The University of Queensland

ABSTRACT

Monitoring teacher and student interactions has traditionally been undertaken by classroom observers. However, real-time movement tracking of all students and their teacher is tedious and often unmanageable for a single live observer in an unpredictable environment. Similarly, it is difficult to ascertain positional information from video footage if cameras are inadequately placed. The increasing mainstream availability of portable devices that have positional information capabilities has created an opportunity for accurate locational mapping of teachers and students for education-based interaction or relationship studies. To assess the potential use of portable technology to track relative classroom movements, we used Sociometric Badge devices to observe a Year 7 class doing groupwork under teacher guidance in a 27min period. 9 of the 16 students, as well as their teacher, were equipped with a Sociometric Badge worn around the neck at chest height, each of which recorded number of detections of every other badge via Bluetooth (proximity detection in a circular area around the device) and infrared (face-to-face detection in a 30 degree cone in front of the device) technology. The count of student-to-student Bluetooth and infrared detections was significantly higher within groups compared to between different groups. In addition, monitoring teacher proximity to individual students over the length of the lesson is feasible. Ultimately, portable devices could automate the collection of positional data for classroom studies and may serve as an indicator for student-student and teacher-student interactions.

CHALLENGING ASSUMPTIONS ABOUT YOUNG CHILDREN'S CAPACITY TO UNDERSTAND ATOMIC-MOLECULAR THEORY

Dr Carole Haeusler, University of Southern Queensland; Dr Jennifer Donovan, University of Southern Queensland

ABSTRACT

Narrow interpretations of Piaget's work which infer that children cannot handle the big ideas of science until they develop abstract thinking at age 14, appear to have dominated the design of science curricula in Australia, US and UK. This practice conflicts with the cognitive psychology literature, which shows that rather than following distinct hierarchical stages, children's cognitive development is variable. What young children are capable of is largely dependent on their prior opportunities to learn. This paper provides empirical evidence that following a teaching intervention about atoms and sub-atomic particles, normally taught at high school, primary aged children are capable of understanding and applying these concepts. The qualitative study used semi-structured individual interviews before, immediately after and 8 weeks after an intervention to ascertain children's understandings. Our data, collected from Grade 3 and Grade 4 classrooms in three schools following a 10 hour intervention using models and interactive activities, shows that many of these children demonstrate understanding that matches that of much older children and is consistent with elements of a published Empirical Learning Progression of Matter (ELPM). The authors propose that leaving the introduction of particle theory until middle school and the more advanced atomic-molecular theory until high school as is common in the Australia and the UK, leaves primary children without the opportunity to develop a conceptual explanatory framework for everyday phenomena involving matter and may in fact contribute to the development of misconceptions which persist in high school and beyond.

LEARNING SOPHISTICATED CONCEPTS IMPOSES A PROCESSING LOAD

Professor Graeme Halford, The University of Queensland and Griffith University; Associate Professor Glenda Andrews, Griffith University

ABSTRACT

Acquisition of sophisticated symbolic STEM concepts causes additional difficulties in pedagogy. The key to symbolic concepts is structures that provide an operating system and define the meaning of the concept. These structures can be conceptualised by relational knowledge which carries a large body of cognitive science contributions that have, so far under-utilised, potential for the science of learning. The crucial process is assignment of entities to slots in a structure. This entails two classes of cognitive processes, knowledge and working memory. An example of assignment by knowledge would be: "The horse is heavier than the dog. The elephant is heavier than the horse. Which is heavier, elephant or dog?" This requires a minimal role for working memory. An example of assignment by working memory would be: "Tom is taller than Peter; Bob is taller than Tom, who is taller Bob or Peter?'. The assignment must be made by placing the elements into an ordering schema Bob, Tom, Peter. This cannot be done by knowledge because of the arbitrariness of the premises. It require structure-consistent mapping in working memory, a process that is now well documented in the theory of reasoning, especially in the analogy literature. It follows that working memory is more important in acquisition of new knowledge. This entails the theory of capacity limitations in working memory which in turn entails the relational complexity metric. It follows that relational knowledge theory has considerable potential for the science of learning symbolic processes.

WALL-E CAN TEACH ME THAT: YOUNG CHILDREN IMITATE HUMANOID ROBOTS, BUT ONLY WHEN THE TASK IS SIMPLE

Ms Kristyn Hensby, The University of Queensland; Professor Virginia Slaughter, The University of Queensland; Associate Professor Mark Nielsen, The University of Queensland; Professor Janet Wiles, The University of Queensland

ABSTRACT

Imitation is universal, intrinsically social and emerges early in the first two years of life. Imitation has been well-documented in previous research, and any barrier highlighted. Biological mismatches between a child's body and a demonstrator also impose a deficit. Children who observe pincers, rather than hands, imitate at a much lower rate. Little research has looked at whether children suffer a deficit in imitation when observing a humanoid robot demonstrate the required task. A previous study found that for simple tasks, young children can imitate robots on a screen. However, it is unknown whether children can imitate more complicated sequences demonstrated by a live robot and how this compares to traditional human demonstration. We presented 22 children (11 per condition) aged between 22 and 36 months with two goal-directed imitation tasks (a simple task and a complex task) modelled either by a humanoid robot or a human. Children were scored on how many actions they completed in sequence for both tasks. In the simple imitation task a Kruskal-Wallis indicated that there was no significant difference between performance in the human condition (Mean Rank = 12.36) and robot condition (Mean Rank = 10.64), H (corrected for ties) =0.482, df = 1, N = 22, p = .488, Cohen's f = .153. However, in the complex imitation task, a Kruskal-Wallis indicated that there was a significant difference between performance in the human condition (Mean Rank = 14.27) and robot condition (Mean Rank = 8.73), H (corrected for ties) =4.485, df = 1, N = 22, p = .034, Cohen's f = .521. This study indicates that young children are capable of imitating robots when the task is simple, however children begin to perform poorer as the complexity of the task increases when the demonstrator is a robot. This may occur due to either a biological mismatch between the child and robot's "hands" or due to a lack of strong social motivation as complexity begins to tax cognitive load.

A CASE STUDY: THE SCIENCE OF COMMUNITIES OF PRACTICE

Mr Andrew Jones, SLRC, The University of Melbourne, SLRC; Mr Vetere Frank, Department of Education and Training (Victoria)

ABSTRACT

'We have sold ourselves into a fast food model of education and it is impoverishing our spirits and our energies as much as fast food is depleting our physical bodies.' — Sir Ken Robinson. Frameworks referencing synthesised bodies of prominent research adorn education improvement policy like curiously named pieces of Ikea furniture. Peculiar in their assemblage, ostensibly contemporary and striking in their modular convenience. Amidst this, most pundits still agree that we have an education advancement issue in this country. Despite significant increases in funding from successive

federal and state governments, we simply haven't been able to shift the needle. What we can ascertain from all this is that compliance-based improvement approaches don't work. They are unable to influence the cognitive maps, beliefs and understandings of the educator to the extent necessary to effectively improve outcomes for students at scale. Paradoxically, advancements in learning research means we know more about learning now than at any other time in human history. Neuroscience, cognitive psychology and pedagogic research offer empirical insight into better understanding, measuring and promoting human development. However, despite this increased emphasis on learning research, one must ask: What has been the impact of this new knowledge really? Schools are awash with professional development options. So, in an age of such proliferation of professional learning and new information for teachers, is it that our school-based practitioners are simply overfed and undernourished? The Science of Learning Research Centre was established in 2012, funded as an Australian Research Council Special Research Initiative and founded to improve learner outcomes in Australian classrooms. Four years later, the extensive transdisciplinary learning research is connecting with Australian schools in a very powerful way indeed. The Science of Learning Network of Schools (SoLNoS) is a research translation initiative, designed to create the necessary platform for schools and researchers to work better together in the implementation, development and refinement of learning research. The best professional learning communities not only have access to quality research, but they are also capable of engineering and implementing adaptive structures and systems that respond to the changing external environment and demands. These schools have a strong learning culture. The SoLNoS supports school leadership teams and syndicates of schools with critical guidance and access to the most relevant and reliable learning research available. Learning research that is specifically related to their school improvement strategy and individual context. In doing so, the SoLNoS is able to assist school leaders in establishing and nurturing the conditions conducive for powerful professional learning to occur. This is a case study of a true Community of Practice. One inhabited by both researchers and by teachers. One that impacts both knowledge and belief. One designed to bridge the divide between research and practice.

NEURAL CORRELATES OF AUDITORY AND VISUAL SELECTIVE ATTENTION IN ADHD

Ms Jasmine Kwasa, Boston University

ABSTRACT

Selective attention is the ability to preferentially pay attention to a single stimulus in a complex sensory environment, in both auditory and visual modalities. This type of cognitive control requires precisely coordinated communication within and between brain regions, and individuals differ in their ability to perform these tasks. People with Attention Deficit Hyperactivity Disorder (ADHD) tend to have system-wide cognitive deficits that negatively affect learning due to distractibility and inefficiencies in organizing, vigilance, and inhibition. Therefore, we hypothesized that young adults with ADHD will exhibit deficits in selective attention which should be observable in both behavioral and neural measures. Using 64- channel human electroencephalography (EEG), we compared subjects' behavioral performance on a set of spatial auditory and visual psychophysical tasks and their neural correlates, including event related potential (ERP) modulations and neural oscillation power modulations. Preliminary Results: Individuals' performance on the visual and auditory tasks correlate ($p<0.001$), and ADHD subjects taking stimulant medications perform generally worse than controls in both modalities (visual $p=0.078$, auditory $p=0.080$), as we expected. In previous experiments, we found that individuals' performance on the auditory task correlated with ERP N1 amplitude modulations between two attention conditions (focusing on one stimulus versus monitoring multiple stimuli). Here we found similar trends in the complimentary visual task between performance and ERP N1 modulations ($p=0.066$). These results imply that the same spatial attention network may be engaged during both tasks, and it may be altered in ADHD, even in the presence of medication. We expect this work to lead to larger-scale studies on the neural bases of ADHD that will be clinically relevant and important for advancing our basic scientific understanding of executive control networks in the brain.

THE THINKPLUS JOURNEY

Mrs Bernie Lanyon, The Elevo Institute/Kingswood College; Ms Kayla Walker, The Elevo Institute/Kingswood College

ABSTRACT

The Journey: The ThinkPlus journey started in 2010. The project was the brainchild of the Elevo Institute of Australia. The Elevo Institute is a not-for-profit research organisation seeded by the Andrews Foundation. Its educational research focus aims to grow young Australian minds to meet the challenges of the future. ThinkPlus was, and continues to be, developed using educational design research. This decision was based on the premise that learning experiences, learning products and classroom aspects need to be co-designed with end users. The users, in this case young learners, parents and teachers, participated in the design in an effort to address the needs of classrooms, young people and educators. Approximately 12 schools became involved in the initial stage of the project. ThinkPlus looked at the research from varied concepts such as self-regulation, cognitive science, mindsets, pedagogy and neuroscience. A critical component of the metacurriculum is helping teachers and young people explore approaches to how emotion works, how learning occurs and neuroplasticity. The development of the program was influenced by the research and the work done by people such as Carol Dweck, Dr Edward deBono, David Perkins, Dr. Michael Merzenich, Robert J. Sternberg and Dr. Daniel J. Siegel. Ideas began to form and the first iteration of the metacurriculum emerged. Since then, the metacurriculum has been added to, modified and rewritten, as it was trialled in the pilot schools. The feedback from teachers and students informed the direction and content of ThinkPlus and continues to do so today. What is ThinkPlus? ThinkPlus is a meta-curriculum that promotes learnable intelligence. It teaches the science and psychology of how we learn, fostering a growth mindset culture within schools. ThinkPlus builds a community of resilient, lifelong learners, better equipped to navigate the challenges of the 21st century. It is not a prescribed program, taught at a set time once a week, but is designed to create a culture in a school of growth focusing on the learning process. The three key concepts of ThinkPlus are neuroplasticity, mindsets and the science of learning. Teaching with neuroscience in mind and developing a growth mindset culture empowers teachers to teach methodology rather than for school scores. It helps build teach efficacy. The research indicates that this promotes self-regulation, engagement and educational outcomes (Dweck, et al 2009). By helping learners consciously adopt more effective learning strategies and giving them insight into the power of those strategies, we can affect the quality of learning. Neuroplasticity is perhaps the single most important concept in terms of learning and the brain and is core to the concept of Dweck's Growth Mindset. The knowledge that our brain is constantly changing and growing—that cortical plasticity extends throughout the human lifespan—shifts our understanding of what is possible for learners. Learning is not just changing external behavior, but changing the very wiring of the brain as it relates to those behaviors. In the past few years, ThinkPlus has been implemented in several schools at a very 'hands on' level with a ThinkPlus Educator working directly with students, teachers and parents within each school. As more schools seek to implement ThinkPlus, the challenge of scalability has seen the development of a 'community of practice' website- the ThinkPlus Journey. The metacurriculum is accessed through the website providing activities, resources and research. The Journey has a social networking component for the sharing of ideas and collaboration across ThinkPlus schools.

So Far: During the trialling and implementation of ThinkPlus, we began observe not only evidence of social and academic anxiety decreasing but also an increase of resilience of students. This was supported by the observations of teachers and parents, as well as student reflections. Students learning about how their brain worked -that their intelligence, behaviours, skills are not fixed- was having a direct impact on their level of anxiety. From these findings, we are now focusing on student well-being. The Australian mental health statistics of young Australians aged 4 -17 are frightening with one in six suffering anxiety. What we have been doing in Australia in recent years has had little impact on the mental health of our children. By approaching student well-being from a scientific as well as psychological angle, we are finding more student buy-in, particularly at a secondary school level. Explicitly teaching neuroplasticity and the science behind good learning practices appeals and engages students. Looking to the future: ThinkPlus continues to evolve and grow. It is in perpetual motion- a journey with twists and turns, supported and grown with collaboration between schools, teachers and students. The sharing of ideas, as well as feedback on existing materials, will continually add to and update the metacurriculum. Adaptations and modifications are expected as teachers find what best serves their local context. As we continue our focus on

POSTER PRESENTATIONS

student well-being, we plan to embark on several action research projects in ThinkPlus schools. The focus of one project is to measure the impact of ThinkPlus on student anxiety. In the second project, we are planning a study of the impact of ThinkPlus on the academic self-view of indigenous Australian students. As ThinkPlus grows in schools from a wide range of contexts, broader research will be conducted. The findings from our research will inform the further development of the metacurriculum and the continued journey of ThinkPlus.

SPACED PRACTICE: A LITTLE FORGETTING AIDS BETTER REMEMBERING

Mrs Maeve Le Bon, The University of Queensland and Classroom Teacher

ABSTRACT

The Melbourne Declaration proposes that education should cultivate 'successful…confident and creative' thinkers (Ministerial Council on Education, Employment, Training and Youth Affairs, 2008), and yet, much of what occurs in classrooms relies on 'memory, rather than thinking' (Hattie & Yates, 2014). Contemporary educators recognise that, to be successful 21st century citizens students need to be resourceful, agile and confident in the face of new learning. Spaced practice, which refers to the method of leaving intervals between practice sessions, offers a compelling means of achieving this goal. Research from the fields of neuroscience, education and psychology indicates that spaced practice, as opposed to massed practice, enhances a learner's ability to recall information from long-term memory, facilitates the transfer knowledge to novel situations, enhances the learners' ability to discern the nuances of a situation and advances their ability to select appropriate strategies to find a solution (e.g. Dunlosky, Rawson and Marsh, 2013, Brown, Roediger and McDaniel, 2014). These are the skills necessary for success, confidence and creativity in a 21st century world. This presentation will look at the research that supports the use of spaced practice in the classroom. Participants will have an opportunity to look at exemplars modelling the use of spaced practice to program and plan and to discuss the potential applications of this method to everyday teaching practice.

CONDITIONAL NEGATIVE STIMULUS EVALUATIONS CAN BE REDUCED WITH COGNITIVE INTERVENTIONS TARGETING VALENCE (BUT THIS REDUCTION DOES NOT REDUCE REINSTATEMENT)

Dr Camilla Luck, SLRC, Curtin University, Professor Ottmar Lipp, Curtin University

ABSTRACT

Conditional negative valence may play an important role in the return of fear, but can be challenging to remove as it extinguishes slowly and, unlike electrodermal responding, does not respond to instructed extinction. We examined whether conditional valence and electrodermal responding, acquired during conditional stimulus (CS) –unconditional stimulus (US) pairings, would respond to cognitive interventions that revaluate the conditional stimuli. During acquisition, an image of one person (CS+) was paired with an aversive electrotactile stimulus, while another (CS-) was presented alone. After acquisition, participants were given positive character information about the CS+ poser and negative character information about the CS- poser, but no information about the CS–US contingency. Instructed revaluation reversed differential CS valence (CS+ became more pleasant) and eliminated differential electrodermal responding. In Experiment 2, we compared positive and negative revaluation by providing positive/negative information about CS+ and neutral information about CS-. When CS+ was positively revaluated differential valence evaluations were removed and differential electrodermal responding remained intact, however when CS+ was negatively revaluated differential valence evaluations were strengthened and differential electrodermal responding was eliminated. The results confirm that CS valence can be modified with revaluation instructions. Contrary to expectations, reinstatement of conditional electrodermal responding was not affected by CS revaluation.

DEVELOPING A MODEL FOR RESEARCH TRANSLATION: THE QUEENSLAND NETWORK OF SCHOOLS

Mrs Stephanie MacMahon, SLRC, The University of Queensland;Mrs Annita Nugent, SLRC The University of Queensland

ABSTRACT

The debate continues over whether the application of neuroscientific findings to the classroom is a "bridge too far" (Bruer, 1997; Bowers, 2016). Competing philosophical and methodological approaches underpin these debates. Consequently, consideration of new paradigms in which to frame the Science of Learning research and its application to practice are sought (Choudhury and Slaby, 2012; Howard-Jones., et al., 2016; Immordino-Yang, 2016). However, the pathway from research to practice is fraught with dangers (Clarke, 2009). In medical literature, translating research into practice is often conceptualised as moving through three phases: from awareness, through acceptance, to adoption (Davis & Taylor-Vaisey, 1997). Practitioners engage knowledge with increasing proficiency across these phases, building upon their current skill set and applying processes in one-on-one contexts (Green & Seifert, 2005). The classroom context, however, is highly dynamic and often unpredictable, shaped by participant's individual and collective beliefs, attitudes and perceptions, as well as their immediate and extended environments (Guskey, 2002). This complexity must be considered if research translation is to be effective (Daniel, 2012). Identifying contextually relevant problems and questions involves collaboration and conversation between researchers and educators, developing research-informed educators (Seary, 2014) as well as education-informed researchers. In 2017, the SLRC commenced a pilot project involving a Network of Schools in the Brisbane region, to trial an evidence-informed model of translation. This poster will outline the model and provide an overview of the six schools and their projects.

WHITE MATTER MICROSTRUCTURE AND STATISTICAL LEARNING IN THE AUDITORY AND VISUAL DOMAINS

Dr Johan Mårtensson, Lund University, Sweden; Associate Professor Joanne Arciuli, The University of Sydney; Associate Professor Janne von Koss Torkildsen, University of Oslo; Professor Magnus Lindgren, Lund University

ABSTRACT

There are substantial individual differences in the capacity for implicit statistical learning (SL). While we know little about the neural mechanisms that underlie these differences, some of this variance may be traced to individual differences in white matter density that have been observed in a number of studies (e.g. Flöel et al. 2009; Qi et al., 2015). We investigated whether performance in auditory and visual SL tasks were related to white matter microstructure as measured by a combined HARDI/DTI sequence. Participants were 21 young adults recruited from the student population at Lund University. The SL tasks utilized the embedded triplet paradigm where a familiarization phase containing either a continuous stream of unfamiliar cartoon figures (visual SL; VSL) or musical tones (auditory SL; ASL) was followed by a surprise test. Learning was significantly above chance in both tasks but with larger variability in VSL as compared to ASL. A whole-brain search in major white matter connections using tract based spatial statistics revealed a correlation between VSL and white matter microstructure (Radial Diffusivity) in the forceps minor (bilaterally), corpus callosum and areas adjacent to the left striatum and left hippocampus. Our findings indicate that differential white matter microstructure in learning and reward areas is related to individual differences in statistical learning in the visual domain.

EXAMINING FEEDBACK IN ELITE SPORT

Mr Robert Mason, SLRC, The University of Melbourne; Professor John Hattie, Melbourne Graduate School of Education; Professor Damian Farrow, Victoria University

ABSTRACT

Initial findings will be presented from a project aiming to combine research on feedback from diverse fields (education, sports coaching, and skill acquisition) to find out "what works?" in terms of feedback in an elite sporting setting. A common thread in these areas is the idea of feedback that provides "where to next?" or information about how to improve performance on future tasks (sometimes known as prescriptive feedback

in the skill acquisition literature). There have been few attempts in domains outside of education to evaluate the effectiveness of prescriptive feedback compared to simple descriptive feedback. In addition, many studies investigate the provision of feedback, but relatively fewer have sought to examine the characteristics of the learner that may help or hinder their ability to attend to, understand, retain and act on feedback provided to them by a teacher or coach. Such characteristics may include self-efficacy, feedback orientation, and working memory. A final area of the feedback literature of relevance to the current study is the learner's interpretation of the feedback they receive, as this is seen as a necessary first step before converting information into improved performance. In this poster, initial findings will be presented from a pilot study involving 3 coaches and 6 players at an Australian Football League (AFL) club.

EMOTICONS, IMPRESSION FORMATION, AND PERCEPTIONS OF THE MARKER IN HIGHER EDUCATION ASSIGNMENT FEEDBACK DELIVERED ONLINE

Dr Robyn Moffitt, Griffith University; Menzies Health Institute Queensland; Dr Rachel Grieve, The University of Tasmania; Dr Christine Padgett, The University of Tasmania

ABSTRACT

Assignment feedback is a valuable tool for student learning, and in higher education this form of feedback is increasingly being provided online. Congruent with research on impression formation, students form impressions of educator's using only very "thin slices" of behaviour. This study investigated emoticon use (i.e., :-)) in written online feedback as one such factor that can influence satisfaction and judgements regarding the performance and competence of a marker. University students (N = 219) read a credit level two-page faux essay along with associated assignment feedback typical of the comments students would receive in the higher education context. Emoticon use was manipulated in two ways: volume and valence. Either 1, 3 or 6 emoticons were included in the feedback, and the emoticons were either happy (i.e., :)), sad (i.e., :(), or confused (i.e., :/). The results revealed more positive perceptions of the marker (in relation to qualities such as warmth and professionalism) when the feedback emoticons were happy faces, than confused faces. An interaction between volume and valence was also present, whereby when 3 happy face emoticons were included in the feedback, markers were also perceived to be more proficient (i.e., more organised, approachable and knowledgeable) than when 3 sad, or 3 confused faces were included. These findings support existing literature demonstrating that students highly value positive feedback and supportive comments to boost confidence and motivation, and that perceptions of marker competence can be easily and efficiently improved by adding several happy face emoticons to written feedback.

SELF-DIRECTED SPEECH IN DEVELOPMENTALLY VULNERABLE CHILDREN: A SYSTEMATIC REVIEW

Aisling Mulvihill, SLRC, The University of Queensland; Professor Annemaree Carroll, School of Education, The University of Queensland; Associate Professor Paul Dux, School of Psychology, The University of Queensland; Dr Natasha Matthews, School of Psychology, The University of Queensland

ABSTRACT

Self-directed speech has long been considered an important developmental milestone, as it is a self-regulatory mediator of thinking and behaviour. A growing body of research suggests interruption in the development of self-directed speech in neurodevelopmental disorders. This systematic review investigates the presence, use and utility of self-directed speech in atypical development, specifically children with Specific Language Impairment, Autism Spectrum Disorder, and Attention Deficit Hyperactivity Disorder. A rigorous search process uncovered 18 relevant peer-reviewed articles. Whilst the investigated developmental disorders display differences in the development or use of self-directed speech, there remains conjecture on the position of delay or deviance, along with the precise mechanisms underpinning these differences. Furthermore, the review spotlights methodological variance and provides suggestions for future research.

TEACHER TALK AND STUDENT VOICE- THE POWER OF OUR LANGUAGE.

Mrs Sophie Murphy, SLRC, The University of Melbourne

ABSTRACT

Sophie will share her current research that she is doing with Professor John Hattie on the power of our language. Sophie will share findings on the most effective ways to use language across primary and secondary schools to create deep level learning, transfer of understandings, effective questioning and classroom talk (and the importance of doing so). Sophie will share findings and

focus primarily on the 'students' voice in the classroom and what this looks like. Sophie has chosen student voice as her focus within her PhD as there has been a significantly greater focus on educational research that has concentrated on how the discourse of 'teachers' mediates the construction of knowledge in classrooms. Yet, without close analysis of the structure, content and function of student's voice we are unable to understand the realities of the student experience and the learning that results from that experience. If students are to become effective problem solvers and self-regulated learners, we need a deeper understanding of the content, nature, and diversity of students actual language in interactions within the classroom. There have been many who have claimed that students must be involved in active dialogue to develop essential skills, such as questioning and the development of vocabulary. The claim is that students need to be active in their voice to know where they are, where they need to go, and how they are going to get there. For this to be done effectively, students must be able to articulate to each other and with teachers about the ongoing opportunities to have a dialogue with peers and the teacher. Yet, what do the nature of student's voice and the private utterances look like within the classroom? Sophie has used Graham Nuthall's pioneer research that contributed valuable insights into the private world of student's voice and classroom discourse at a microanalytic level to increase understanding of the nature of student's discourse and its contribution to learning. In Nuthall' s view, the truth lies in the detail. Every generalisation we make, every conclusion we draw, must be true of every individual student, accounting for the realities of student experience in the classroom. This study will build on the work published by Nuthall to provide further analysis and conceptual understandings in this area. Using effective language, including clarity of instructional practice, questions that are both 'surface and deep' has a significant impact on learning. Sophie will provide participants with current research on classroom discourse and her own research in this area. She will share how it is being captured using the Science of Learning and Research Centre's Interactive Classroom at the University of Melbourne.

PRO-ACTIVE CONTROL OF ATTENTION IN YOUNG ADOLESCENTS

Ms Anica Newman, SLRC, The University of Queensland; Dr Natasha Matthews, The University of Queensland; Ms Aisling Mulvihill, The University of Queensland; Associate Professor Paul Dux, The University of Queensland

ABSTRACT

Metacognition encompasses skills such as cognitive control and self-monitoring, and allows us to effectively regulate our attentional resources in preparation for task performance (Schneider & Artelt, 2010; Shraw, 1995). In the laboratory, we can measure attentional engagement using electroencephalography (EEG). There is increasing evidence for the involvement of alpha oscillations in the voluntary allocation of attention (Foxe and Snyder, 2011). The amplitude of activity in the alpha band immediately preceding a stimulus (prestimulus alpha) has been found to be related to stimulus processing and task performance (Hanslmayr et al., 2007; van Dijk et al., 2008). Thus, anticipatory alpha appears to be an index of proactive control of attentional resource allocation. Previous studies have shown that such recruitment of attentional resources is modulated by task difficulty (Lenartowicz et al., 2014). Here, we investigated whether alpha oscillations in high-school students can be voluntarily modulated in preparation for a task according to task difficulty. Participants (12 – 14 year olds) completed a visual search task while EEG data were recorded and were presented with a cue prior to stimulus presentation, which was informative about the difficulty of correctly identifying the target in a search display. Our data sheds light on: 1) whether participants can use this informative cue to differentially (proactively) control their allocation of attention prior to target presentation, as measured by prestimulus alpha amplitude and 2) how prestimulus alpha amplitude might relate to stimulus processing, task performance and participants' self-reported metacognitive skills. The results will have implications for understanding how metacognitive skills being employed in educational settings.

POSTER PRESENTATIONS

COGNITIVE CHARACTERISTICS OF LEARNERS WITH HIGH-FUNCTIONING AUTISM: TRANSLATING NEUROSCIENCE RESEARCH FOR TEACHER PROFESSIONAL LEARNING

Dr Nola Norris, Morling College Faculty of Education

ABSTRACT

Thinking, memory and learning were investigated utilising interpretive phenomenological analysis in five in-depth case studies with gifted adults diagnosed with Asperger syndrome. The starting-point research question was "How do gifted adults with Asperger syndrome think and learn?" The initial purpose was to investigate the participants' experiences of schooling and the supports or obstacles that helped or hindered their learning. However, the unusual ways in which participants reported their memories drew attention to the area of memory itself. Memory in autism and its relationship to learning subsequently became the key focus of the research. To provide the interpretive framework for the case studies, the major theories of autism were mapped to Schacter & Tulving's (1994) model, "Major systems of human memory and learning." The framework was further developed to include relevant cognitive characteristics through an iterative literature search and the novel methodological step of treating the literature as though it was data: relevant research articles were imported and analysed in "NVivo." Codes and categories were developed that were then applied to the data. The data consisted of: participant and key informant (life partner, parent) interview transcripts; artefacts such as photos, artistic works, published works; and, email threads generated from prolonged engagement with the researcher. Over the course of the study, the interpretive framework was further developed as an explanatory framework for teacher professional learning and, within the context of phenomenological research, represents theory development. The final part of the framework is a model titled the "Learning Ladder"—the focus of this presentation. It is an evidence-based framework of thinking and learning that supports the existence of a hierarchy of thinking activities. Learners with high-functioning autism are advantaged at the lower end and challenged at the higher end. The Learning Ladder makes the unusual learner characteristics of gifted and high-functioning learners with autism spectrum disorder (ASD) amenable to explanation and is a tool to facilitate teacher professional judgement with regard to lesson planning and the likely support needs, depending on the types of thinking activity required by students in the lesson. Furthermore, the Learning Ladder elucidates learning characteristics of all learners, not just those with autism, and translates neuroscience research for the professional learning of teachers.

USING WORKED EXAMPLES FOR IMPROVING PROPORTIONAL REASONING SKILLS IN YOUNG ADULTS.

Dr Mariya Pachman, SLRC, Macquarie University, Dr Amael Arguel, SLRC, Macquarie University; Professor Joanne Mulligan, Macquarie University; Professor Lori Lockyer, SLRC, University of Technology Sydney

ABSTRACT

Mathematics education researchers often describe proportional reasoning as one of the most difficult skills to develop in school age children. Moreover, young adult learners are also prone to making mistakes in this domain (Vandercruysse, ter Vrugte, de Jong, et al. 2016). Identified errors in this domain include application of absolute instead of proportional thinking (Van Dooren, De Bock & Verschaffel, 2010) and a "fraction avoidance syndrome" (Karplus, Pulos & Stage, 1983) leading to quantified whole numbers responses. Learners are claimed to be almost insensitive to various types of support guiding them to correctly apply proportional reasoning (Van Dooren, De Bock, Hessel et al., 2005). In this study we were interested in whether tertiary level learners experience problems with correctly applying proportional reasoning and whether using various types of pre-training will help improving their proportional reasoning skills. One type of pre-training, worked examples, was aimed at providing students with steps involved in a problem solution and allowing students more cognitive headroom to re-examine a mental model of the problem. The other generic type pre-training, using a difficult prior task, was aimed at inhibiting an automatic thinking leading to the problems with differentiation between proportional and not-proportional situations. Research reported in this presentation is a part of the larger study on metacognition and emotions during complex problem solving. Seventy-three students were pre-tested on their prior numeracy knowledge, then practiced problem-solving tasks and finally completed a test with similar problems. Before the practice task, two pre-training groups received either worked examples or a difficult prior task (Raven's test items) while control group received a filler task. The findings indicate that pre-training helped learners provide correct proportional answers and avoid the influence of absolute thinking in both experimental groups, but for a difficult prior task group this effect was delayed and manifested itself

only at the final test stage. Pre-training also helped reduce the number of incorrect answers, but only for worked examples group and only at the final test stage. The number of absolute thinking answers in a difficult prior task group diminished from practice to the final test, and the number of correct proportional answers increased. Learners in the control group provided a significantly lower number of correct proportional answers and significantly higher number of absolute thinking answers (80%), than the experimental groups during the practice. Absolute thinking answers led to a random pattern of responses during the final test for a control group confirming poor differentiation hypothesis and the importance of pre-training. Implications for a development of proportional reasoning skills and for mathematics education are discussed.

REFERENCES:

Karplus, R., Pulos, S., & Stage, E. (1983). Proportional reasoning of early adolescents. In R. Lesh & M. Landau (Eds.), Acquisition of mathematical concepts and processes (pp. 45–89). New York: Academic Press.

Van Dooren, W., De Bock, D. & Verschaffel, L. (2010) From Addition to Multiplication … and Back: The Development of Students' Absolute and Multiplicative Reasoning Skills. Cognition and Instruction, 28(3), 360-381.

Van Dooren, W., De Bock, D., Hessels, A., Janssens, D., & Verschaffel, L. (2005). Not everything is proportional: Effects of age and problem type on propensities for overgeneralization. Cognition and Instruction, 23(1), 57–86.

Vandercruysse, S., ter Vrugte, J., de Jong, T., Wouters, P., van Oostendorp, H., et al. (2016). The effectiveness of a math game: The impact of integrating conceptual clarification as support. Computers in Human Behavior, 64, 21-33.

CREATIVE REASONING IN LINKING SCIENCE AND THE ARTS

Professor Vaughan Prain, SLRC, Deakin University; Professor Russell Tytler, Deakin University; Dr Shelley Hannigan, Deakin University

ABSTRACT

There is growing advocacy of the value to scientists in working intensively and extensively with artists (Eldred, 2016; Synapse, 2017). These partnerships are claimed to enable scientists to frame problems freshly, identify blind-spots in their current knowledge and approaches, and embrace new ways to reason and visualise that enable research breakthroughs. This recognition of the key role of adaptive creativity in problem-solving is also evident in many national school curricular prescriptions about desirable attributes in learners and future citizens. Education systems are tasked with developing creative, flexible, team-oriented problem-solvers who can also demonstrate disciplinary creativity. However, the conditions likely to promote these outcomes in subjects such as science remain under-researched. These conditions include: (a) problem-solving tasks and investigative sequences that are likely to engage and extend student reasoning, (b) flexible and targeted teacher support in these processes, and (c) clarification of the role and use of disciplinary knowledge and processes to guide this creative reasoning. While there are many advocates for interdisciplinary approaches to problem-solving, such as STEM and STEAM programs, how disciplinary creativity in school science can be conceptualised and enacted remains under-researched. Our understanding of creative activity in general, and in science in particular, is guided by Csikszentmihalyi's (1999) generic sociological perspective. Here creativity is understood as the interplay between a set of practices within a domain with recognized symbolic rules and procedures, participants who bring new approaches, processes or insights and solutions to this domain, and experts (teachers) who can appreciate and endorse these domain contributions. The extent to which students can be creative in learning science is therefore partly bounded by disciplinary norms around symbolic expression, curricular demands, and teacher expectations that students demonstrate authorized procedures and representations of understanding (Jacobson, 2016). Creative reasoning entails students using informed abductive "what if" problem-posing and problem-solving. We contend that art approaches offer embodied and applied ways to learn that can motivate students and deepen experiential understanding. In this paper, we report on two case studies in secondary schools where science teachers aimed to integrate art approaches and creativity as part of teaching and learning programs. We aimed to identify (1) students' reasoning approaches in engaging with these programs, (2) teacher strategies to support these approaches, and (3) student attitudes towards, and learning from, these programs. Research methods included lesson observations, artefact analyses, and interviews with participant teachers and students. "Ambrose College" has a half-year year-9 program called the Da Vinci project. This project-based, interdisciplinary study aims to develop students' knowledge of the arts, humanities and sciences through studying environmental issues. Students choose to explore a particular environmental problem in science, mathematics, arts and humanities classes. The semester of work then culminates in an exhibition where students present their work to the community. We report on evidence demonstrating how this project leads to improved ways to communicate scientific understandings by incorporating new and novel

images about 'impacts and conditions of mitigation and adaptation to climate change' (Jacobson et al., 2016, p. 30). Students demonstrate a range of creative problem-solving strategies, supported by their teachers' guidance and feedback. "Cezanne College", a year 7-10 school in regional Victoria, runs a two-day annual Arts/Science festival with a focus on students using creative approaches to demonstrate understandings of scientific concepts. The theme for 2017 was light and sound, with teachers offering many electives, including ones where students produced photographs with pinhole cameras, lazer maze games, kaleidoscopes, periscopes, and experimented with colour lens to create "invisible" drawings. We present case study data including field notes, student artefacts and interviews to demonstrate how these electives supported creative problem-solving. These electives were characterised by enthusiastic student creative problem-solving, collaborative team-play and positive attitudes to this approach to science learning. Our case studies confirm the value of extended time for students to engage in designing and enacting applied understandings of scientific concepts, where they are expected to utilize diverse creative options to achieve aesthetic, functional, informative and rhetorical effects. We claim to have developed findings concerning how science disciplinary representational work is supported by engagement with creative /art-based processes and teacher support in line with Csikszentmihalyi's framework. We intend to use the SLRC classroom at the University of Melbourne in school third-term this year to extend this research through fine-grained analyses of student interactions and reasoning, teacher input, and learning outcomes.

REFERENCES:

Csikszentmihalyi, M. (1999). Implications of a systems perspective for the study of creativity. In R. Sternber (ed). Handbook of Creativity. Cambridge University Press. (pp.313-335).

Eldred, S. (2016). Art-science collaborations. Change of perspective. Nature 537, 125-6.

Jacobson, S., Seavey, J., Mueller, J. (2016). Integrated Science and Art Education for Creative Climate Change Communication. Ecology and Society 21(3).

Synapse (2017). Art science collaborations. https://www.synapse.net.au/

MEAN DIFFUSIVITY REVEALS MICROSTRUCTURAL ANATOMICAL DIFFERENCES BETWEEN BILINGUALS AND MONOLINGUALS

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ABSTRACT

DTI is an established method to study cerebral white-matter microstructure. Two established measures of DTI are fractional anisotropy (FA) and mean diffusivity (MD) and both differ for bilingual and monolingual speakers. Less is known about differences in two other measures called radial diffusivity (RD) and axial diffusivity (AD) for bilinguals and monolinguals. We report differences in mean RD and AD values in the right SLF and forceps minor between bilingual (Hindi-English) and monolingual (English) speakers as well as differences in mean FA-values in the anterior thalamic radiation, right inferior fronto-occipital fasciculus and inferior longitudinal fasciculus (ILF) and mean MD values in forceps minor and bilateral superior longitudinal fasciculus (SLF). We also observed a positive correlation between L2 (English) proficiency for speaking and writing and mean RD-values in the right SLF. Our findings suggest that changes in the geometry of white matter tracts reflects regular bilingual language experience - specifically in the right superior longitudinal fasciculi. We contend that neuroplasticity in right SLF results from demands on cognitive control for bilingual speakers.

USING STRUCTURED FAMILY ROUTINES TO IMPROVE CHILDREN'S EXECUTIVE FUNCTION SKILLS

Mr Andrei Semenov, University of Minnesota Institute of Child Development

ABSTRACT

Promoting the development of reflection and EF skills may be especially important for children in high-risk environments. Children who grow up in a highly mobile, low SES environment are exposed to unique environmental and family stressors (Evans, Gonnella, Marcynyszyn, Gentile, & Salpekar, 2005). The lack of stability and predictable routines in high-risk families

makes it difficult to take time to settle down and reflect, and compared to more advantaged peers, children in these families show difficulties with EF over and above other cognitive indices (e.g., Casey et al., 2014; Masten et al., 2012). At the same time, however, there is evidence that good EF skills serve as protective factor in children from highly mobile, at-risk environments, buffering them against subsequent academic difficulties (Masten, 2015). The Ready 4 Routines intervention is delivered to parents participating in Head Start programs and involves 6-8 weekly workshops during which parents are taught about routines and specific practices to implement with their children. The intervention is based on the PEER(e) mantra, which encourages parents to Pause, Engage, Encourage, Reflect, and Extend during interactions with their children. Parents are given a set of activity cards that they are encouraged to use during interactions with their children. For example, instead of just reading a book to a child, a parent might have an activity card that both scaffolds reading and infuses the activity with the PEER(e) mantra (e.g., encouraging children to tell their own story from the pictures). Through the activity cards and the support and practice from the weekly workshops, parents learn important parenting skills that utilize reflective practices and scaffold the development of these practice in their children. The R4R intervention was administered by trained staff in the spring of 2014 and 2015. The first study examined the feasibility of the intervention and included 65 mother-child dyads, predominantly from low income, at-risk populations. Parents were given pre-test and post-test measures of parenting stress (PSI-IV). Children were given pre-test and post-test measures of EF as measured by the Minnesota Executive Function Scale (MEFS; Carlson & Zelazo, 2014) and a computerize Theory of Mind task. The first study found that children's performance on the MEFS increased from pre-test to post-test $F(1, 41) = 4.35$, $p < .05$. Parenting stress decreased from pre-test to post-test $t(49) = 2.82$, $p < .001$. Despite not having a control group, the first study provided support for the intervention being feasible and highlighted areas for improvement. Following a round of revisions, the second study included a control group as well as more streamlined measures and procedures. The second study consisted of 89 parent-child dyads, including 23 control dyads. A post-hoc analysis accounting for fidelity and implementation concerns found child EF improved by an average of 7.63 points more in the intervention group than in the control group ($F(1, 48) = 5.81$, $p < .05$). Self-reported parent stress significantly decreased from T1 to T2 by an average of 14.78 ($t(39) = -5.162$, $p < .001$), though the control group did not take the PSI-IV, so it is not clear if this decrease is due to the intervention effect. Results from these two studies suggest that the R4R intervention is feasible and accessible for low-income families and accomplishes its goal of introducing structured family routines. There is evidence to suggest that participation in the 3-month R4R intervention is associated with an increase in child EF as measured by the MEFS and a decrease in self-reported parent stress. Additional assessments are planned to measure delayed effects of the intervention and whether families continue to use the routines outside of the structured intervention.

THE SOCIAL CHRONNECTOME: TIME-VARIANT CONNECTIVITY BASED ON BIOMETRICS AS A RESEARCH TOOL IN REAL CLASSROOM SETTINGS

Dr Chase S Sherwell, SLRC, The University of Queensland; Professor Annemaree Carroll, School of Education, The University of Queensland; Professor Robyn Gillies, School of Education, The University of Queensland; Professor Ross Cunnington, Queensland Brain Institute, The University of Queensland

ABSTRACT

Structuring classroom activities around effective social interactions is of fundamental importance. Teacher-student and peer-to-peer engagement are at the centre of current pedagogical strategies to encourage cognitive states that are conducive to learning. Previously, physiological evidence of successful interactions inducing shared states, or social synchrony, has been limited to the controlled research laboratory. With the increasing availability of wearable technologies, recording biometric data from students in real-life classrooms has become an accessible means of integrating physiology and educational research to assess the state of the learner. I will present recent developments in the analysis of data recorded from high-school students using biometric wristbands, focusing on skin conductance. By taking a network analysis approach based on graph theory, we quantify social synchrony as mutual changes in physiological arousal. Using techniques developed for the analysis of neural networks, we can establish a social 'connectome' of the classroom that maps the level of connectivity, or shared engagement, of students during various learning activities. Our recent expansion of this concept to time-variant connectivity, or the social 'chronnectome', provides a detailed picture of changes in shared student engagement over time. I will present case-studies validating such graph metrics as useful research tools for supporting behavioural data, as well as providing unique insights into social dynamics in real classroom settings.

POSTER PRESENTATIONS

COGNITIVE ACCELERATION AND THE SCIENCE OF LEARNING: IN SEARCH OF THE PLASTICITY OF INTELLIGENCE

Mr Tim Smith, SLRC, The University of Queensland

ABSTRACT

Our understanding of creative activity in general, and in science in particular, is guided by Csikszentmihalyi's (1999) generic sociological perspective. Here creativity is understood as the interplay between a set of practices within a domain with recognized symbolic rules and procedures, participants who bring new approaches, processes or insights and solutions to this domain, and experts (teachers) who can appreciate and endorse these domain contributions. The extent to which students can be creative in learning science is therefore partly bounded by disciplinary norms around symbolic expression, curricular demands, and teacher expectations that students demonstrate authorized procedures and representations of understanding (Jacobson, 2016). Creative reasoning entails students using informed abductive "what if" problem-posing and problem-solving. We contend that art approaches offer embodied and applied ways to learn that can motivate students and deepen experiential understanding.

MEASURING DOMAIN-GENERAL FAMILIAR AND NOVEL OBJECT RECOGNITION ABILITY USING A LATENT-VARIABLE APPROACH

Mackenzie Sunday, Vanderbilt University

ABSTRACT

Individual differences in personality and intelligence have been extensively studied but individual differences in visual abilities remain relatively unexplored. Recently, our laboratory used a latent variable approach to find evidence of a higher-order factor accounting for the majority of shared variance between performance on several tasks with novel objects. This finding supports the idea of a domain-general object recognition ability. We are currently exploring this ability's divergent validity with respect to various cognitive skills, including fluid intelligence, working memory capacity and executive functions. To further elucidate the nature of this construct, we designed a study to investigate how this novel object recognition construct relates to familiar object recognition using a similar latent variable approach. While novel object recognition cannot be influenced by previous experience with the domain, familiar object recognition can. Thus, using a latent variable approach will help determine the extent to which this domain-general factor is relevant to familiar object recognition, and if experience with domains reduces the role of a domain-general ability in tasks involving recognition of the experienced domains. In designing this study, we consider in a data-driven manner which and how many familiar and novel object domains to use as stimuli, deciding on three familiar and three novel domains possessing characteristics well-suited for our goals. Additionally, we consider which tasks will produce reliable scores and tap into different aspects of perception to maximize differences between performance indicators submitted to latent variable analyses, ultimately deciding on a matching task, a learning exemplar task and an ensemble perception task. We also include in our design a measure of semantic knowledge of the familiar domains as an index of experience so that we can determine if this measure will sufficiently capture the role experience plays in a familiar object recognition factor.

ITEM RESPONSE THEORY MEASUREMENT MODEL TO IMPROVE INFERENCE OF BAYESIAN NETWORKS

Dr Ling Tan, Australian Council for Educational Research; Dr Xiaoxun Sun, Australian Council for Educational Research; Mr Steven Kambouris, Australian Council for Educational Research

ABSTRACT

The Interactive Adaptive Learning System being developed at the Australian Council for Educational Research (ACER) is a digital learning environment designed to facilitate adaptive learning and dynamic assessment. The main purpose for building the Interactive Learning System (ILS) is to investigate and measure learning taking place as students interact with this digital learning environment. The Bayesian Network (BN) is one of the most popular methods for implementing student models in digital learning systems. BNs are flexible in representing complex relationships among latent variables and indicators of the latent variables. Inference about students' proficiency levels in a learning area in Bayesian nets can be useful for delivering appropriate hints and instructions. Typically, BNs estimate conditional probabilities from data of students' interaction with tasks, without estimating task difficulties explicitly. In digital learning environments, a student can be provided with tasks which are appropriate to their age and learning needs. For example, a student may be assigned to an easy or a challenging learning path depending on her ability in a learning area. As a result, the observations collected on each task are

often non-random samples. Probability of success can be estimated using task difficulties and student ability based on Item Response Theory (IRT). BN's conditional probabilities can be initialised using these probabilities. This poster describes practical considerations in using BNs in dynamic assessment and learning environment. We will present methodology of using IRT model for initialisation of conditional probabilities for Bayesian nets. We will also give examples of estimating task difficulties and location of proficiency levels.

STUMBLING BLOCKS IN ALGEBRAIC PROBLEM SOLVING: DIFFICULTIES WITH EQUIVALENCE AND NEGATIVE NUMBER CONCEPTS

Dr Kelly Trezise, SLRC, The University of Melbourne; Dr Judi Humberstone, University of Melbourne; Professor Robert Reeve, University of Melbourne

ABSTRACT

An understanding of equivalence and negative number is crucial for algebraic reasoning. Surprisingly little research however has examined the ways in which different mathematical representations of these two concepts affect algebraic problem solving. We conducted four studies to better understand how variations in algebraic equation representation involving the two concepts affect the ability to solve equations. In two studies, students solved five types of linear algebraic equations that differed in complexity with respect to the "structural" properties of equations (i.e., x+b=c, ax+b=c, -ax+b=-c, -a=-bx+c, -ax+b=-cx+d). Study 1 showed similar levels of algebraic abilities in 13- and 14-year-olds, with both ages experiencing difficulties with negative signs and equations with an increasing number of operations. Study 2 showed 14-year-olds' algebraic problem solving abilities remained stable: their problem solving abilities did not change over the school year. Study 3 showed while 15-year-olds' had begun to acquire a more sophisticated understanding of equivalence, their understanding of the negative sign remained limited. Study 4 showed 13- and 15-year-olds' linear algebraic problem was affected by negative integers, but not subtraction. Together, the four studies showed during early adolescence, students do not improve in their ability to solve equations that demand a more detailed understanding of equivalence and the negative sign. Overall, the findings highlight a need to examine the cognitive constraints and processing difficulties that limit an ability to acquire an understanding of negative numbers and equivalence concepts.

INSTRUCTOR PRESENCE, VISUAL ATTENTION, AND LEARNING IN EDUCATIONAL VIDEO: CONTENT DIFFICULTY MATTERS

Jiahui Wang, University of Florida

ABSTRACT

In an effort to reach more students, educators are designing online learning experiences, particularly in the form of online videos. While many instructional videos feature a picture-in-picture view of instructor, it is not clear how instructor presence influences learners' visual attention and what it contributes to learning and affect. On one hand, instructor presence could elicit beneficial socio-emotional responses and provide additional nonverbal modalities of interaction. On the other hand, it introduces complex visual stimuli that may distract learners and hinder cognition, especially when the content itself has already imposed a high intrinsic cognitive load. This study explored the impact of instructor presence on visual attention, learning and affect in mathematics instructional videos of varying content difficulty. Thirty-six participants (age 18-21, 21 female) each viewed two 10-minute-long mathematics videos (easy and difficult topics), either with instructor present or absent. When instructor was present, the main frame was devoted to a Khan Academy style pencast, and the bottom right-hand corner displayed a shoulder-up video of the instructor. Findings suggest considerable dwell times when the instructor was present in either easy topic (25%) and or difficult topic (22%) video, even though the instructor only occupied approximately 7% of the entire screen. Also, the effect of content difficulty on the instructor fixation count percentage was significant, $F(1, 34) = .042$, $p < .05$, $\eta 2 = .130$, with more fixations devoted to the instructor in easy topic video. Although no significant difference in learning transfer was found for either topic, participants' ability to recall information from the easy topic video was better when instructor was present, $F(1, 34) = 8.588$, $p < .05$, $\eta 2 = .202$. Finally, instructor presence had a positive effect on participants' perceived learning and satisfaction for both topics and led to a lower level of self-reported mental effort for difficult topic.

POSTER PRESENTATIONS

ENGAGEMENT FLUCTUATION DURING DIGITAL LEARNING TASKS

Mr Paul J Wiseman, SLRC, The University of Melbourne; Dr Jason M Lodge, University of Melbourne; Professor Gregor E Kennedy, University of Melbourne; Dr Amael Arguel, Macquarie University

ABSTRACT

Student engagement has been a useful construct for enquiry into students' motivation and performance in digital and online learning in higher education. A growing body of research is increasing the clarity of the construct in terms of its granularity and the contexts in which it is operationalised. Within-person states of engagement at a task-level have been shown to promote positive learning experiences and enhanced performance in higher education. However, the processes through which these engaged states are initiated and maintained are still not well understood. This presentation reports on a study that explored undergraduate students' experiences of task-level states of engagement during a digital learning task. We found that the cognitive and affective dimensions of engagement fluctuated throughout the duration of the learning task. Changes in participants' states of engagement appeared to be in response to particular characteristics of the learning task such as duration and feedback. This research reveals that the three dimensions may vary independently of one another and that multiple points of observation during a learning task can reveal temporal change of task-level engagement. Researchers should consider digital task engagement as a dynamic process rather than a fixed state during digital and online learning tasks.

DELAY PERMUTATION ENTROPY ANALYSIS OF EEG SIGNALS IN SOFTWARE PROGRAMMING

Dr Guohun Zhu, The University of Queensland; Miss Jiang Ying, Guilin University of Electronic Technology; Mr Yuebin Zheng, Guilin University of Electronic Technology; Mr Li Huiyu, Guilin University of Electronic Technology

ABSTRACT

Cognitive workloads during computer language programming have been studied in frequency domain. However, it is unclear what essential difference between short-term coding and long-term programming in software development. In addition, the mental load difference is still unknown between computer programming and book reading activities. This paper estimates cognitive workload differences among book reading activity and four programming stages: before, short-term, long-term and after programming by delay permutation entropy (DPE) method, respectively. The DPE features are extracted from single channel EEG signals with dry EEG sensors. Experimental results show that the DPE of EEG before programming are significant lower than those of during programming and after programming ($p<0.01$). In addition, the DPE of short-term programming are slightly lower than those of long-term coding stage when selecting valid delay factor ($p<0.01$). Importantly, the DPE differences between before and after programming stages are larger than those of before and after reading tasks. The results indicate that the DPE could be efficient represent the mental workload from the programming tasks.


E=mc2