

EPS

Experimental
Psychology
Society

**EPS
ONLINE**

8-9 July 2021



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A scientific meeting will be held online between 8th – 9th July 2021.

EPS Prize Talks

48th Bartlett Prize Lecture

Friday 9th July, 4:30pm

The ontogenetic origin of the capacity for logically structured thought: a case study of the logical connectives *or*, *not*, and *possible*.

Professor Susan Carey, Harvard University

27th EPS Prize Lecture

Thursday 8th July, 4:30pm

Understanding the complexities of learning mathematics.

Professor Camilla Gilmore, Loughborough University

2021 BSA / EPS Undergraduate Project Prize Talk

Thursday 8th July, 12:00pm

Exploring temporal dynamics of facial expressions: Early categorisation confusions do not indicate shared evolutionary function.

Jessica Teed, University of York

Poster Session

The poster session for EPS Online will run between 11:00 and 12:00pm on Thursday 8th July.

The posters will be available to view on the EPS website, with links to accompanying talk-through videos on YouTube, from 9:00am on Monday 5th July.

To engage with presenters during the poster sessions, we welcome you to join us in our [online poster room on Gather](#) and to ask questions / comment on posters via Twitter and YouTube (indicated below on pp. 15-18 – ‘How to Engage with Poster Presenters’).

Oral Presentations

Please visit the Zoom links in the programme schedule below (for free) to view the parallel sessions.

Any queries about the online event should be sent to Sam Hurn at expsychsoc@kent.ac.uk.

START OF PARALLEL SESSION A – ([Click here to join this session](#))

11:00 **Poster Session on [Gather](#) / [Twitter](#) / [YouTube](#)**

12:00 **2021 BSA / EPS Undergraduate Project Prize Talk**

Jessica Teed, University of York

Exploring temporal dynamics of facial expressions: Early categorisation confusions do not indicate shared evolutionary function.

12:45 **Break**

EPS Prize Symposium.

The symbol-grounding problem in numeracy and arithmetical development.

Organised by Silke Göbel.

13:00 **Andy Ribner** (University of Pittsburgh, United States of America)

Multidimensionality and domain-general predictors of the development of mathematical skills.

13:30 **Ilse Coolen** (Université de Paris, France) Domain-general and domain-specific predictors of mathematics skills and their interactions.

14:00 **Sara Caviola** (University of Padova, Italy) Going beyond mathematical (missing?) achievement: A large cross-sectional study in primary and secondary school children.

14:30 **Break**

14:45 **Silke Göbel** (University of York) Number words and Arabic digits: Foundations of arithmetic development in primary school.

15:15 **Jo-Anne LeFevre** (Carleton University, Canada) Development of math-specific symbolic knowledge: Digits and beyond.

15:45 **Daniel Ansari** (University of Western Ontario, Canada) Number symbols in brain and mind.

16:15 **Break**

16.30 **27th EPS Prize Lecture**

Professor Camilla Gilmore, Loughborough University

Understanding the complexities of learning mathematics.

[\[Click here to join via the Session A link\]](#)

START OF PARALLEL SESSION B – ([Click here to join this session](#))

- 11:00** **Poster Session on [Gather](#) / [Twitter](#) / [YouTube](#)**
- 12:00** **2021 BSA / EPS Undergraduate Project Prize Talk**
Jessica Teed, University of York
Exploring temporal dynamics of facial expressions: Early categorisation confusions do not indicate shared evolutionary function. ([Click here to join via the Session A link](#))
- 12:45** **Break**
- 13:00** **Matthew Belmonte, Emma Weisblatt, Ailbhe McKinney, Kathryn Hotson, Zahra Ahmed, Claudia Días, Dorit Ben Shalom, Juliet Foster, Sofia Villar, Suzanne Murphy, Alapika Jatkari and Sophie Langhorne** (The Com DEALL Trust, India, Nottingham Trent University, University of Cambridge, Cambridgeshire and Peterborough NHS Foundation Trust, University of Edinburgh, Ben Gurion University of the Negev, Israel, King's College London, University of Bedfordshire, University of North Carolina, United States of America, University of Manchester) Touchscreen training of fine motor skills in autistic children with impaired speech and motor function but spared receptive language.
- 13:30** **Lorna Hamilton, Malak Olamaie and Nicola Cutting** (York St John University)
Longitudinal associations between fiction reading experience and theory of mind in late childhood: A Bayesian analysis.
- 14:00** **Andrew Surtees, Anna Lewis-Keen, Jing A and Megan Evison** (University of Birmingham) Individual, interpersonal and contextual influences on spontaneous perspective taking.
- 14:30** **Break**
- 14:45** **Matthias Gobel and Miles Tufft** (University of Exeter, University College London) In the eye of the beholder: Perceived cooperation in social interactions shapes spatial orienting effects.
- 15:15** **Tahani Alqahtani and Doug Barrett** (University of Leicester, King Saud University, Saudi Arabia) Age related changes in single- and dual-target search: Impaired top-down guidance or a general slowing of RTs?
- 15:45** **Kirsty Lu, Jennifer Nicholas, Thomas Parker, Christopher Lane, Sarah-Naomi James, Ashvini Keshavan, Sarah Keuss, Sarah Buchanan, Ivanna Pavisic, Rebecca Street, Heidi Murray-Smith, David Cash, Carole Sudre, Ian Malone, William Coath, Andrew Wong, Susie Henley, Nick Fox, Marcus Richards, Jonathan Schott and Sebastian Crutch** (University College London, London School of Hygiene and Tropical Medicine, King's College London) Cognition at age 69-74 and its relationships with biomarkers of preclinical Alzheimer's disease.
- 16:15** **Break**
- 16.30** **27th EPS Prize Lecture,**
Professor Camilla Gilmore, Loughborough University
Understanding the complexities of learning mathematics.
([Click here to join via the Session A link](#))

START OF PARALLEL SESSION A – ([Click here to join this session](#))

EPS 75th Anniversary Symposium.

Organised by Heather Ferguson.

- 09:30** **Aidan Horner, Lisa Henderson and Nora Andermane** (University of York)
Forgetting across a hierarchy of episodic representations.
- 10:00** **Lorraine Tyler** (University of Cambridge) DNNs as explanatory models? Vision and
Language.
- 10:30** **Mike Burton** (University of York) Recognising Faces: Why familiarity matters.
- 11:00** **Break**
- 11:15** **Nicola Clayton** (University of Cambridge) Jays and Magic.
- 11:45** **Patrick Rabbitt** (University of Oxford) Fifty years of the experimental psychology of
human cognitive aging.
- 12:15** **Jennifer Cook** (University of Birmingham) Flexible mechanisms for social and
individual learning.

START OF PARALLEL SESSION B - ([Click here to join this session](#))

- 09:30** **Treshi-Marie Perera and Adrian Willoughby** (Monash University Malaysia, Nottingham Trent University) The time course of visual and tactile integration in the somatic signal detection task.
- 10:00** **Matthew Weightman, John-Stuart Brittain, Chris Miall and Ned Jenkinson** (University of Birmingham) Residual errors in visuomotor adaptation persist despite extended motor planning periods.
- 10:30** **Maria Gallagher, Iqra Arshad and Elisa Ferrè** (Cardiff University, Royal Holloway University of London) Visuo-vestibular conflicts impact vestibular processing.
- 11:00** **Break**
- 11:15** **Marko Tesic and Ulrike Hahn** (Birkbeck, University of London) The impact of explanations as communicative acts on belief in a claim: The role of source reliability.
- 11:45** **Oliver Herdson, Matilda Minchin, Holly Parker, Selina Muller and Amir-Homayoun Javadi** (University of Kent) The enhancing and impairing effect of sad music: Moderating role of cognitive reappraisal.
- 12:15** **Tina Seabrooke, Chris Mitchell, Andy Wills, Angus Inkster and Tim Hollins** (University of Southampton, University of Plymouth) Retrieval competition in the pretesting effect.

START OF PARALLEL SESSION A – ([Click here to join this session](#))

Bartlett Prize Symposium.

Origins of Mind: Developmental and comparative perspectives.

Organised by Josep Call.

- 13:00** **Lisa Feigenson** (Johns Hopkins University, United States of America) Intuitive empiricism and the study of early learning.
- 13:30** **Gergely Csibra** (Central European University Budapest, Hungary) Literal symbol manipulation.
- 14:00** **Giorgio Vallortigara** (University of Trento, Italy) Number sense without a cortex.
- 14:30** **Break**
- 14:45** **Luca Bonatti** (Catalan Institution for Research and Advanced Studies (ICREA) and Universitat Pompeu Fabra, Spain) What mental representations ground early rational thinking?
- 15:15** **Josep Call** (University of St Andrews) Ape inferential reasoning.
- 15:45** **Fei Xu** (University of California-Berkeley, United States of America) Infants are rational constructivist learners.
- 16:15** **Break**
- 16:30** **48th Bartlett Prize Lecture**
Professor Susan Carey, Harvard University
The ontogenetic origin of the capacity for logically structured thought: a case study of the logical connectives *or*, *not*, and *possible*.
[\[Click here to join via the Session A link\]](#)

End of Meeting

START OF PARALLEL SESSION B - ([Click here to join this session](#))

- 13:00** **Anastasia Ulicheva and Kathleen Rastle** (Royal Holloway, University of London)
Cognitive influences on English spelling.
- 13:30** **César Gutiérrez, Lena Blott, Joanne Taylor and Jennifer Rodd** (University
College London) A single exposure to both meanings of ambiguous words helps
rather than hinders processing of subordinate meanings.
- 14:00** **Josef Toon and Anuenue Kukona** (De Montfort University) Semantic competition
captured by the cursor: tracking cognitive processing during spoken word
comprehension.
- 14:30** **Break**
- 14:45** **Ciara Egan, Manon Jones, Paul Warren and Anna Siyanova-Chanturia** (Bangor
University, University of Oxford, Victoria University Wellington, New Zealand,
Ocean University of China, China) As clear as glass: How figurativeness and
familiarity impact idiom processing in readers with and without dyslexia.
- 15:15** **Polly Barr, Britta Biedermann and Lyndsey Nickels** (University of Bristol,
Macquarie University, Australia, Curtin University, Australia) Two bee or not to be:
The Effects of orthography and bilingualism on spoken homophone production.
- 15:45** **Johanna Tomczak, Jean-Francois Delvenne and Ekaterini Klepousniotou**
(University of Leeds) Interhemispheric transfer in monolingual and bilingual young
and older adults in a divided-field Stroop task.
- 16:15** **Break**
- 16:30** **48th Bartlett Prize Lecture**
Professor Susan Carey, Harvard University
The ontogenetic origin of the capacity for logically structured thought: a case
study of the logical connectives *or*, *not*, and *possible*.
[\[Click here to join via the Session A link\]](#)

End of Meeting

1. **Katie Brown***, **Mirta Stantic***, **Caroline Catmur** and **Geoff Bird** (University of Oxford, King's College London) (Sponsor: Geoff Bird) Investigating face perception and face memory in autism.
2. **Connor Keating*** and **Jennifer Cook** (University of Birmingham) (Sponsor: Jennifer Cook) Two Pathways: The contribution of autistic and alexithymic traits to emotion recognition difficulties.
3. **Jasmine Lee***, **Steve Janssen*** and **Alejandro Estudillo*** (University of Nottingham, Malaysia, Bournemouth University) (Sponsor: David Keeble) Exploring the modulation effects of one's self-concept style, depressive traits, and autistic traits on a self-face advantage.
4. **Bryan Leong Qi Zheng***, **Alejandro Estudillo***, **Ahamed Miflah Hussain Ismail*** and **Wong Hoo Keat*** (University of Nottingham Malaysia, Malaysia, Bournemouth University) (Sponsor: Peter Hills) The whole or the sum of its parts: Holistic processing deficits in developmental prosopagnosia.
5. ~~**Kho Siew Kei***, **David Keeble**, **Wong Hoo Keat*** and **Alejandro Estudillo***~~ (University of Nottingham Malaysia Campus, University of Bournemouth) (Sponsor: David Keeble) ~~Research Plan – The effect of transcranial direct current stimulation (tDCS) and transcranial random noise stimulation on face recognition.~~ *Withdrawn.*
6. ~~**Sarah Alharbi***, **Iris Holzleitner***, **Adil Saribay***, **Benedict Jones*** and **Anthony Lee***~~ (University of Glasgow, Kadir Has Üniversitesi, Turkey, University of Strathclyde, University of Stirling) (Sponsor: Andrew Johnson) ~~Does self-rated attractiveness predict women's preferences for facial masculinity? Data from an Arab sample.~~ *Withdrawn.*
7. **Alexander Diel*** and **Michael Lewis** (Cardiff University) (Sponsor: Michael Lewis) Famous face familiarity increases and inversion reduces distortion sensitivity for uncanniness ratings and detection of facial distortions.
8. **Hellen Jing Yuan***, **Elisabeth Van der Hulst***, **Elisabeth Von Dem Hagen**, **Johan Wagemans*** and **Christoph Teufel** (Cardiff University, Katholieke Universiteit Leuven, Belgium) (Sponsor: Christoph Teufel) Early sensory processing of a feature is modulated by the feature's relevance to high-level object perception.
9. **Courtney Mansfield***, **Fraser Smith*** and **Stephanie Rossit** (University of East Anglia) (Sponsor: Stephanie Rossit) Investigating affordance effects in people with high traits of developmental coordination disorder (DCD): An online stimulus-response compatibility study.
10. **Annie Warman*** and **Stephanie Rossit** (University of East Anglia) (Sponsor: Stephanie Rossit) Research Plan - Is there a lower visual field preference for object affordances? A series of online reaction time studies.
11. **Kimberley Dundas*** and **Joseph Brooks** (Keele University) (Sponsor: Joseph Brooks) Multivariate decoding of EEG data reveals similar mechanisms mediate perceptual adaptation and spontaneous perceptual reversals.

12. **Iqra Arshad* and Elisa Ferre** (Royal Holloway University of London) (Sponsor: Elisa Ferre) Ready, Steady, Go! Altered gravity influences responses to environmental stimuli.
13. **Mariana Babo-Rebello* and Patrick Haggard** (University College London) (Sponsor: Patrick Haggard) Looking, liking and locating: aesthetic experiences shape spatial representation.
14. **Roberta Roberts*** (University of Birmingham) (Sponsor: Alan Wing) Roughness perception spans the hands.
15. **Hayley Dewe*, Janna Gottwald*, Laura-Ashleigh Bird*, Harry Brenton*, Marco Gillies* and Dorothy Cowie** (Durham University, Uppsala University, Sweden, University College London, Bespoke VR Ltd., United Kingdom, Goldsmiths, University of London) (Sponsor: Dorothy Cowie) Exploring the effects of visuomotor synchrony, touch, and human form on the embodiment of virtual hands in children.
16. **Hannah Slack*, Georgina Jackson, Danielle Ropar and Stephen Jackson** (University of Nottingham) (Sponsor: Stephen Jackson) Exploring the development of the forward model system for motor control in children.
17. **Laura-Ashleigh Bird*, Tamar Makin* and Dorothy Cowie** (Durham University, University College London) (Sponsor: Dorothy Cowie) Research Plan - Compensatory motor behaviour in children with limb differences.
18. **Richard O'Connor, Andrew Lucas* and Kevin Riggs*** (University of Hull) Research Plan – Measuring egocentric bias on the false belief task in adults using mouse tracking.
19. **Rory Baxter* and Alastair Smith** (University of Plymouth) (Sponsor: Alastair Smith) Unreliable landmarks influence the use of viewer centred navigational cues.
20. ~~**Helen Morse*, Amy Jolly*, Valerie Pomeroy*, Allan Clark* and Stephanie Rossit** (School of Psychology, University of East Anglia, Department of Clinical Neurosciences, University of Cambridge, School of Health Science, University of East Anglia, Norwich Medical School, University of East Anglia) (Sponsor: Stephanie Rossit) Visual search in extrapersonal space: A large sample study. *Withdrawn.*~~
21. **Tamara Giménez-Fernández*, David Luque*, David Shanks and Miguel Vadillo** (Autonomous University of Madrid, Spain, University of Málaga, Spain, University College London) (Sponsor: Miguel Vadillo) Probabilistic cueing of visual search is not an inflexible attentional habit: meta-analytic evidence.
22. **Melina Kunar** (University of Warwick) The optimal way to present computer aided detection in low prevalence search.
23. **Siobhan McAteer*, Anthony McGregor and Daniel Smith** (Durham University) (Sponsor: Daniel Smith) The precision of representations in visuospatial working memory depends on their location in the visual field.

- 24. Christ Billy Aryanto***, **Emma Blakey**, **Renee Timmers***, **Claudia von Bastian** (Department of Psychology, University of Sheffield, Atma Jaya Catholic University of Indonesia, Indonesia, Department of Music, University of Sheffield) (Sponsor: Claudia von Bastian) Research Plan - Why are active music making and executive functions related? Testing the mediating roles of sensory discrimination and fluid intelligence.
- 25. Stuart Moore***, **Megan Owen***, **Peirce Proctor*** and **James Grange** (Keele University) (Sponsor: James Grange) Reconfiguration or inertia? Identifying a possible origin of switch costs during visual short-term memory resource allocation.
- 26. Loredana Frau***, **Valentina Cazzato** and **Davide Bruno*** (Liverpool John Moores University) (Sponsor: Valentina Cazzato) The role of age, cognitive reserve and depression in executive functioning.
- 27. Sho Ishiguro***, **Kaichi Yanaoka***, **Masataka Nakayama***, **Yoshiyuki Ueda*** and **Satoru Saito** (Kyoto University, Japan, University of Tokyo, Japan) (Sponsor: Satoru Saito) Control schedule learning: An exploratory examination with the Multi-Source Interference Task.
- 28. Meg Attwood*** and **Chris Jarrold** (University of Bristol) (Sponsor: Chris Jarrold) Investigating the relationship between anxiety and working memory performance in adolescents.
- 29. RuoChong Zhang***, **JeYoung Jung*** and **Christopher Madan*** (University of Nottingham) (Sponsor: Mark Haselgrove) Using neuromodulation to attenuate the negative impact of high task load on memory.
- 30. Ayanfe Adebayo*** and **Deborah Talmi** (University of Cambridge) (Sponsor: Deborah Talmi) Multiple determinants of recall: Does the influence of temporal contiguity on recall diminish with time?
- 31. Bethanie Richards*** and **Shane Lindsay*** (University of Hull) (Sponsor: Richard O'Connor) Research Plan - Does oral breathing disrupt memory consolidation during wakeful rest?
- 32. Anna Guttesen***, **Gareth Gaskell** and **Scott Cairney** (University of York) (Sponsor: Scott Cairney) The sleeping brain's response to verbal and non-verbal memory cues.
- 33. Tim Hollins**, **Tina Seabrooke**, **Chris Mitchell*** and **Angus Inkster*** (University of Plymouth, University of Southampton) Is the pre-testing effect driven by curiosity?
- 34. Gwen Brekelmans***, **Nadine Lavan**, **Meghan Clayards*** and **Elizabeth Wonnacott** (Queen Mary University of London, McGill College, Canada, University of Oxford) (Sponsor: Nadine Lavan) Research Plan - Does high talker variability improve the learning of non-native phoneme contrasts? A replication study.
- 35. Andrew Lucas***, **Shane Lindsay***, **Richard O'Connor** and **Kevin Riggs*** (University of Hull) (Sponsor: Richard O'Connor) Computer mouse tracking shows evidence of immediate lexical engagement effects in adults.
- 36. Alex Bond***, **Lorna Hamilton*** and **Nicola Cutting** (York St John University) (Sponsor: Nicola Cutting) Investigating the relationship between mentalising and reading comprehension.

- 37. Fawziah Qahtani***, **Kayleigh Warrington**, **Kevin Paterson** and **Sarah White** (University of Leicester, Nottingham Trent University) (Sponsor: Sarah White) Effects of reading goals on processing of syntactic ambiguity and semantic plausibility.
- 38. Dario Fuentes Grandon*** and **Nina Kazanina** (University of Bristol) (Sponsor: Nina Kazanina) Lost in pronunciation.
- 39. Emma Tecwyn** and **Angela Nyhout*** (Birmingham City University, University of Kent) Research Plan - The development of mental simulation as a strategy for solving problems with multiple alternatives.
- 40. Joanne Eaves***, **Camilla Gilmore** and **Lucy Cragg** (University of Nottingham, Loughborough University) (Sponsor: Lucy Cragg) The conflict adaptation effect: Transfer across mathematical and non-mathematical domains.
- 41. Daniel Perez-Zapata***, **Xavia McKenzie-Smart***, **Ian Charest*** and **Ian Apperly** (University of Birmingham) (Sponsor: Ian Apperly) Children and adults solve pure coordination games via alignment of intuitions.
- 42. Francisco Vicente-Conesa***, **Tamara Giménez-Fernández***, **David Luque*** and **Miguel Vadillo** (Autonomous University of Madrid, Spain, University of Málaga, Spain) (Sponsor: Miguel Vadillo) Learning to suppress a distractor may not be unconscious.
- 43. Jason Hill***, **Ross Vanderwert*** and **Travis Proulx*** (Cardiff University) (Sponsor: Lewis Bott) Inconsistency-induced tonic LC-NA arousal associated with enhanced environmental abstraction.
- 44. Delali Konu***, **Brontë McKeown***, **Adam Turnbull***, **Nerissa Siu Ping Ho***, **Theodoros Karapanagiotidis***, **Tamara Vanderwal***, **Cade McCall***, **Steven Tipper**, **Elizabeth Jefferies** and **Jonathan Smallwood*** (University of York, University of Rochester, United States of America, University of Plymouth, University of British Columbia, Canada, Queen's University, Canada) (Sponsor: Steven Tipper) Exploring patterns of ongoing thought under naturalistic and conventional task-based conditions.

How to Engage with Poster Presenters



Please find below the best ways to engage with our poster presenters during the EPS Online Poster Session at 11:00am on Thursday 8th July.

We encourage you to view posters on the EPS website and to link up with presenters on Gather, Twitter and YouTube. Talk-through videos will be available alongside posters on Gather and on the EPS website. Presenters with the YouTube symbol below will also be able to respond to any YouTube comments.

Please use #EPSPosterQs to help others follow the discussion!

If you do not receive a response straight away during the poster session, it means you have chosen a popular poster! A reply may reach you outside of the poster session.

Poster No.	Name of Presenter	Gather	YouTube	Twitter
1	Katie Brown			 @katiebrown_psy
	katie.brown@wolfson.ox.ac.uk			
2	Connor Keating			 @ConnorTKeating
	cxk655@student.bham.ac.uk			
3	Jasmine Kar Wye Lee			 @Jasminelkwy
	jassielee29@gmail.com			
4	Bryan Leong Qi Zheng			 @qizhenggg
	khpy6blq@nottingham.edu.my			
5	Kho Siew Kei <i>Withdrawn.</i>			
6	Sarah Alharbi <i>Withdrawn.</i>			
7	Alexander Diel			
	diela@cardiff.ac.uk			
8	Hellen Jing Yuan			 @JingHellen
	yuanj12@cardiff.ac.uk			
9	Courtney Mansfield			 @Courtney_EM_
	courtney.mansfield@uea.ac.uk			
10	Annie Warman			 @agwarman
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How to Engage with Poster Presenters

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12	Iqra Arshad			 @IqraArshadPsych
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13	Mariana Babo-Rebello			 @BaboRebello
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17	Laura-Ashleigh Bird			 @BOLDkidsUK
	laura-ashleigh.bird@durham.ac.uk			
18	Richard O'Connor			
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19	Rory Baxter			 @rorybaxterpsy
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20	Helen Morse <i>Withdrawn.</i>			
21	Tamara Giménez-Fernández			 @CALL_UAM
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How to Engage with Poster Presenters

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Parallel Session A

2021 BSA / EPS Undergraduate Project Prize Talk

Exploring temporal dynamics of facial expressions: Early categorisation confusions do not indicate shared evolutionary function.



Jessica Teed
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A substantial body of evidence supports the universality of six basic facial expressions of emotion: anger, disgust, fear, surprise, happiness, and sadness. However, Jack, Garrod and Schyns (2014) investigated the previously neglected influence of temporal dynamics of facial expressions, hypothesising that early overlapping muscle movements produce confusions between emotion categories. They propose initial facial movements result in four emotion categories that are biologically relevant: disgust/anger, fear/surprise, happiness, and sadness. Here, we aimed to test this hypothesis by presenting participants with videos of the start or full development of the six expressions and analysing categorisation accuracy. As expected, results revealed significantly higher categorisation accuracy when viewing the full expression clip. Importantly, the systematic confusions made when categorising the start of the dynamic expressions did not support Jack et al.,’s (2014) hypothesis of a shared evolutionary function underlying early morphological similarities between expressions. This disputes the existence of only four early basic emotion categories. Nevertheless, results did indicate facial expression categories are not as discrete at the start of dynamics, potentially signifying alternative perceptual processing. This has important theoretical implications regarding how facial expressions are processed over their entire time course and presents valuable avenues for future study.

EPS Prize Symposium.
The symbol-grounding problem in numeracy and arithmetical development.
Organised by Silke Göbel.

Multidimensionality and domain-general predictors of the development of mathematical skills.



Andy Ribner
University of Pittsburgh, United States of America
andy.ribner@pitt.edu

Acquiring an understanding of early mathematical principles—including approximate and exact quantities, more-less relations, and multiple representations of numerical values—is difficult but critical for success in academic mathematics. The difficulty underlying the acquisition of these complex principles is, in part, due to the fact that mathematics is not in fact a unidimensional skill, but rather a multidimensional construct made up of several interactive and overlapping abilities (e.g., number sense, arithmetic, geometry, patterning). As such, students must leverage various capacities in order to master the varied constructs that make up “early math.” These capacities include language skills which are necessary for communicating about and honing children’s understanding of quantity and executive functions—a broad construct comprised of an interrelated set of skills which are implicated in the achievement of goals—which allow children to appropriately

direct their attention and manipulate incoming information in order to assimilate it into existing knowledge. In this talk, I will discuss the structure of the construct broadly referred to as “early math” and the role of domain-general skills language and executive function in predicting individual differences therein across several different datasets.

Domain-general and domain-specific predictors of mathematics skills and their interactions.



Ilse Coolen
Université de Paris, France
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A large number of domain-general and domain-specific skills are thought to be foundational to mathematics achievement. Domain-general skills such as visuospatial (working) memory, inhibition and attention have been shown to predict mathematics skills throughout the development. Similarly, domain-specific skills such as the ability to represent and manipulate approximate numerical magnitudes, sometimes referred to as the Approximate Number System (ANS), are known to predict mathematics abilities. More recently, it appeared that domain-general skills are to some extent reflected in ANS tasks. In a first instance, this calls for research to disentangle the different foundational predictors of mathematics abilities during a child’s development and to explore whether these skills are indeed distinguishable constructs. Subsequently, the dynamic interplay between these domain-general and domain-specific skills needs to be determined.

Going beyond mathematical (missing?) achievement: A large cross-sectional study in primary and secondary school children.



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Mathematics is a complex domain and likely relies on a comprehensive network of cognitive skills. Research in mathematical cognition is offering an increasing number of empirical evidence showing the importance of investigating both domain-general as well as domain-specific abilities in math achievement. In a large cross-sectional studies (N>1200, children in grades 2, 4, and 6), we investigated the relation between non-symbolic and symbolic magnitude comparison tasks and math achievement, by also taking into account domain-general variables, such as working memory measures. The aim of our study was to determine the relative contribution of various cognitive factors to math achievement. We used Bayesian analysis which allows us to quantify support for both null and alternative hypotheses and to provide highest density intervals for parameters. Results showed no robust evidence to suggest any specific relation between non-symbolic magnitude comparison measures and math achievement, when symbolic magnitude comparison measures or domain-general factors are taken into account. Moreover, testing multiple age groups allowed us to comment on developmental possible effects, in particular for educational and clinical implications.

Number words and Arabic digits: Foundations of arithmetic development in primary school.



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In this talk I'll present results from a longitudinal study investigating predictors of arithmetical development from Year 1 to Year 3 in primary schools in the UK and in Austria. Children's symbolic and non-symbolic number comparison skills at the beginning of primary school did not emerge as a significant predictor of arithmetic growth over the next two years. However, children's ability to translate accurately and efficiently between Arabic digits and spoken number words was a significant longitudinal predictor of arithmetical growth even when domain-general factors (working memory, general cognitive skills and phonological skills) were included in the model. This was the case for children in the UK and in Austria despite their differences in language background: in English number words the order of tens and units (e.g., forty-two) follows the written order of the Arabic digits (e.g., 42), whereas in German number words are inverted (e.g., two and forty). While these differences in spoken number word structure clearly influenced the type of errors made by children in the transcoding tasks, there were clear concurrent and longitudinal relationships between transcoding ability and arithmetic in both language groups, even when controlling for a range of domain-general and other domain-specific measures. This shows the importance of understanding the numerical symbol system for mathematical development in primary school.

Development of math-specific symbolic knowledge: Digits and beyond.



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We assessed mathematical orthography skills for children in grades 2, 3, 4, and 6 and adults. Mathematical orthography was measured with a symbol decision task (SDT-Math) in which participants decided if combinations of symbols were acceptable or not (e.g., $1 + 4 = 5$ vs. $1 _ 4 = 5$). Orthography knowledge is related to, but distinct from other symbolic mathematical skills, for example, digit comparison (e.g., which is larger 4 or 7?), and from language-specific math vocabulary skills and arithmetic fluency. We focus on the issue of how fluent symbol processing beyond digits contributes to theories of individual differences in the development of mathematical skills.

Number symbols in brain and mind.



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Humans share with animals the ability to process numerical quantities in non-symbolic formats (e.g., collections of objects). Unlike other species, however, over cultural history, humans have developed symbolic representations (such as number words and digits) to represent numerical quantities exactly and abstractly. These symbols and their semantic referents form the foundations for higher-level numerical and mathematical skills. It is commonly assumed that symbols for number acquire their meaning by being mapped onto the pre-existing, phylogenetically ancient system for the approximate representation of non-symbolic number over the course of learning and development. In this talk I will challenge this hypothesis for how numerical symbols acquire their meanings (“the symbol grounding problem”). To do so, I will present evidence from both behavioral and neuroimaging studies with both children and adults that demonstrate that symbolic and non-symbolic processing of number are dissociated at both the behavioral and brain levels of analysis. I will discuss the implications of these data for theories of the origins of numerical symbol processing.

End of Symposium.

Parallel Session B

Touchscreen training of fine motor skills in autistic children with impaired speech and motor function but spared receptive language.

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As part of a feasibility randomised controlled trial of Point OutWords (<http://PointOutWords.online/>), a caregiver-delivered, iPad-assisted intervention designed for and with those minimally verbal autistic children whose severe deficits in expressive language are coincident with impaired motor skills, we tested motor and communicative skills in 30 minimally speaking or non-speaking subjects aged 3-15 years. All 13 treatment-group children decreased jerk (temporal derivative of acceleration), measured internally within the intervention software. These decreases were consistent, fitting exponential learning curves, only for the 5 who engaged consistently with the intervention. This engagement was predicted by Vineland receptive language ($F(1, 7)=11.67, p=0.0112$) and interaction with expressive language ($F(1, 7)=5.94, p=0.045$): those with more intact receptive language, especially those with relatively impaired expressive language, were the ones who engaged. 8 children significantly lessened time to complete movements (each $p<0.02$). In slight ($r^2=0.045, 0.0115$) but significant ($p<0.0001$) effects, greater jerk was associated with greater error in movement direction and longer movement paths. External measures revealed no consistent effects of treatment versus control caregiver-child interaction with other iPad software, although Mullen motor and language ($p=0.027$) and Social Responsiveness Scale ($p=0.033$) improved across both groups. Future work will target autistic children with large Vineland receptive-expressive differences.

Longitudinal associations between fiction reading experience and theory of mind in late childhood: A Bayesian analysis.

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The narrative practice hypothesis states that explicit theory of mind (ToM) skills are scaffolded through childhood engagement with specific kinds of narrative (Hutto, 2008). Cross-sectional work has demonstrated concurrent associations between young children's exposure to narratives and ToM (Mar et al., 2010); however, longitudinal studies on this topic are lacking. The current study investigated longitudinal relations between cumulative experience of reading fiction books and explicit ToM (mental state attribution; mental state reasoning) between the ages of 9-10 and 10-11 years. Sixty-one children were tested on a battery of tasks assessing reading habits, explicit ToM, and oral language skills at two time points separated by one year (mean age = 9 years 10 months at time 1; 10 years 11 months at time 2). Using Bayesian linear regression models, we found that cumulative experience of reading fiction books predicted mental state reasoning – but not mental state imputation – one year later. Contrastingly, earlier ToM skills did not predict later fiction reading. The longitudinal association between fiction reading experience and mental state reasoning was not explained by children's receptive vocabulary or listening comprehension. We interpret these findings in the light of cultural evolutionary accounts of the development of explicit ToM beyond early childhood.

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Individual, interpersonal and contextual influences on spontaneous perspective taking.

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Representing other people's perspectives is a vital human social ability. Recent debate has focussed on the degree to which perspective taking requires deliberate, effortful processing, or can be achieved through spontaneous, efficient sensitivity. We argue that studies in this area commonly neglect the impact of three crucial factors: i) interactive context, ii) individual psychological traits, and iii) current psychological state. Across four studies we investigate these factors. Experiment 1A shows that spontaneous perspective taking does not relate to individual differences in explicit perspective taking in a single task, and Experiment 1B that it does not relate to self-reported social behaviour in the real world. Experiment 2 evidences that competitive, cooperative and neutral contexts are all sufficient to prime spontaneous perspective taking. Experiment 3 shows that taxing working memory can cause people to stop spontaneously taking each other's perspectives, but through implicit adaptation, rather than through concurrent resource depletion. How we take the perspectives of others is impacted not only by the complexity of the perspective taking task, but also by subtle variation in individual and interpersonal context.

In the eye of the beholder: Perceived cooperation in social interactions shapes spatial orienting effects.



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This research investigated how interactive social contexts scaffold basic visual attention. Interacting with another person increases social inhibition of return effects in joint spatial cueing tasks. We predicted that if perceptions of cooperativeness explain this phenomenon, then we would observe larger social inhibition of return effects for more cooperative individuals and in highly cooperative situations. Experiment 1 (N = 75) found larger social inhibition of return effects for female compared to male participants, consistent with the literature on gender stereotypes and the behavioural evidence that women are more cooperative than men. In Experiment 2 (N = 143), we experimentally manipulated the cooperativeness of the task, describing it as either a team or an individual game. This time, larger social inhibition of return effects were found for male participants in the team game condition, compared to the individual game condition. Across both experiments, subjective perceptions of cooperativeness predicted larger social inhibition of return effects. Construing the interaction context as cooperation might play a crucial role for joint visual search and behavioural coordination.

Age related changes in single- and dual-target search: Impaired top-down guidance or a general slowing of RTs?



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RTs during search are typically longer for old than younger adults. This finding has been interpreted as evidence of an age-related impairment of top-down guidance during search. In this study, we contrasted the speed and accuracy of target-detection in young and older adults during single- and dual-target searches. Participants were 30 young (M = 23.73 SD = 4.08) and 30 older (M = 65.47 SD = 5.44) adults. Cues were used to elicit search for one, or one of two targets in displays containing two subsets of coloured Landholt's Cs. Targets were defined by a unique orientation (feature) or combination of orientation and colour (conjunction) and displays could contain 4, 8 or 12 Cs on the circumference of a virtual circle. Accuracy and RTs were dependent on search type, target-presence and set size on feature and conjunction searches. RTs were also significantly slower and the dual-target cost significantly higher for old compared to young observers. Age-related effects were not statistically significant when observers' RT distributions were Z-transformed. These data suggest age-related changes in RT during single- and dual-target search are attributable to a general slowing of responses rather than specific impairments in top-down guidance during feature or conjunction searches.

Cognition at age 69-74 and its relationships with biomarkers of preclinical Alzheimer's disease.

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Subtle cognitive decline is detectable during the preclinical stage of Alzheimer's disease, but questions remain about its nature and timing. 502 participants in the Insight 46 study, all born during the same week in March 1946, completed baseline assessments at age 69-71 and follow-up visits ~29 months later. Cognitive measures included memory, processing speed, reasoning, reaction time, and visuomotor integration. Accelerated long-term forgetting was measured at follow-up only. We investigated whether baseline cognition and subsequent cognitive change were associated with brain pathologies determined from 18F-Florbetapir-PET/MRI (β -amyloid positive/negative status, whole brain volume, white matter disease burden). At baseline, cognitively-normal amyloid-positive participants (18%) scored ~0.3 SD lower than amyloid-negative across various cognitive domains (Lu et al., 2019, 2020, 2021). White matter disease and whole brain volume were associated with various timed measures. In amyloid-positive participants, rate of brain atrophy was associated with decline on a cognitive composite z-score (-0.08 per ml/year [-0.12--0.04], $p<0.001$) and poorer accelerated long-term forgetting (-0.12 per ml/year [-0.21--0.03], $p=0.010$). On the visuomotor integration test, individual differences in speed-accuracy trade-offs remained stable, with residual error rates highly correlated between baseline and follow-up ($r=0.64$; $p<0.0001$). Subtle differences in cognition associated with preclinical AD pathologies are detectable in cognitively-normal older adults.

27th EPS Prize Lecture.

Understanding the complexities of learning mathematics.



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Research in mathematical cognition has flourished over the past two decades and identified a set of cognitive and non-cognitive factors that are associated with mathematical achievement. However, to fully understand the mechanisms and processes of learning mathematics we must consider mathematics as a multi-componential domain. I will present data from a set of studies that explore the complex relationships between cognitive skills and different components of mathematics. These studies demonstrate how overall mathematics achievement arises out of the interactions between basic cognitive skills, specific mathematical competencies and learners' exposure to different mathematical material. This nuanced view of mathematical learning is essential in order to identify how to best support mathematical learning and understand why so many individuals struggle with learning mathematics.

Parallel Session A

EPS 75th Anniversary Symposium.

Forgetting across a hierarchy of episodic representations.



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Forgetting is often conceptualised as a unitary process; we typically think of forgetting as following a specific forgetting function and being caused by either decay or interference. Recent research has suggested that both when and how forgetting occurs depends on what is being forgotten. For example, the forgetting function of episodic events appears to be linear (Fisher & Radvansky, 2019), which differs from the classic logarithmic forgetting curve (Ebbinghaus, 1885). Related, whether forgetting occurs via interference or decay may depend on the representation being retrieved (Sadeh et al., 2016). We recently proposed that episodes are represented across a neural hierarchy, and that forgetting differs both qualitatively and quantitatively across the levels in this hierarchy (Andermane et al., 2021). The framework predicts a qualitatively different pattern of forgetting for events relative to object features, with events being forgotten in a more holistic ‘all-or-none’ manner and object features being forgotten in a more fragmented manner. I will present experiments that test this prediction, suggesting that events are forgotten in a slow holistic manner, whereas object features are forgotten in a rapid fragmented manner. Our research challenges orthodox views of forgetting and highlights that forgetting is a complex non-unitary process.

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DNNs as explanatory models? Vision and Language.

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Explanatory models of dynamic processes such as visual perception or language comprehension require a spatiotemporally well-resolved account of *what* neural computations support these processes and *where* and *when* in the brain they are located. My goal here is to consider how far ‘Deep Neural Net’ (DNN) systems for vision and language can be related to these explanatory goals. In particular, this requires us to relate the internal properties of DNN operations in a given domain to the underlying brain systems supporting human performance. Human vision is well understood as a cortical system, and a strong tradition in machine vision reflects these theories of cortical

organization. This enables direct comparisons between DNN systems for object recognition and the real-time neural activity of human perceivers, showing success for DNNs in modelling early stages of visual processing in the brain but failure to capture meaning-related processes. Language is more challenging, with no consensus neurobiological models of speech and language, and DNNs constructed with little reference to the human system. This makes it less straightforward to relate DNN language models to the operations of the human brain. I will present current research relating these two ‘black boxes’ to each other, showing how DNNs may be profitably related to human neural solutions.

Recognising Faces: Why familiarity matters.



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Most of us find it easy to recognise the people we know, but harder to identify unfamiliar faces – for example when checking photo-ID. Automatic face recognition systems can now out-perform human viewers matching unfamiliar faces, but this does not seem to have helped us to understand how we recognise our friends. It is becoming increasingly clear that the concept of ‘familiarity’ is both critical and poorly understood. I will review some recent developments in the field and argue that we need a more sophisticated model of familiarity than we currently have available. In designing such a model, it may be possible to make novel theoretical connections between face recognition and other cognitive abilities.

Jays and Magic.

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Psychologists have become increasingly interested in using magic effects to explore blind-spots in seeing and road-blocks in thinking. Recently, we suggested that similar techniques could apply to non-human animal observers, especially those such as jays that watch where other birds have hidden food caches and use this information to attempt to pilfer those caches at a later date. In this talk, I will briefly review the caching and pilfering tactics in jays, and then explore how we can further our ways of thinking using a magical framework. I will focus specifically on our recently published paper, in which we performed three different magic effects (palming, French-drop, and fast pass), which rely on different cues and expectations all of which mislead human spectators into thinking that one object has, or has not, been transferred from one hand to the other. The jays were not deceived by palming and French-drop effects, which required them to expect an object to move between the magician’s hands. However, they were misled by the fast pass effect. This is the first study to investigate how another taxon perceives magic effects, providing important insight into the similarities and differences in perception and cognition in humans and animals.

Fifty years of the experimental psychology of human cognitive aging.



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In the 1970's because brain scans were unavailable experimental psychologists sought to identify which measures of cognitive performance are most sensitive to age related changes in the CNS. James Birren identified slowing of information processing speed as a key index. Contemporary experimentalists tested models to that, putatively, guided “decomposition” of RTs to yield values for successive processes that might be unequally affected by neurological aging. This approach was abandoned when John Cerella and Paul Verhaegen analysed all published age comparisons of decision times and found that age slows all, hypothetically different, processes by the same, simple, constant. A different approach was to compare trajectories of age-related performance changes between individuals, and how scores on tests of different cognitive abilities such as decision speed, memory and intelligence differ between people of different ages or change in the same individuals as they grow old. Advances in brain scanning began to allow co-tracking of performance and brain changes. Our studies examined differences in trajectories of change for tests of speed, memory, and intelligence and related these parallel measures indices of health, education, intelligence and socio-economic advantage. As scanning became more accessible these data could be related to measurements of gross brain integrity such as loss of overall brain volume, in blood supply and of white matter integrity. Changes in speed account for most of the variance in changes in intelligence and memory. Age – related changes in white matter lesions, brain blood supply and brain volume account for nearly all of age-related changes in speed.

Flexible mechanisms for social and individual learning.



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The existence in the human brain of neural and/or neurochemical pathways that are specialised for learning from social information is the topic of much debate. Indeed, some theories of human cultural evolution posit that humans have social-specific learning mechanisms that are adaptive specialisations moulded by natural selection. Cognitive neuroscientific studies present mixed evidence: some studies find dissociable mechanisms for social learning and learning from individual experience (individual learning), whereas others find the same brain areas and, dopamine-mediated, computations involved in both. In this talk I will argue that neurochemical mechanisms underpinning learning can be dissociated along a primary-secondary but not a social-individual axis. That is, social learning relies upon the dopamine-rich mechanisms that also underpin individual learning when social information is the primary learning source, but not when it comprises a secondary, additional element. This proposal resolves conflicting literature because in studies which find common mechanisms participants are generally encouraged to learn primarily from social information, whereas in studies which find dissociable mechanisms social information generally comprises a secondary source. Our proposal supports a burgeoning field showing that, rather than being fixedly specialised for particular inputs, neurochemical pathways in the human brain can process both social and non-social cues and flexibly switch between the two depending upon which cue is primarily relevant for the task at hand.

End of Symposium.

Parallel Session B

The time course of visual and tactile integration in the somatic signal detection task.



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Vision modulates our perception of sensory events. For example, presenting a task irrelevant visual stimulus (e.g., illuminating an LED) in conjunction with a tactile stimulus not only increases the detection of touch, but also leads to illusory perceptions of touch in the absence of any tactile stimulus. The Somatic Signal Detection Task (SSDT; Lloyd et al, 2008) is a visuo-tactile integration task requiring the detection of near-threshold tactile stimuli presented in the presence or absence of a visual stimulus. Using signal detection theory analyses, it is possible to determine whether changes in tactile detection in the presence of a visual stimulus are driven by increased tactile sensitivity (d') and/or changes to response criteria (c). Here, we used a modified version of the SSDT, in which the visual and tactile stimuli were presented asynchronously, to examine the time-course of visuo-tactile integration. Signal detection theory analyses revealed increased hit rates when tactile stimuli preceded the visual stimulus by 30 - 90 ms, demonstrating asymmetries in the integration of asynchronous visuo-tactile events.

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Residual errors in visuomotor adaptation persist despite extended motor planning periods.



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A consistent finding in sensorimotor adaptation is a stereotypical lack of full compensation where performance asymptotes below optimal performance. This behaviour has been attributed to limiting factors within the implicit adaptation system i.e. an equilibrium between trial-by-trial learning and forgetting. However, recent research has suggested that increasing the motor planning periods prior to movement during these tasks can help to eliminate these persistent residual errors. The suggestion being that, the additional planning time allows the required cognitive processes to be completed before movement onset, thus increasing accuracy. Here we looked to extend these findings by investigating the relationship between increased motor planning time and the size of imposed visuomotor rotation, with regards to the final asymptotic level of adaptation. We found no evidence to suggest extended planning time aids the elimination of persistent errors during visuomotor adaptation at any magnitude of cursor rotation (30°, 45° or 60°). While restricting planning time to only 0.35 seconds significantly impaired adaptation to larger rotations (which was accompanied by greater aftereffects). We found that neither 1 second nor 2.5 seconds of preparation time resulted in complete compensation, with learning asymptotes in all experimental groups significantly different from the degree of imposed rotation. These data suggest that, alone, prolonging motor planning

periods is insufficient for individuals to reliably achieve complete adaptation and therefore provides indirect support for evidence proposing implicit learning mechanisms restrict asymptotic adaptation levels.

Visuo-vestibular conflicts impact vestibular processing.



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As we move through the world, visual and vestibular cues provide complementary information regarding the direction and speed of our movements. Specifically, optic flow signals heading direction and distance, while the vestibular system provides cues regarding acceleration and rotation of the head. While natural motion results in corroborating visuo-vestibular signals, certain circumstances such as Virtual Reality (VR) can lead to visuo-vestibular conflicts. For example, viewing a rollercoaster in VR provides visual cues that one is moving in a certain direction with a certain acceleration, however the vestibular system signals that one is stationary. In these cases, it is possible that the brain re-weights vestibular cues, impacting subsequent vestibular processing. In my talk, I will describe the vestibular consequences of exposure to visuo-vestibular conflicts. After viewing optic flow cues in VR for just one minute, participants' sensitivity to vestibular stimulation was significantly reduced. In addition, vestibular postural reflexes (Vestibular-Evoked Myogenic Potentials) were altered following optic flow in VR. Finally, viewing optic flow on a PC screen also reduced participants' sensitivity to verticality. Together, these findings demonstrate the potential for visuo-vestibular conflicts to alter the processing of vestibular cues, which may have consequences for VR and other conflict-inducing platforms.

The impact of explanations as communicative acts on belief in a claim: The role of source reliability.



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Providing an explanation is a communicative act. It includes an explainees, a person who is receiving an explanation and an explainer, a person who provides an explanation and attempts to influence explainees' beliefs (Hilton, 1990). The majority of research on explanation has focused on how explanations alter an explainees' beliefs (Koehler, 1991; Lombrozo, 2006, 2007; Pennington & Hastie, 1993). However, one general feature of communicative acts is that they also provide information about the speaker, such as the speaker's reliability (Hahn, Harris, & Corner, 2009, 2016; Harris, Hahn, Madsen, & Hsu, 2016; Jarvstad & Hahn, 2011; Madsen, Hahn, & Pilditch, 2020; Merdes, Von Sydow, & Hahn, 2020). To explore the role of reliability in the context of explanations, we conducted three experiments. All three experiments utilized dialogues between two people on five different issues and included everyday explanations. We found that (i) in line with the previous literature, providing an explanation for a claim increased people's confidence in the claim; (ii) providing an explanation increased people's perceived reliability of the explainer; (iii) the reliability

of the explainer mostly mediated the effect of proving an explanation; (iv) providing an explanation had a significantly greater impact on people's confidence when explainer's reliability was low compared to when that reliability was high, and (v) an expert who did not provide an explanation for their claim had the same impact on people's confidence as a non-expert who provided a good explanation for their claims.

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The enhancing and impairing effect of sad music: The Moderating role of cognitive reappraisal.



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Seemingly paradoxical, sad music has exhibited potential in improving mood in individuals, as well as being detrimental to mood and indicative of maladaptive behaviours concerning emotion regulation. Research suggests that different adaptive and maladaptive behaviours underlie sad music listening. As such, we explored if cognitive reappraisal (CR) was effective at promoting adaptive behaviours associated with sad music listening, while negating the negative psychological outcomes. CR is a cognitive skill that focuses on the reframing and re-evaluation of negative events in a positive way. Across two studies we explored the combined effects of sad music and CR when exposed to neutral or sad events on mood. Preliminary data analysis revealed that CR significantly improved mood notably more than the control task, while happy music was more effective at improving mood compared to sad music. An interaction effect revealed that the disparity in mood change between happy and sad music was greater when CR was absent. This suggests that with CR,

the negative effects of sad music were better negated compared to when CR was absent. Therefore, this highlights that CR can be effective in improving one's mood and may be protective against the negative effects of sad music.

Retrieval competition in the Pretesting effect.



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The Pretesting effect demonstrates that attempting (but failing) to guess the target associated with a specific cue word (e.g., pond) can improve subsequent memory for that target (e.g., frog), relative to an equivalent study period. When the final test task involves cued recall of the target, this effect critically depends on the semantic relatedness of the cue and target. The current experiments investigated two possible reasons for the importance of cue-target relatedness to the pretesting effect in cued recall. The first is that relatedness is important at test; related (but not unrelated) cues allow participants to identify which of the well-remembered targets was presented with each specific cue at encoding. That is, the cue resolves competition between a range of retrieved targets at test. The second possibility is that cue-target relatedness plays a crucial role at encoding. This may be because in the related (but not unrelated) case, all three components of the encoding experience - the cue, the guess and the target - are likely to be semantically related. We found evidence for both of these ideas. The findings for theories of the pretesting effect will be discussed.

Parallel Session A

Bartlett Prize Symposium.

Origins of Mind: Developmental and comparative perspectives.

Organised by Josep Call.

Intuitive empiricism and the study of early learning.

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The origins of our minds are an enduring puzzle - what parts of what we know require learning, and what emerges in the absence of specific experience? Questions about how nature and nurture contribute to human knowledge have been productive in driving contemporary research in psychology, linguistics, and neuroscience. Yet, these questions also have been controversial, with some arguing that it is no longer useful to consider development in terms of nature and nurture. Here I revisit classic ideas in this theme, and provide new evidence. First I argue that people, including children and scientists, naturally and intuitively think about human abilities in terms of innateness versus learning. Moreover, we find that their thinking exhibits strong empiricist biases. Characterizing these biases, and their potential to distort scientific reasoning, is critical if we are to come to understand the actual origins of knowledge. Next, I present a case study for thinking about learning that puts new emphasis on the role of prior knowledge. In a series of experiments, we find that infants' acquisition of new information (i.e., nurture) is guided and enhanced by prior knowledge that is likely innate (i.e., nature). These experiments highlight that integrating across the contributions of nature and nurture, rather than ignoring this distinction, is central to understanding phenomena of interest. I suggest that researchers must continue to think about nature/nurture, with the recognition that in so doing we also must characterize, understand, and correct for our intuitive biases.

Literal symbol manipulation.



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In 'The Origin of Concepts', Susan Carey proposed that the acquisition of external, public symbol systems, such as conveyed by natural language, assist children in the construction new internal representational resources that mirror the structure of the corresponding external representations. The operation of such a bootstrapping system presupposes children's competence in recognizing and interpreting external entities as symbols. Carey discusses lexical learning and the language acquisition device as potential vehicles of this crucial ability. In addition to these, I propose the existence of a further system of core cognition that is embedded in infants' and children's communicative competence and is devoted to dealing with public symbols that are not, or not necessarily, linguistic in nature. In this system, real physical entities (such as objects) serve as symbols for discourse referents (tokens of concepts), and the literal manipulation of these symbols serves as spatiotemporal predication on the referents. I show that some existing findings from infants and adults could be reinterpreted as evidence of the operation of this system, and present some recent studies that tested predictions derived from this proposal.

Number sense without a cortex.



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What underlies the ability to deal with numbers and where did it come from? It has been hypothesized that our ability to accurately represent the number of objects in a set (numerosity), and to carry out numerical comparisons and arithmetic, developed from an evolutionarily conserved system for approximating numerical magnitude, the so-called Approximate Number System. Non-symbolic number cognition based on an approximate sense of magnitude has been documented in a variety of species. However, we know little of its neural and molecular bases, in particular we do not know anything for those species, such as zebrafish, that in recent years became established as developmental and behavioral genetic model systems. Using a combination of early gene expression and in-situ hybridization we identified for the first time a small region in the caudal part of the dorso-central division of the zebrafish pallium that shows selective activation upon change in numerosity of visual stimuli. As pallial regions are implicated in number cognition in mammals and birds, these findings support the existence of an evolutionarily conserved ANS and provide an avenue for exploring the underlying molecular correlates.

What mental representations ground early rational thinking?

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Recent data suggest that preverbal infants possess remarkable capacities to process complex events and modify hypotheses about them facing inconsistent evidence. I will present data about the behavioural and neural correlates of some of these processes in infants and adults, focusing on elementary logical inferences. I will critically discuss various proposals about the mental representations underlying these capacities.

Ape inferential reasoning.



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Knowledge about the spatial and temporal continuity of objects as well as their relations with other objects play a crucial role in inferential reasoning. Comparative approaches have mainly focused on distinguishing inference from non-inferential processes, most notably heuristics based on attentional, perceptual or motor predispositions, or heuristics acquired via associative processes. Comparative researchers have devoted far less research attention to distinguishing weak from strong inferences, an aspect that Susan Carey and her colleagues brought to my attention a few years ago. In this talk I will classify the empirical evidence available in nonhuman primates regarding spatio-temporal inferences (e.g., inference by exclusion) in terms of their strength. I will then use this evidence to identify the gaps in our knowledge in this area and the connections that one can establish between inference by exclusion and other areas of cognitive research such as probability estimation and intuitive statistics from a comparative perspective.

Infants are rational constructivist learners.



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The study of cognitive development has often been framed in terms of the nativist/empiricist debate. Here I will argue for a rational constructivist approach: Young learners take into account both prior knowledge and biases (learned or unlearned) as well as statistical information in the input; prior knowledge and statistical information are combined in a rational manner (captured by Bayesian probabilistic models); and there exists a set of domain-general learning mechanisms that give rise to domain-specific knowledge. Furthermore, learners actively engage in gathering data from their environment. I will present empirical evidence supporting the idea that early learning is rational, statistical, and inferential, and infants and young children are rational, constructivist learners.

End of Symposium.

48th Bartlett Prize Lecture.

The ontogenetic origin of the capacity for logically structured thought: a case study of the logical connectives *or*, *not*, and *possible*.



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For centuries, philosophers have argued that the capacity for logically structured thought is unique to linguistically competent humans (but see Fodor for counterarguments). One scientific case study within this debate seeks evidence for reasoning according to the disjunctive syllogism (A or B, not A; therefore B) on the part of non-linguistic creatures on non-linguistic tasks. I draw on data inspired by Call's 2-cup task, success on which is consistent with reasoning according to the disjunctive syllogism. This task is solved by non-human animals of many species, and by human infants beginning around 17 months of age, but not before. I present data from three extensions of Call's paradigm that looked for, and failed to find, evidence of representations of *or* in children until beginning at age 4, speaking against the conclusion that success on this task necessarily involves the disjunctive syllogism. I present evidence that one source of difficulty on these tasks is absence of the modal concept *possible* until after age 4. The data I present is consistent with the conclusion that the capacity to deploy the disjunctive syllogism in thought develops in two steps: the capacity for negation beginning at age 17 months or so, and the capacity for disjunction beginning at age 4. I present evidence that learning the language of negation and possibility, respectively, coincides with these milestones.

Parallel Session B

Cognitive influences on English spelling.



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Modern English spelling is often described as “broken”, “crazy”, “irregular”. However, our recent work suggests that the complexity of English writing (e.g., spelling seri-ous differently from atl-as) may serve a purpose, such that it helps to recover the meaning of the written word more easily. We present new corpus analyses of modern English spelling that develop this idea. In particular, we compare spoken words with their written counterparts and demonstrate that English spelling carries a disambiguating function more often than would be predicted based on the properties of the English alphabet, and this extends beyond morphology. Further, we present evidence that spelling distinctions are introduced specifically when words sound similar to each other. Finally, we present a series of computer simulations investigating what would happen to the lexicon if the English writing system were simpler. In sum, our findings suggest that modern English spelling carries cognitive footprints. We discuss these results in the context of language evolution literature and the idea that “languages get the writing systems they deserve”.

A single exposure to both meanings of ambiguous words helps rather than hinders processing of subordinate meanings.



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Many English words have multiple meanings. Less frequent (subordinate) meanings are more difficult to access than dominant meanings. Previous studies have shown that a single encounter with a subordinate meaning can reduce this difficulty. Natural language exposure, however, will include both dominant and subordinate meanings. Such inconsistent experience could potentially increase processing difficulty due to enhanced competition between word meanings. However, recent work (1) found that mixed exposure made processing of subordinate meanings non-significantly faster and significantly more accurate, while processing of dominant meanings and unambiguous words was unaffected. In the present preregistered experiment, 182 native English speakers read sentences selected from The British National Corpus containing ambiguous words (one for each meaning) and matched control sentences containing unambiguous words. Participants then made semantic relatedness decisions to target words paired with probe words related to the subordinate meaning. Responses were significantly more accurate and faster for trained subordinate meanings compared to an untrained baseline, while for unambiguous words responses were significantly more accurate and non-significantly slower for trained vs untrained items. These results confirm that mixed exposure to dominant and subordinate meanings does not reduce performance due to competition, but instead enhances performance for the more difficult subordinate meanings.

Semantic competition captured by the cursor: tracking cognitive processing during spoken word comprehension.



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Semantically related concepts compete during language comprehension (e.g., Yee & Sedivy, 2006). The aim of this research was to investigate the activation of semantic knowledge by measuring cursor movements (e.g., Spivey et al., 2005). In two online experiments, participants viewed visual arrays containing a target (e.g., accordion) and a semantically related competitor (e.g., banjo) or unrelated distractor (e.g., plum) while hearing the target word (e.g., “accordion”). Participants were tasked with moving their cursor from the lower visual array to the target in one of the upper corners. In Experiment 1, target word onset followed visual array onset by 500ms. In Experiment 2, to encourage cursor movements throughout, target word onset was triggered by vertical movements. In both experiments, temporal (e.g., RT) and spatial measures (e.g., area under the curve and maximum deflection) showed significant differences between competitors and distractors, such that trajectories were more attracted to semantically related competitors than unrelated distractors (i.e., the corner opposite the target). Additionally, the vertical trigger manipulation (Experiment 2) reduced the effect sizes. These results show that online cursor tracking methods can index semantic competition and highlight the sensitivity of these measures for studying the activation of semantic knowledge during language processing.

As clear as glass: How figurativeness and familiarity impact idiom processing in readers with and without dyslexia.



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Idiomatic language has been shown to have a processing advantage over non-idiomatic language for typical readers. However, to date little is known about how poorer readers, such as readers with dyslexia, process idioms and other conventional sequences. Here, we utilized eye-tracking while typically developed readers, and readers with dyslexia read sentences which contained similes (e.g. as cold as ice). These similes were orthogonally manipulated for familiarity (e.g. as cold as ice / as cold as snow) and figurativeness (e.g. as cold as ice – referring to emotions / referring to temperature). Both participant groups exhibited a processing advantage for familiar and figurative similes over novel and literal items. However, participants with dyslexia had greater difficulty with both unfamiliar similes, and with similes which needed to be interpreted literally rather than figuratively based on the available context. This study provides the first evidence regarding the online processing of idiomatic language in individuals with dyslexia. Potential mechanisms to explain the greater difficulty these participants experience processing unexpected simile endings will be discussed.

Two bee or not to be: The effects of orthography and bilingualism on spoken homophone production.



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The distinct meanings and shared phonology of homophone pairs are useful tools for investigating lexical retrieval: previous research has tried to identify a language production model using homophone production. However, there is inconsistency in previous research as to whether there is a homophone advantage in spoken production. We investigated the effect of three potential confounding factors on the presence of a homophone advantage by asking participants to name and translate homophones and control words: i) speaker type (monolingual/bilingual); ii) homophone spelling (heterographic/homographic) and iii) task (picture naming/translation). We found no evidence of a difference between monolinguals and bilinguals; previous inconsistencies were not due to speaker type. Fascinatingly though there is evidence homophone production is modulated by spelling and task: in translation a slight-but not full advantage of homophones was found regardless of spelling, whereas in picture naming a slight advantage was found for heterographs only. In combination with previous research, we suggest that the Interactive activation model (Middleton et al., 2015) is the most plausible model of spoken word production.

Middleton, E. L., Chen, Q., & Verkuilen, J. (2015). Friends and foes in the lexicon: Homophone naming in aphasia. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *41*(1), 77–94.

Interhemispheric transfer in monolingual and bilingual young and older adults in a divided-field Stroop task.



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The corpus callosum is the largest white matter structure of the human brain, which enables interhemispheric transfer of information. As a potential consequence of age-related thinning of the corpus callosum and therefore less facilitated interhemispheric transfer, older monolingual adults seem to experience less interference from contradicting stimuli when bilaterally displayed. The current study aimed to investigate whether bilinguals, due to a larger corpus callosum, would experience more interference from bilaterally displayed contradicting stimuli and whether age-related decline in interference would be reduced by bilingualism. In this divided-field Stroop task, older and younger monolinguals and bilinguals were tested online, using spatially separated target and distracter stimuli. As expected, all groups showed a significant Stroop effect. For the older bilinguals, the Stroop effect was significantly larger in the bilateral than in the unilateral display, while there was no difference between these for the other groups. As hypothesised, this suggests that older bilinguals experience more interference from contradicting stimuli in the bilateral display when compared to their monolingual peers. This could be explained by increased white matter integrity through lifelong bilingualism and would mean that older bilinguals are less able to inhibit distracter stimuli in a bilateral display compared to older monolinguals.

Investigating face perception and face memory in autism.



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The facial recognition ability of those with Autism Spectrum Disorder has been the subject of hundreds of studies. However, there remains little consensus as to whether autistic people are impaired at recognising faces. In aiming to understand whether impairments to face perception and face memory are in fact associated with autism, a group of autistic adults ($N = 57$) and a group of matched neurotypical controls ($N = 57$) completed a standard test of face perception (GFMT), a novel test of face perception specifically designed for use in atypical groups (the Oxford Face Matching Test; OFMT) and a standard test of face memory (CFMT), as well as a measure of self-reported face recognition difficulties (PI-20). On average, the autistic group scored significantly lower on all tests of face recognition but did not report significantly more problems with face recognition in everyday life. However, some autistic individuals performed within the neurotypical range. When estimating the perceptual similarity of face pairs, estimates produced by autistic participants deviated significantly more from algorithm-provided similarities than estimates produced by neurotypicals. This suggests that poor performance in face matching paradigms is partly driven by problems with perceptual representation formation in autism, rather than suboptimal decision-making alone.

Two Pathways: The contribution of autistic and alexithymic traits to emotion recognition difficulties.



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Recent developments suggest that alexithymia, and not autism, is responsible for the difficulties with emotion recognition that are often documented in the autistic population. Despite great progress, research has not yet elucidated the mechanisms behind its involvement. Here we investigated whether alexithymic and autistic traits contribute directly to emotion recognition accuracy or indirectly by influencing variability of emotion representations. 25 autistic and 25 non-autistic individuals completed two emotion-based tasks which employed dynamic point light displays of happy, angry and sad facial expressions (PLFs). In the first task, on each trial, participants were required to move a slider to manipulate the speed of a PLF stimulus until it moved at the speed of a typical angry, happy or sad expression. Variability was calculated as the standard deviation of the speeds attributed to angry, happy and sad PLFs respectively. In the second task, participants viewed emotional PLFs and rated how angry, happy and sad the expressions appeared. Emotion recognition accuracy was calculated as the correct emotion rating minus the mean of the two incorrect emotion ratings. Our analyses revealed that whilst autistic traits directly contributed to emotion recognition accuracy, alexithymic traits (specifically externally oriented thinking) indirectly contributed to accuracy by influencing variability.

Exploring the modulation effects of one's self-concept style, depressive traits, and autistic traits on a self-face advantage.



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The self-face advantage (SFA) shows that, compared to familiar and unfamiliar faces, individuals are faster in identifying their own face among a set of distractor faces. Evidence has suggested that the SFA is modulated by several factors, including one's self-concept, depressive and autistic traits. In two separate experiments, we further explore the contribution of these factors to the SFA. While Experiment 1 explored if individuals with a more interdependent self-concept style show a weaker SFA, Experiment 2 explored if those with a higher depressive trait and individuals with a higher autistic trait show a weaker SFA. Participants were asked to search for a frontal view of self, friend (only in Exp.1), and unfamiliar faces among an array of distractor faces in a visual search task. Participants also completed the Self-Construal Scale (in Exp.1), CES-D, and AQ-28 questionnaires (in Exp.2). Findings in Experiment 1 showed that though Malaysian Chinese demonstrated no evidence of SFA, self-concept could not fully account for the SFA. Findings in Experiment 2 showed no differences in the searching time and search accuracy for the own face between the high and low depressive traits group and between the high and low autistic traits group, altogether suggesting no modulation effects of depressive and autistic traits on the SFA.

The whole or the sum of its parts: Holistic processing deficits in developmental prosopagnosia.



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Face recognition has been considered an important research problem that has numerous practical applications and is essential for self-perception or consciousness, as well as communication and interactions with others (Tolba et al., 2006; Jeantet et al., 2018). Studies also suggested that the face recognition deficit in Developmental Prosopagnosics (DP) is caused by impaired holistic processing, although there have been mixed findings in the literature. These mixed findings could be the result of the independent use of different measures of holistic processing that show poor to no association between each other (Rezlescu et al., 2017). Accordingly, the study reported here aimed to gain further insight into the role of holistic processing and differences in face recognition ability (FRA). Groups of DP and neurotypicals were recruited online to complete several tests that measure different aspects of holistic processing in faces and holistic processing in non-face objects. By comparing performances in holistic measures between those with and without difficulties in FRA (as measured with the Cambridge Face Memory Test), we seek to understand whether deficits in FRA can be predicted by deficits specific to the holistic processing of faces. Our results suggested that DPs have diminished susceptibility for the inversion and part-whole effect, but not the composite effect. This provides further evidence that holistic processing is impaired, not absent, in DPs. Additionally, our findings also argue against the functional significance of the composite effect.

Research Plan – The effect of transcranial direct current stimulation (tDCS) and transcranial random noise stimulation on face recognition. *Withdrawn.*

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Recently, there has been increasing interest in improving face recognition using transcranial electrical stimulation. However, the effectiveness of transcranial direct current stimulation (tDCS) and transcranial random noise stimulation (tRNS) on face recognition is still unclear. The current study aims to explore the effects of tDCS and tRNS with direct current (DC) offset on face recognition, and to ascertain if the effect is face-specific. Sixty Malaysian-Chinese will first complete a face and object recognition baseline task. Next, participants will receive either sham-stimulation, tDCS or tRNS with DC offset. Participants will then complete new versions of the face and object recognition task. We hypothesized that accuracy for face and object recognition task will increase following tDCS and tRNS with DC offset compared to sham stimulation. We further hypothesize that accuracy on the face recognition task will increase after tRNS with DC compared to tDCS. ANOVA will be performed on the baseline score to check for potential pre-stimulation differences in face recognition ability between groups. To investigate the effect of stimulation on face and object recognition, a mixed 3 (stimulation: sham vs. tDCS vs. tRNS) x 2 (task: face vs. object) ANOVA will be conducted on both accuracy and reaction time.

Does self-rated attractiveness predict women's preferences for facial masculinity? Data from an Arab sample. *Withdrawn.*

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Objectives: Because more attractive women may be better able to attract and/or retain masculine mates, many researchers have proposed that women who consider themselves to be more physically attractive will show stronger preferences for men displaying masculine facial characteristics. Empirical evidence for this putative association between women's self-rated attractiveness and preference for facial masculinity has come almost entirely from studies of Western women. Thus, we investigated whether this pattern of results also occurs in a sample of non-Western women. **Methods:** We investigated the relationship between self-rated attractiveness and facial masculinity preferences in a sample of Arab women (N = 281). Facial masculinity preferences were assessed from attractiveness judgments of masculinized versus feminized versions of face images. **Results:** By contrast with previous findings for Western women's self-rated attractiveness, we observed no compelling evidence that Arab women who considered themselves to be more attractive showed stronger preferences for masculine men. **Conclusions:** Our results suggest that previously reported associations between self-rated attractiveness and masculinity preferences might be somewhat culture-specific, potentially reflecting cultural differences in typical mating strategies.

Famous face familiarity increases and inversion reduces distortion sensitivity for uncanniness ratings and detection of facial distortions.



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The uncanny valley describes aversive reaction towards humanlike artificial entities. Previous research found that closeness to human faces sensitizes the effect of face distortions on uncanny feelings. One possible mechanism underlying this distortion sensitivity is the level of perceptual experience or familiarity with the stimulus. The current study investigates the effect of familiarity and inversion on uncanniness ratings for facial distortions. The detection sensitivity of these distortions was also investigated. Images of British and German celebrities were incrementally distorted (increased interocular distance and lowered mouth) and presented either both upright and inverted to participants from the United Kingdom and Germany. Uncanniness ratings increased across the distortion level, and this effect was stronger for familiar and upright faces. Furthermore, the ability to detect differences between the distorted variants of the same face (distortion sensitivity) increased across the levels of distortion, and again, this effect was enhanced when faces were upright and familiar. Our findings show that familiarity towards a stimulus increases the sensitivity to uncanniness for distorted faces, likely by increasing the sensitivity to subtle distortions in the face. This suggests a reinterpretation of the uncanny valley as being a feature of deviation from the expected or perceptually familiar.

Early sensory processing of a feature is modulated by the feature's relevance to high-level object perception.



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Sensory processing of low-level, local features is known to be affected by high-level, global representations. However, previous studies disagreed on whether high-level percepts enhance or suppress sensitivity to local features. We propose a resolution to this conflict, suggesting that the effects of top-down modulation are dictated by whether the local feature is relevant to the global percept. In an online psychophysical task, over 200 observers viewed dynamic point-light walkers made of gratings, which induced a global percept of a person walking. Local grating orientations were manipulated to be either relevant to the global walker percept – by being aligned with the walker's limbs – or irrelevant – by being misaligned. Results indicated higher orientation sensitivity when local orientations were relevant to the high-level percept compared to the irrelevant condition. Control conditions, in which gratings formed no global percept, indicated that this modulation was a top-down effect induced by the high-level representation, and that the presence of a global percept differentially modulated relevant and irrelevant features. Overall, the study provides direct behavioural evidence for predictive coding models and demonstrates the role of global relevance in the dynamic and flexible interaction between high- and low-level visual processing.

Investigating affordance effects in people with high traits of developmental coordination disorder (DCD): An online stimulus-response compatibility study.



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Automatic motor representations are thought to facilitate object use, a phenomenon termed the affordance effect. Most affordance experiments use the stimulus-response compatibility (SRC) paradigm, which elicits faster reaction times (RTs) when the handle orientation of a stimulus is compatible with the hand used to respond. The present study used an online SRC paradigm to investigate affordance effects remotely and investigated whether SRC effects would be affected by traits of developmental coordination disorder (DCD), given that this neurodevelopmental condition is often associated with sensorimotor deficits. Participants (N = 178) were presented with graspable objects, with handles oriented to the left or right, and completed 4 blocks of compatible and incompatible SRC trials. During experimental blocks they were asked to make upright vs. inverted judgments and in control blocks they completed colour judgements. Participants were screened for traits of DCD, dyslexia and ADHD. We replicated the SRC effects online, but only for the experimental task, in line with affordance interpretation. Additionally, we found that participants with high traits of DCD had significantly longer RTs in incongruent trials than those with low traits of DCD. These results were not mirrored in ADHD or dyslexia, suggesting that affordance effects may be sensitive to DCD.

Research Plan - Is there a lower visual field preference for object affordances? A series of online reaction time studies.



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The handle compatibility effect (CE) consists of faster reaction times (RT) when the handle orientation of graspable objects is congruent with the hand used to respond, even if handle orientation is irrelevant to performance. This effect is often attributed to Gibson's affordance model and is one of the main behavioural paradigms used to study affordance. Nevertheless, the effect has been subject to debate given replication failures, small effect sizes and suggestions that speeded RTs are due to spatial compatibility rather than affordances. In the proposed series of pre-registered online studies, we will comprehensively investigate this effect using a stimulus-response compatibility paradigm to investigate: (a) whether we can replicate the handle CE while controlling for spatial compatibility by manipulating task (orientation vs colour judgements); (b) whether the same effect is observed when objects are presented briefly (100ms) to prevent eye-movements; and (c) whether the handle CE differs when objects are briefly presented either in the upper (UVF) or lower (LVF) visual fields. RTs will be analysed using repeated-measures ANOVAs and we expect larger handle CEs for orientation than colour judgements and for objects presented in the LVF than UVF, given that the LVF is more specialised for action.

Multivariate decoding of EEG data reveals similar mechanisms mediate perceptual adaptation and spontaneous perceptual reversals.



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The cause of spontaneous perceptual reversals of visually ambiguous stimuli (e.g., Rubin’s faces-vase) has been attributed to several different mechanisms. One hypothesis suggests that adaptation, or “neural fatigue”, builds up while one interpretation is dominant and eventually triggers a reversal. Although there is behavioural evidence that adaptation to an unambiguous stimulus (i.e., adaptor) can bias subsequent perception of an ambiguous one, it is unclear whether adaptation plays a role in spontaneous reversals (i.e., no adaptor). We used multivariate pattern analysis of human EEG data to test whether adaptation is involved in spontaneous perceptual reversals. We presented two block types: adaptation and ambiguous. In adaptation blocks, perceptual reversal was induced by adapting to an unambiguous motion stimulus before presentation of an ambiguous stimulus. During ambiguous blocks, only ambiguous stimuli were presented, and any reversals occurred spontaneously. We trained a classifier on the pattern of EEG scalp voltage during adaptation-induced reversals. We then tested this classifier on spontaneous reversal data and found above-chance decoding and similar activity patterns. These results suggest that similar brain mechanisms mediate perceptual adaptation and spontaneous perceptual reversals. This provides support for the “neural fatigue hypothesis” of multi-stable perception.

Ready, Steady, Go! Altered gravity influences responses to environmental stimuli.



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Humans have evolved in a 1g gravitational environment. That is, on Earth gravity is always there, stable and unchanging. The vestibular system in the inner ear constantly monitors the magnitude and direction of gravitational acceleration. Gravity is the most persistent sensory signal in the brain, and it may play an important role in regulating behaviour. Accordingly, astronauts have reported perceptual and cognitive alterations during spaceflight. Responding to changes in the environment is crucial for survival. Using the oddball task, we investigated how people react to environmental stimuli in physical and visually altered gravity. In Experiment 1, the vestibular system was stimulated by passively tilting participants in body orientations congruent or incongruent to terrestrial gravity. No differences were found in accuracy; however, participants were slower in detecting the oddball stimulus when the body was incongruent to terrestrial gravity. In Experiment 2, the oddball task was administered during Virtual Reality simulation of terrestrial and non-terrestrial gravity. Again, no differences were found in accuracy, yet responses were significantly slower in non-terrestrial gravity compared to terrestrial gravity. Taken together, our results demonstrate sub-optimal behavioural responses in both physical and visually altered gravity. Vestibular-gravitational signals may be crucial in successfully adapting to the environment.

Looking, liking and locating: aesthetic experiences shape spatial representation.



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Object-location associations are established while we interact with objects at certain locations. Where binding might therefore be shaped by subjective experience with an object. We investigated how aesthetic experience could incidentally modulate memory for location, in three experiments performed at science festivals (n=96) and online (n=118 and n=80). Participants visited a virtual museum, not knowing they would later be tested for spatial memory. Afterwards, they located the artwork on a museum map and reported how much they liked it. Liking an artwork increased the ability to recall on which wall the artwork was hung. This result was replicated in all three experiments. This effect was not explained by mere exposure. The association between liked artworks and walls was stored in memory from encoding, as revealed by faster reaction times in a recognition task. This effect was specific to aesthetic experience and could not be explained by goal-directed behaviour. It was present even in the absence of explicit attention to aesthetic experience or to spatial organisation of the museum. Recalling the wall requires recalling heading direction, so our findings suggest positive aesthetic experience enhances first-person spatial representations. Aesthetic experience has an impact on the representation of space.

Roughness perception spans the hands.

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There have been conflicting reports of whether the perception of roughness on a single digit is influenced by the texture of surfaces simultaneously touched by other digits on the same or different hands. This discrepancy may reflect the use of differing techniques for measuring roughness perceived through touch. The present work examined multi-digit roughness perception using both texture discrimination and absolute magnitude estimation techniques. Pairs of tactile gratings were actively touched using the thumb and index fingers from the same or different hand. Roughness at the thumb was to be attended while that at the index finger ignored. In both discrimination and rating tasks the roughness perceived at the thumb varied with the texture of surfaces touched by the index finger. The effect occurred when the pairs of digits were on the same or on different hands but showed some tendency to be reduced in the latter condition. These findings show that roughness perception during active touch is not restricted to a single digit or side of the body. Furthermore, they suggest that the sensory signals contributing to a sense of roughness on the hands interact in brain regions able to integrate information from opposite sides of the body.

Exploring the effects of visuomotor synchrony, touch, and human form on the embodiment of virtual hands in children.

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Feelings of ownership and agency over one's body are driven by the integration of multisensory signals and top-down information about the body. Yet relatively little is known about the constraints of these factors in children. We examined the effects of movement, touch, and form on children's embodiment of virtual hands. A total of 197 children (4-14 years) played a virtual reality bubble-popping game where a virtual hand moved synchronously or asynchronously with their own movements. In Experiment 1 only, participants either received congruent touch, delayed touch, or no touch upon hitting each bubble. In Experiment 2 only, participants used either a virtual human hand or non-human block. Movement synchrony influenced embodiment ratings in both experiments. In Experiment 1, touch had no influence on embodiment. In Experiment 2, participants embodied both virtual forms, provided visuomotor signals were synchronous. However, only the virtual hand during synchronous movement was described as feeling like the participant's own body, rather than like a tool (e.g., controller). Findings highlight the overall dominance of visuomotor synchrony for the children's own-body representation. Children embodied a non-human virtual form, yet it was constrained by prior expectations about the body. Therefore, both top-down and bottom-up processes drive body representations in childhood.

Exploring the development of the forward model system for motor control in children.



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The current study aimed to establish the development of the forward model system in children. The forward model system in the brain controls motor action execution. Previous research has shown that children are less accurate in using their forward model system to control their movements than adults. However, limited research has investigated how the use of the forward model system changes as children grow. It was hypothesized that successful use of the forward model system would be predicted by age. 43 children (mean age=9.11, SD=2.48, range= 4.25-12.95 years) completed an online computer task containing two race-cars and a set of traffic lights. Participants clicked the screen as soon as the green traffic light was visible. Responses were classified as anticipatory or reactive using a two-horse race-to-threshold model based on participants' reaction time. The likelihood of participants making an anticipatory response was significantly predicted by age (Beta=.36, SE=.03, $p=.03$). This was not predicted by gender or parent-reported impulsivity (all $p>.05$). The overall model fit was $R^2 = .13$. The findings suggest that the successful use of the forward model system improves as children age. These results improve our understanding of how the motor system develops in childhood.

Research Plan - Compensatory motor behaviour in children with limb differences.



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How flexible are body representations and motor skills during development? To answer this question, we study compensatory motor strategies in children with congenital upper limb differences. Children with one functional hand (n=17, 35 months – 10 years), whereby ‘function’ is defined as the ability to pincer grip, were filmed completing 14 semi-ecological tasks including undoing buttons and separating Lego bricks. We observed children use a variety of effectors, including the mouth, legs, and torso, to substitute for their missing hand. Whilst the balance of effectors was highly variable between participants, use of the residual limb was consistently higher (78% of task time compared to 18%, 2%, 37%, and 8%, $p=.001$ for each comparison). From 5-6 years we observed a marginally significant reduction in foot use (13% of task time compared to 1.3%, $p=.054$). Limb different children flexibly adapt their behaviour relying on multiple effectors. Our data suggest that social factors may play a role in developmental changes in effector use: at 5-6 years when foot use declines, children’s seated school environment may physically inhibit foot use and raise awareness that foot use is not common among peers. More work is needed on how effector use changes with age.

Research Plan – Measuring egocentric bias on the false belief task in adults using mouse tracking.



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Theories of belief processing typically assume that processing another person's false belief requires inhibition of one's salient current knowledge. This project uses computer mouse tracking to measure, in adults, egocentric bias towards one’s current knowledge during a false belief task. Participants will view video scenarios in which an object is moved. An agent will either have a true (“TB-scenarios”) or a false (“FB-scenarios”) belief as to the object’s final location. Participants will use a mouse to answer questions about the final location of the ball (“reality”) and where the agent thinks it is (“belief”), choosing from two possible answers. Mouse tracking allows researchers to measure on-line attraction to different response options during the decision-making process. Here, on belief questions where the agent has a false belief, the alternative incorrect answer will reflect participants’ own knowledge of where the ball is hidden. We therefore predict that the alternative answer will be most salient during that condition, as measured by greater mouse-path deviation towards that answer. Mouse-path data will be analysed with repeated-measures ANOVA to assess effects of scenario (TB/FB) and question (Reality/Belief) on mouse-path deviation. We present here pilot data and planned further experiments investigating the mechanisms underlying any such effects.

Unreliable landmarks influence the use of viewer centred navigational cues.



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A key component of our daily navigational behaviour is the ability to employ internal and external spatial cues to encode locations in the world around us. Typically, this behaviour is examined empirically through tasks in which participants learn the whereabouts of a hidden location using a combination of allocentric and egocentric cues, the availability and reliability of which can then be manipulated to identify their respective contributions to learning. This talk presents an experiment in which participants learned three different hidden locations across three conditions in a virtual environment. In the first condition, both allocentric and egocentric cues were reliable indicators of the hidden location in conjunction, and in two further conditions, either the allocentric or egocentric cues were reliable only in isolation (with the alternative cue type rendered unreliable). An additional manipulation was employed in which unreliable allocentric cues were either present or absent in the egocentric cues only condition. Results indicate that the presence of unreliable allocentric cues deleteriously effects participants' ability to accurately identify the hidden location. These data highlight the integral role of landmarks in human navigation, and the difficulty that can arise when attempting to suppress uninformative cues in the environment around us.

Visual search in extrapersonal space: A large sample study. *Withdrawn.*

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~~We carry out visual search tasks in the real world every day. Cancellation tasks are a widely used measure of attention and visual search. Most studies have focused on peripersonal (within reach) cancellation tasks and recent reports (Benjamins et al., 2019) suggest no effects of aging on peripersonal cancellation search organization. Here, we investigated visual search performance in extrapersonal space in a large sample of healthy adults. Members of the public were recruited using convenience sampling and completed a computerized cancellation task involving searching for object targets among distractor stimuli from afar on a large television screen, using a wireless remote. A sample of 179 healthy adults (m age = 49; 18-94) were included in the analysis. We computed accuracy, revisits, duration, search speed, search path intersections and quality of search. We found that age was significantly negatively correlated with search speed and quality of search. Age was also associated with longer times to complete the search. Gender and years of education were not significantly associated with any variables. Our results suggest that visual search in extrapersonal space may be more sensitive to age-related decline in visual search abilities and may be a better measure of attentional abilities in the real world.~~

Probabilistic cueing of visual search is not an inflexible attentional habit: meta-analytic evidence.



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Probabilistic cueing of visual search has been characterized as an inflexible attentional habit, independent from goal-driven attention. This claim is partly based on the evidence that, once established, probabilistic cueing is difficult to unlearn. Studies exploring this issue usually include a training stage, in which a location search bias is acquired, followed by a testing stage, where the bias persists even when it is no longer advantageous. We carried out a meta-analysis with the aim to test whether the mean size of probabilistic cueing decreases from the training stage to the testing stage. To compare effect sizes, we fitted a multi-level random-effects model. This analysis confirmed that the effect size of the testing stage was statistically smaller than that of the training stage. Our results challenge the claim that probabilistic cueing is inflexible and suggest instead that it can be easily unlearned in response to changes in the experimental contingencies.

The optimal way to present computer aided detection in low prevalence search.

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Previous research has shown that, in visual search, people miss a high proportion of targets when they only appear rarely (Wolfe et al., 2005). This ‘Low Prevalence’ effect also occurs in clinical settings where radiologists search mammograms for cancers that have a low prevalence. To improve cancer detection, Computer Aided Detection (CAD) has been developed, which uses algorithms to highlight areas of potential interest for radiologists to search. Previous research found that when CAD cues are correct, miss errors to find a low prevalence mass are reduced (Kunar et al., 2017). However, when CAD cues are incorrect, miss errors are greatly increased. The current research investigates the best way to present CAD to mitigate high errors when the CAD cues are incorrect. Three conditions were compared. CAD cues were presented: (i) simultaneously with a mammogram (Automatic condition), (ii) after the mammogram was initially searched, to help participants confirm or change their original judgement (Confirm condition), or (iii) interactively where participants could choose to check CAD after the initial reading (Interactive condition). The results showed that miss errors were lowest in the Confirm condition and that this presentation method helped reduce miss errors when the CAD cue was incorrect.

The precision of representations in visuospatial working memory depends on their location in the visual field.



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Visuospatial working memory (VSWM) has a limited capacity. However, the nature of this capacity limitation is debated. Slot models argue that there is an upper limit on the number of items that can be retained in VSWM (Zhang & Luck, 2008). In contrast, resource models propose a limit on the quality of representations that can be maintained in VSWM (Bays et al., 2009). Slot and resource models make different predictions about how the eccentricity of stimuli might affect representation in VSWM. According to the slot model, eccentricity should not effect of the quality of representations. In contrast, the resource model predicts that the precision of representations will decline as eccentricity increases. We tested these predictions in a series of online and laboratory experiments. VSWM representations were less precise when presented further from central fixation for both online and laboratory experiments. However, the pattern of response errors in the online experiment offers support for the slot model, whereas the pattern of results in the laboratory version indicates support for the resource model of VSWM. We propose that differences in eye movements might underlie the differences in results and thus differing support for the slot and resource models of VSWM.

Research Plan - Why are active music making and executive functions related? Testing the mediating roles of sensory discrimination and fluid intelligence.



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Music training and music ability have been shown to be positively associated with higher-level cognitive skills underpinning goal-directed behaviour (known as executive functions). However, it is yet unclear why this correlational relationship exists. There is evidence that musicians may have an advantage on their general cognitive and discrimination abilities compared to non-musicians. Equally, previous research has shown that both abilities are related to executive functions. The goal of the present study is to replicate and extend these past findings by testing two possible explanatory mediators of the relationship between active music making and executive functions with: sensory discrimination and fluid intelligence. In a sample of 250 participants, active music-making and executive functions will be measured, including inhibitory control, shifting, and working memory updating. As for the mediators, fluid intelligence, visual and auditory discrimination ability will be measured. A latent mediation model will be tested to examine whether active music making predicts better executive functions, and whether there is an indirect effect through sensory discrimination and fluid intelligence. Findings from this study may explain why playing music may have a transfer effect to executive functions.

Reconfiguration or inertia? Identifying a possible origin of switch costs during visual short-term memory resource allocation.



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Several models of visual short-term memory performance implicate a memory resource as being responsible for the fidelity at which representations are held in memory. Such resource allocation appears to rely on attention, with impairments of attention seemingly detrimental to resource allocation. In previously reported work we embedded a vSTM change detection paradigm within a task switching paradigm and showed that change detection performance was detrimentally impacted by switching between feature dimensions. In the current work, we attempt to differentiate between task-set inertia and reconfiguration accounts of this switch cost. Task-set inertia was manipulated by varying the duration between trials (i.e., response–cue interval; RCI); longer RCIs increase the time available for the previously relevant task-set to dissipate, leading to reduced proactive interference (which reduces switch costs). Reconfiguration was manipulated by varying the duration between cue and stimulus presentation (i.e., cue–stimulus interval; CSI); longer CSIs increase the time available for activation/reconfiguration of the relevant task-set (which reduces switch costs). Our results show that neither manipulation reduced the switch cost, suggesting a different origin than reconfiguration or inertia.

The role of age, cognitive reserve and depression in executive functioning.



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Cognitive reserve (CR) is known to reduce or even protect against the negative effects of ageing on cognitive functioning by facilitating the use of compensatory strategies. CR has also often been associated with compensatory mechanisms related to executive functions, which in turn can be affected by depression. The aims of the present study were to investigate: 1) age-related differences across younger and older adults; 2) whether age, CR and depression predicted different executive domains; 3) and whether the relationship between age and executive functioning was moderated by CR. A between-groups, cross-sectional design assessed a sample of 55 older (Mage = 69.45) and 55 younger (Mage = 22.91) participants. CR was estimated using the Cognitive Reserve Index questionnaire. Depression was assessed with the Patient Health Questionnaire-9. Executive functions were measured using Trail Making Test-A/B and Digital Symbol Substitution Test. A composite score for the executive function was also computed. Results showed that CR and age predicted performance on cognitive flexibility, executive control and working memory. Depression predicted executive control. No moderating effect of CR was detected on the association between age and executive functions across age groups, indicating a limited role of CR in the prediction of executive functioning.

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Control schedule learning: An exploratory examination with the Multi-Source Interference Task.



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Learning is a fundamental component of cognition. The present study explored the role of learning in the implementation of executive function, the role, which had not been scrutinized until recently. Specifically, we examined whether and how control schedule learning is possible by manipulating temporal regularity of conflict detection and need for control. The Multi-Source Interference Task (Bush & Shin, 2006) was used to tax executive function. Each block of the task had five trials including four control trials and one interference trial. Temporal regularity of conflict was manipulated by presenting interference trials either at the same position (for three experimental groups; $n = 67$, $n = 54$, $n = 68$) or at varying positions (for a control group; $n = 53$) across blocks. The results indicate that (a) the experimental groups showed higher accuracy for interference trials than the control group (i.e., the regularity reduced the deleterious incongruency effect of interference trials), (b) the regularity effect was not observed in reaction time, and (c) a subset of participants was aware of the temporal position of interference trials. These findings suggest that knowledge about control schedules acquired during a task supports executive function.

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Investigating the relationship between anxiety and working memory performance in adolescents.



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Working memory has emerged as a key explanatory mechanism for the cognitive difficulties observed in anxious individuals. According to well-established cognitive interference theories, anxiety captures resources from the limited capacity working memory system, and interferes with task performance (Eysenck et al., 2007). Mixed empirical findings suggest these accounts are oversimplified (see Moran, 2016 for a review). Using a battery of carefully matched verbal and visuospatial working memory tasks (including N-back and complex span) and self-report measures of anxiety (STICSA; Ree et al., 2000) and executive function (BRIEF-2; Gioia et al., 2000), we investigated the relationship between anxiety and cognitive performance in an adolescent sample. Adolescence is a critical stage for the development of anxiety, yet there is limited understanding of the cognitive mechanisms that underpin the onset and maintenance of these symptoms. While anxious individuals reported greater impairment in executive function, there was limited association between anxiety and working memory performance on the behavioural measures (in spite of the tasks demonstrating good reliability and interrelatedness). Findings suggest a more nuanced account of the anxiety-working memory relationship and are discussed with reference to the acknowledged lack of agreement between self-report and behavioural measures of cognitive performance (e.g., Soto et al., 2020).

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Using neuromodulation to attenuate the negative impact of high task load on memory.



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Anodal transcranial direct current stimulation (tDCS) and transcranial alternating current stimulation (tACS) over the left dorsolateral prefrontal cortex (dlPFC), even at short durations, have been shown to improve cognitive control and memory capacity in healthy adults. However, few past studies have compared these different neuromodulation techniques. The present study proposes that anodal tDCS or tACS can attenuate the adverse effects of high task load during memory encoding. In this task, to-be-remembered words are interleaved with processing blocks presented at varied pace, during which participants complete a cognitively demanding task involving a letter-one-back and a number-parity judgement procedure. Letters and numbers will be presented at a faster pace under high, relative to under low, task load. Participants will also receive one of the three types of stimulation: anodal tDCS, tACS, and sham, concurrent with these processing blocks. Participants' memory for the to-be-remembered words will be assessed in a free recall task. We will use a repeated-measures ANOVA to examine the effects of task load and stimulation type on recall. The results will lend insights into how task load can be modulated by the short-term plasticity of the memory system, with implications for the therapeutic potential of neuromodulation.

Multiple determinants of recall: Does the influence of temporal contiguity on recall diminish with time?



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In free recall tasks, it has been observed that after a participant recalls a stimulus, the next stimulus they are likely to recall is one they encoded immediately before or after. This effect, termed the temporal contiguity effect, is a signature of the influence of the temporal context of a stimulus on memory. While the temporal contiguity effect has been observed across a range of time scales, it is not known whether it remains constant across time. Indeed, there are suggestions that with the passage of time, the influence of temporal organisation on recall dwindles, while that of semantic organisation increases. Here we tested this possibility by comparing the temporal and semantic organisation of free recall in tests taken immediately after study, and those taken a few minutes later. We obtained evidence for temporal and semantic organisation effects of equal magnitude across conditions. A notable observation, however, was the presence of increased intrusion errors in delayed recall, which may indicate increased use of semantic context in aiding delayed recall, alongside the temporal context. This study provides further evidence for the robustness of temporal contiguity effects across time scales and suggests that a short retention interval, between a few minutes to an hour, does not affect the memory's reliance on temporal context.

Research Plan - Does oral breathing disrupt memory consolidation during wakeful rest?



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Benefits for declarative memory over short time periods during wakeful rest are shown in studies that compare passive rest with an active task, which have been argued to occur through increases in slow oscillations during rest. Arshamian et al. (2018) found that nasal respiration while resting for an hour led to an advantage for memory consolidation of olfactory memory compared with oral breathing, which was argued to occur due to disruption of slow oscillations during oral breathing. In the present research we aim to see whether this nasal breathing memory advantage would extend to declarative memory consolidation and be modulated by the presence of an active task. Our plan is for a within-participants counterbalanced design, where in sessions separated by a week apart, participants will breathe orally (induced by a nose clip) or nasally (induced through a tape over the mouth). Each session will involve learning two sets of 15 concrete nouns followed by either wakeful rest or an active task (spot the difference), an interference phase and a free recall task. We looked to see if oral breathing would be equivalent to an active rest condition, with both conditions potentially disrupting consolidation processes during wakeful rest.

The sleeping brain's response to verbal and non-verbal memory cues.



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Sleep is thought to actively support memory consolidation through reactivation of newly formed memories. Mediated by oscillations of slow-wave sleep, these memory traces are reorganised into stable representations. One way to investigate memory reactivation during sleep is by re-exposing the sleeping brain to stimuli that are linked to newly formed memories, a paradigm known as targeted memory reactivation. Here, participants (N=51) associated visually-presented words with both spoken words and environmental sounds. A subset of the words and sounds were then replayed during slow-wave sleep, alongside previously unheard control cues. In this secondary analysis, we explored how verbal and nonverbal memory cues influenced oscillatory activity during sleep (behavioural data published in Cairney et al., 2017). Overall, memory cues compared to control cues were associated with an increase in spindle and theta power, which has been implicated in overnight consolidation. Interestingly, the extent of the evoked spindle response was stronger for spoken words than environmental sounds. For a subset of the participants (N=23), the speaker for the word cues was changed, but we found no significant effects of this manipulation. These results suggest that the type of information in the memory cues, here, verbal or non-verbal, might differentially evoke spindle-mediated memory processes.

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Is the pre-testing effect driven by curiosity?



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An unsuccessful guess can boost memory for the correct answer to a question, relative to study alone - a phenomenon known as the pre-testing effect. One potential mechanism for this effect is that the initial guess elicits an increase in curiosity to know the answer. According to the PACE framework (Gruber & Ranganath, 2019), increased curiosity leads to enhanced memory not only for the target that induced the curiosity, but also other material encountered whilst in a state of enhanced curiosity. Given that guessing induces curiosity, we hypothesised that it may also lead to enhanced memory for incidental material encountered before the corrective feedback is provided. We tested this idea in two experiments. While both found robust pre-testing effects for the target of the guess, there was no evidence of a general memory benefit to incidental material encountered between the guess and the feedback in either experiment. Thus, while pre-testing may increase rated curiosity to know the answer, it does not provide a generalised boost to encoding predicted by the PACE framework.

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Research Plan - Does high talker variability improve the learning of non-native phoneme contrasts?
A replication study.



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When learning new languages, acquiring non-native speech contrasts can be difficult. This acquisition can, however, be improved through phonetic training. Seminal studies (Logan, Lively & Pisoni, 1991; Lively, Logan & Pisoni, 1993) suggest that high-variability phonetic training (HVPT) results in better learning outcomes to low-variability training. This finding has proved influential, with HVPT now being a standard methodology in the field. Intriguingly, however, alongside methodological weaknesses in the seminal studies, the comparison of high- over low-variability training has only been replicated infrequently, with mixed results. We propose to replicate Logan et al. (1991) and Lively et al. (1993) to establish whether learners achieve better speech perception after phonetic training including multiple talkers (high variability) vs. a single talker (low variability). Japanese speakers will receive either high- or low-variability training on the non-native speech contrast /r/-/l/ by learning to discriminate between minimal pairs (“lock”-“rock”). In our replication, we will use an adequate sample to power our analysis (up to 160 participant’s vs 6 participants in both original studies). To test whether there is an advantage for high- over low-variability training, we will use Bayesian statistics to quantify evidence for the null (no difference between high- and low-variability training) and for H1.

Computer mouse tracking shows evidence of immediate lexical engagement effects in adults.



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Lexicalisation is the process by which novel input is transformed into meaningful word representations, and a focus of word learning research. A key measure is that of lexical engagement by lexical competition, whereby the impact of learning a new word (e.g., ‘aliet’) is indexed by its effect on the processing of an existing word (e.g., ‘alien’). Following lexicalisation of ‘aliet’, responses to ‘alien’ become more inefficient (e.g., slower in a lexical decision task). It was previously argued that lexicalisation was largely a function of sleep, although more recent research now shows that this is not the case. A faster time course has been suggested by evidence that lexicalisation of novel words is possible shortly after learning. This experiment provides a conceptual replication of a recent paper that used eye tracking to show immediate lexicalisation (Weighall et al., 2017). We used computer mouse tracking – a novel technique not previously used in L1 word learning research – to measure lexical engagement. Evidence of lexical engagement shortly after learning was observed, consistent with reports that novel words are immediately word-like. Additionally, mouse tracking was demonstrated to be a robust and sensitive technique, well-suited to further word learning research.

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Investigating the relationship between mentalising and reading comprehension.



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Mentalising is the ability to understand the mental states - of oneself and others - that underpin behaviour. Without the ability to take others' perspectives it would be difficult for readers to understand characters' behaviours in narrative texts. Research has found associations between mentalising and reading comprehension in younger children. However, there has been little research in adults in this area. This online study investigated the association between mentalising skills and reading comprehension in an adult sample and tested whether associations were more strongly related to comprehension of literary texts than expository texts. Ninety-four adults (aged 18-68, $M=30.70$, $SD=13.92$) completed three mentalising tasks (visuo-spatial perspective taking, mental state imputation, mental state reasoning), two reading comprehension tasks based on either literary or expository texts, and two control tasks measuring vocabulary and inference generation. Age positively correlated with reading comprehension measures, vocabulary and mental state reasoning. Contrary to expectations, mentalising (specifically mental state reasoning) predicted unique variance in reading comprehension of expository texts but not literary texts after controlling for age, vocabulary, and inference generation. This pattern of results may be due to methodological differences in our reading comprehension measures. However, the findings indicate that mentalising skills are implicated in reading comprehension beyond childhood.

Effects of reading goals on processing of syntactic ambiguity and semantic plausibility.



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While many studies have examined mechanisms underlying skilled reading, relatively few have directly examined effects of reading goal (Masson, 1982) or task demands (Weiss et al., 2018). We investigated this issue in two eye-tracking experiments, examining how different goals (reading for comprehension versus scanning for a topic [Experiment 1], skimming for gist versus scanning for a topic [Experiment 2]), modulate effects of syntactic ambiguity (Experiment 1) and semantic plausibility (Experiment 2). Reading times were overall longer during both reading and skimming compared to scanning. Crucially, the results showed that effects of ambiguity/plausibility were similar during the initial processing of critical words across all reading goals. However, for measures sensitive to rereading, effects were larger for reading compared with scanning and for skimming compared with scanning, suggesting that text integration processes can be modulated by reading goals. We discuss the implications for theories of reading and models of eye movement control.

Lost in pronunciation.



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Non-native speech may present challenges to native listeners as it contains phonetic irregularities. For example, Spanish speakers pronounce English /p/ without aspiration which makes it confusable with a /b/ for a native English listener. How can English listeners adapt to this and other idiosyncratic non-native features? In an online experiment, we exposed 160 English listeners to the speech of a Chilean speaker of English. The listeners' general comprehension was tested in a transcription task which was repeated at several time points corresponding to increasing exposure to the non-native speech. Consistent with previous research (Bradlow & Bent, 2008, Xie, Liu & Jaeger, 2020), comprehension accuracy increased over time suggesting listeners' adaptation to non-native accent. Our question was whether, in addition to general factors contributing to their comprehension improvement (e.g. exposure, predictability, lexical disambiguation), there is also evidence of contribution that is specifically due to the listeners' gradual finetuning to sublexical features of the non-native accent. The outcomes of a sound identification task suggest it may be so: identification accuracy of consonants that were trained with the transcription tasks sentences increased over time, while a consonant that received no training, did not show such changes in identification accuracy.

Bradlow, A. R., & Bent, T. (2008). Perceptual adaptation to non-native speech. *Cognition*, 106(2008), 707-729.

Xie, X., Liu, L., & Jaeger, T. F. (2021, January 11). Xie, Liu, & Jaeger (2020). *Cross-talker generalization during foreign-accented speech perception*.

Research Plan - The development of mental simulation as a strategy for solving problems with multiple alternatives.



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Introduction: Mental simulation enables us to work through alternative courses of action prior to acting. Despite recent interest in the development of the ability to prepare for alternative possible events, little work has investigated how children approach problems in which they are faced with a choice between alternative courses of action. This study aims to: (1) Examine developmental changes in the use of mental simulation when solving problems with multiple options (2) Investigate the influence of resource availability on the tendency to simulate vs. act without simulating across development. Methods: 4- to 7-year-olds (N=120) and adults (N=30) will complete 2 x 20-trial blocks of a computerised vertical maze task. Mazes will have 3 entrances at the top and one goal at the bottom. Block 1: Aim is to hit goal; single ball available. Block 2: Aim is to fill goal with 3 balls. Manipulate no. balls available between-participants: minimum required (3) vs. excess (5). Analyses: GLMMs with trial outcome (success/failure) as a binary outcome variable; age (months), latency to

act (ms), reported strategy (simulate/not simulate); and trial number as predictors; participant ID as a random factor. Block 2 additional predictors: no. balls available (min/excess); no. balls used (3-5).

The conflict adaptation effect: Transfer across mathematical and non-mathematical domains.



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In 2020, the UK government emphasised the importance of having a good understanding of number facts by introducing a new national multiplication test for 8- to 9-year-olds. Theoretical models propose that multiplication problems (e.g. ‘6×7’ and ‘6×8’) are associated in memory and cause interference. A better understanding of how individuals manage this interference when learning and retrieving number facts, as well as how this relates to inhibitory control in other domains, may help to inform best practice in number fact learning. In multiple, well-powered pre-registered studies, we investigated inhibitory control in mathematics and non-mathematics domains using a conflict adaptation paradigm. In Study 1 participants completed interleaved trials of an animal and number Stroop task. We found a conflict adaptation effect, whereby performance on incongruent trials was better when they were preceded by incongruent trials than congruent trials, indicating that inhibitory control can transfer from non-mathematical (animal stimuli) to mathematical (number stimuli) contexts. Our subsequent research investigated whether inhibitory control transferred between these two contexts and multiplication facts. Our findings shed light on the domain-generality of inhibitory control and the mechanisms through which multiplication facts are retrieved.

Children and adults solve pure coordination games via alignment of intuitions.



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In pure coordination games, players seek to coordinate responses with one another without communicating, in situations where there is no logically correct response. Success therefore depends upon players intuiting the response that is mutually obvious. Previous work highlights that such coordination requires a distinctive form of “group” thinking and sufficient mutual knowledge, but not the basis for the intuitive judgements themselves. Here, that question was addressed for the first time by examining the basis of coordination performance of groups whose intuitions might plausibly differ: children versus adults. Twenty-five 5-year-olds, 30 7-year-olds, and 25 adults undertook four types of coordination game (two visual and verbal tasks), and novel metrics allowed “intuitive alignment” in responses to be evaluated within- and cross-groups. All groups showed above-chance levels of intuitive alignment on all items of the tasks applying one-sample t-test comparisons (all $t > 2.10$, all $p < .001$), and adults showed significantly higher levels of alignment than children through one-factor ANOVAs (all $F > 8.06$, all $p < .001$). Analysis of the patterns of intuitive judgements revealed both similarities and differences between children and adults. These findings are discussed in light of a new socio-cognitive phenomenon: alignment of intuitions.

Learning to suppress a distractor may not be unconscious.



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The additional singleton task has become a popular paradigm to explore the influence of statistical learning on selective attention. In this task, participants have to find a different-shaped target among a series of distractors (e.g., a diamond between circles). In some trials, a different-coloured distractor is also presented, making search significantly harder. This singleton distractor appears more often in one location (the high probability location) than in the others. Eventually, participants learn to suppress the area of the screen that is more likely to contain the singleton distractor. Since measures of awareness conducted after the search task find no evidence of explicit knowledge, this learning has been considered unconscious. However, it is possible that these measures of awareness are not sensitive enough to detect explicit knowledge. In the present study, we tested alternative measures of awareness in three large-scale experiments. Our results show clear evidence of explicit knowledge of the statistical regularities, suggesting that this learning may not be unconscious.

Inconsistency-induced tonic LC-NA arousal associated with enhanced environmental abstraction.



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General theories of inconsistency propose a link between inconsistency detection and subsequent fluid compensation towards unrelated schema, such as affirming alternative beliefs and abstracting unrelated environmental patterns. Extant models posit that inconsistency-induced arousal mediates compensation, but there is limited direct evidence for this. Moreover, the role of personality variables associated with increased arousal states (e.g., mindfulness) in impacting this process remains untested. The link between inconsistency and arousal has been reliably demonstrated, as has the utility of pupillometry to assess this arousal as a proxy of locus-coeruleus noradrenaline (LC-NA) activity. Accordingly, through the lens of adaptive gain theory (AGT), which accounts for the link between inconsistency detection and tonic LC-NA activation / exploratory attentional states (e.g. comparable with “learning” states), we utilised PD as a proxy of inconsistency-induced arousal (DUT task) and examined relationships with subsequent compensatory abstraction (AGL task). Moreover, we included a measure of self-reported mindfulness (MAAS) to examine personality variables in impacting this process. We found that (H1) greater magnitudes of inconsistency-induced PD were associated with improved AGL performance, and (H2) self-reported mindfulness mediated this relationship, insofar as higher MAAS scorers exhibited elevated LC arousal and improved AGL performance. Our findings are the first to demonstrate links between inconsistency, arousal and compensation in one experiment, thus supporting extant inconsistency frameworks.

Exploring patterns of ongoing thought under naturalistic and conventional task-based conditions.

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Research has highlighted that ongoing thought varies across situations and individuals. However, few studies examine thought across a wide range of laboratory tasks. Studies commonly include thought sampling during an undemanding task context which is less representative of the everyday situations in which people spend their time. We aimed to bridge this gap in the literature by examining how context and individual variation influence thought. We investigated how reported thought, measured via experience sampling, varied across 9 task environments from simple and complex laboratory tasks to more naturalistic everyday tasks. A Principal Component Analysis was used to create a low-dimensional representation of the experience sampling data revealing four patterns of ongoing thought: episodic social cognition, unpleasant intrusive, concentration and self-focus. Linear Mixed Modelling revealed contextual distributions of these thought patterns. We found that different task contexts reliably evoked different thought patterns. Moreover, intrusive and negative thought pattern expression were influenced by measures of depression. Our study provides insight into how thoughts systematically vary across task conditions and a useful way to experimentally manipulate the content of ongoing thought.

EPS

Experimental
Psychology
Society

The 48th Bartlett Prize Lecture



will be delivered by

Professor Susan Carey

Harvard University

The ontogenetic origin of the capacity for logically structured thought: A case study of the logical connectives *or*, *not*, and *possible*.



4.30pm, Friday 9th July 2021

This lecture will be available on Zoom.

[\[Click here to join via the Session A link.\]](#)



APPLYING FOR ORDINARY MEMBERSHIP OF THE EXPERIMENTAL PSYCHOLOGY SOCIETY

To apply for ordinary membership to the Experimental Psychology Society please go to the EPS website: <https://eps.ac.uk/applying-for-membership/> and fill in the form, ensuring all boxes are completed (entries should be made in clear black type) before signing and returning to the EPS Administrator: expsychsoc@kent.ac.uk or sending to:

Sam Hurn
EPS Administrator
School of Psychology
Keynes College
University of Kent
Canterbury
CT2 7NP

All information should be included on the form, not on additional sheets.

Under "Publications", only articles that have appeared in print by the time of nomination, in peer-reviewed psychological or cognate journals, should be listed. Because of space limitations, a complete publication list is not required; *two* recent examples, where the nominee is single or first author, are sufficient.

Applicants must be nominated by two EPS ordinary members.

These forms should be returned by 1st March 2021 or 1st September 2021.

See Criteria and Procedures on following page.

CRITERIA AND PROCEDURES TO JOIN

Soon after the closing date of 1st September or 1st March, brief details of all candidates will be circulated to members of the Society, who may request further information if they wish. The nomination forms will be considered by the Committee at their Autumn meeting after the September deadline, or at their July meeting after the March deadline. The Committee will decide whether each candidate is eligible for admission to Ordinary Membership, i.e. those candidates who have:

- secured a PhD.
- published at least two independent accounts of their work in reputable, peer-reviewed psychological journals.
- personally delivered an oral paper to the Society at one of the three EPS meetings held each year (due to the exceptional circumstances surrounding the Covid-19 pandemic, a poster presentation at EPS Online meetings is sufficient to satisfy this criterion).

Candidates who do not meet all these criteria can be considered only in exceptional circumstances. Those who are resident outside Europe will be asked for assurance that they can attend meetings reasonably often.

Any candidate not selected as eligible by the Committee will be informed of this and will be advised whether he/she may again be proposed for membership in a future year and if so subject to what conditions. The list of eligible applicants will be put to the July Business Meeting, following the March deadline, and the Annual General Meeting in January, following the September deadline, for approval.



APPLYING FOR POSTGRADUATE MEMBERSHIP OF THE EXPERIMENTAL PSYCHOLOGY SOCIETY

To apply for postgraduate membership to the Experimental Psychology Society please go to the EPS website: <https://eps.ac.uk/applying-for-eps-postgraduate-membership/> and fill in the form, ensuring all boxes are completed (entries should be made in clear black type) before signing and returning to the EPS Administrator: expsychsoc@kent.ac.uk or sending to:

Sam Hurn
EPS Administrator
School of Psychology
Keynes College
University of Kent
Canterbury
CT2 7NP

All information should be included on the form, not on additional sheets.

Applicants must be nominated by an EPS ordinary member.

Application forms can be returned to the EPS Administrator at any time.

Postgraduate membership is required in order to apply for Grindley Grants and Study Visit Grants.

Postgraduate members are not eligible to apply for the Small Grant scheme until they become ordinary members of the Society.

To be eligible for postgraduate membership of the EPS, the applicant must either be:

- registered for a PhD, MRes or MPhil programme.
- contracted as a post-doctoral researcher (up to 2 years after receiving PhD).
- contracted as a pre-doctoral researcher.

Those who are resident outside Europe will be asked for assurance that they can engage with the Society reasonably often.

Candidates who do not meet all these criteria can be considered only in exceptional circumstances.

Identifying EPS ordinary members for nomination.

Applicants who meet all the eligibility criteria for postgraduate membership, but do not have a sponsor in the Society, are invited to contact the EPS Administrator at expsychsoc@kent.ac.uk for help identifying EPS members in their home institution, or a member of the committee, who can provide a nomination.



University College London. January 2022.

This meeting is scheduled to include the 49th Bartlett Lecture by Chris Frith (with an accompanying symposium), the 19th Mid-Career Lecture by Michael Anderson (with an accompanying symposium) and the 28th EPS Prize Lecture by Sarah Lloyd-Fox (with an accompanying symposium organised by Mark Johnson).

Local Organiser: Jo Taylor

