

ESLP 2018

ELEVENTH EMBODIED AND SITUATED
LANGUAGE PROCESSING CONFERENCE

10-12 AUGUST 2018
LANCASTER, UK

KEYNOTE SPEAKERS

Linda Smith

Indiana University

Lorraine Tyler

University of Cambridge

Gabriella Vigliocco

University College London


SPECIAL SESSION ON METHODS & REPRODUCIBILITY

Daniel Lakens

Eindhoven University of Technology

LOCAL ORGANISERS: Louise Connell & Dermot Lynott, Lancaster University

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ESLP 2018 - programme at a glance

	Friday 10 August	Saturday 11 August	Sunday 12 August
09:00	registration + coffee + welcome	coffee	coffee
09:30	Marloes Mak and Roel M. Willems – Embodiment in narratives: An eye-tracking study of perceptual simulation, motor simulation and mentalizing during narrative reading.	Chelsea Gordon, Timothy Shea, Alondra Wences, David Noelle and Ramesh Balasubramaniam – Word learning is grounded in naturalistic interaction: a gamified virtual reality experiment	
10:00	Pei Q Liu, Louise Connell and Dermot Lynott – Continuous neural activation of modality switching costs	Felix Hill and Stephen Clark – Language learning simulations with an embodied connectionist agent	Michela Caldano and Kenny Coventry – Spatial demonstratives and perceptual space: To reach or not to reach in the sagittal and lateral planes?
10:30	Valentina Niccolai, Anne Klepp, Hanneke van Dijk, Alfons Schnitzler and Katja Biermann-Ruben – Auditory cortex sensitivity to the loudness attribute of body-related verbs	James Brand – Predicting the age of acquisition of concepts from sensorimotor information	Barbara Tversky, Azadeh Jamalian, Valeria Giardino, Yang Liu, Melissa Bradley-Zrada, Eliza Bobek and Seokmin Kang – Semantics of visual communication
11:00	coffee	coffee	coffee
11:30	keynote: Gabriella Vigliocco	keynote: Linda Smith	keynote: Lorraine Tyler
12:30	lunch	lunch	lunch
14:00	Ye Zhang, Diego Frassinelli, Jyrki Tuomainen and Gabriella Vigliocco – The role of multimodal non-linguistic information in face-to-face spoken comprehension	special session on methods & reproducibility Daniël Lakens	Ajitesh Ghose – Extending Symbol Interdependency: Introducing Perceptual Scene Vectors
14:30	Jens Nirme – Stronger activation of spatial representations of words by presentation of gestures in absence of spatial task		Louise Connell, James Brand, James Carney, Marc Brysbaert and Dermot Lynott – Separating heaven and earth: Emergent abstract and concrete categories from latent structure in sensorimotor experience
15:00	Dimana Kardzhieva and Lawrence Taylor – Embodied emotion: The role of bodily feedback in explicit comprehension of emotion in language.	Caroline Handley – Investigating LASS theory through word association tasks	Maya Zara – To what extent do abstract concepts, metaphoricity and aspectual framing influence sensorimotor simulation during language comprehension?
15:30	Kristina Oldroyd and Monisha Pasupathi – Virtual exercise makes me eat more--the relation between embodied narration and caloric consumption	Cai Wingfield and Louise Connell – What kind of linguistic distributional information best predicts conceptual processing? A systematic cross-task comparison.	Matthew Slocombe, Michael S. C. Thomas and Andrew Tolmie – The role of words in a developing grounded conceptual system
16:00	coffee	coffee	farewell & coffee
16:30	poster session 1	poster session 2	leave
18:00	leave	leave	
19:30		conference dinner	

Poster Session 1 - Friday 10 August 16:30-18:00

- 1 Oleksandr Horchak and Margarida Garrido – But I can still see your shadow: How language processing guides shadow perception
- 2 Agata Dymarska and Louise Connell – Memory for concepts - linguistic versus sensorimotor representations in working memory
- 3 Rens van Hoef, Louise Connell and Dermot Lynott – The role of linguistic and sensorimotor information in the basic-level advantage
- 4 Stephanie Huetten and Ariel Mathis – Learning meaning through statistics and embodiment: an artificial language learning and eye-tracking paradigm
- 5 Roberto Aguirre, María Noel Macedo, Mauricio Castillo, Alejandro Fojo, Julio Santiago, Adriana de León and Maximiliano Meliande – Metaphorical mappings and modal representations grounded on space for spoken and signed languages
- 6 Srabasti Dey and Himanshu Yadav – Role of embodied spatial orientations in the meaning of light verb constructions (LVCs)
- 7 Harmen Gudde and Kenny Coventry – Spatial demonstratives in English and Japanese: universals or variation?
- 8 Sumeysa Saatci, Ö. Ece Demir-Lira, Hale Yapıcı-Eser, Özgür Öztöpe-Çakmak and Tilbe Gökşun – Parkinson's Disease patients' comprehension and production of co-speech gestures
- 9 Zoé Cayol, Sarah Carvallo, Claire Barel Moisan, Yves Paulignan, Anne Reboul, Anne Cheylus, Victor Mazel, and Tatjana Nazir – Discriminating literary fiction from documentaries in β -band brain activity and through linguistic/stylistic elements
- 10 Alex A. Miklashevsky and Martin H. Fischer – Have you grasped the idea? Embodiment in figurative language processing depends on perspective
- 11 Katja Münster and Pia Knoeferle – Towards a socially situated real-time language processing account
- 12 Yusuf Ahmed Gwarzo – A cognitive analysis of chained metonymies in Hausa common nouns
- 13 Briony Banks, Cai Wingfield and Louise Connell – Linguistic distributional associations predict category member production

Poster Session 2 - Saturday 11 August 16:30-18:00

- 14 Amber Sheldon and Jack Crumley – Investigating the innateness of language
- 15 Richard Thomas, Marcelle Fernandes and Zeno Onokaye-Akaka – The embodiment of abstract concepts: A TMS study
- 16 Olga Dubrovskaya – How meaning is constructed in the mind
- 17 Shun Kudo – The idiosyncratic interpretation of Japanese degree expression mazi-manzi -With reference to yabai-
- 18 Bo Yao, Jason Taylor, Briony Banks and Sonja Kotz – Inner speech during silent reading of direct quotations is linked to theta-band neural oscillations
- 19 Cole Robertson, James Carney and Jackie Thompson – Reading minds through language? Creating an automated text analysis measure for mental state content
- 20 Mahsa Barzy, Jo Black, David Williams and Heather Ferguson – Individuals with and without Autism Spectrum Disorder integrate the speaker and meaning: evidence from eye-tracking and ERPs
- 21 Shane Lindsay and Robert Nightingale – Spatial interference and facilitation effects of novel word and object learning on visual perception
- 22 Elena Kulkova and Martin H. Fischer – Embodied aspects of Non-Literal Language: A Grip-Force Study
- 23 Samuel H Cospers, Claudia Männel and Jutta L Mueller – Infants' mapping of novel words onto auditory referents
- 24 Milena Rabovsky – How event probability impacts sentence comprehension: Modeling N400 amplitudes in role-reversed sentences
- 25 Bernardo Rizzo, Ernesto Guerra and Mónica Véliz – Over-reliance on vertical association affects visual attention during spoken word categorization in Parkinson's disease patients
- 26 Amanda Sjöblom and Rob Hughes – The motoric and perceptual bases of verbal sequence learning
- 27 Andrés Méndez, Xu Tian, Leonel Gómez-Sena, Chen Yu and Linda Smith – Sensorimotor change as a relevant component of early word learning

PREFACE





ESLP 2018 programme committee

Chairs Louise Connell, Dermot Lynott
Members Briony Banks, James Brand, Cai Wingfield

Special thanks

- Lynne Hargreaves for organisational and administrative support
 - James Brand for invaluable local knowledge
 - Agata Dymarska and Rens van Hoef for on-the-ground support
 - The Dukes for hosting the conference in their venue
 - J Atkinson & Co. (<https://thecoffeehopper.com>) and Cedrus Corporation (<https://www.cedrus.com>) for providing prizes to delegates
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Sponsors

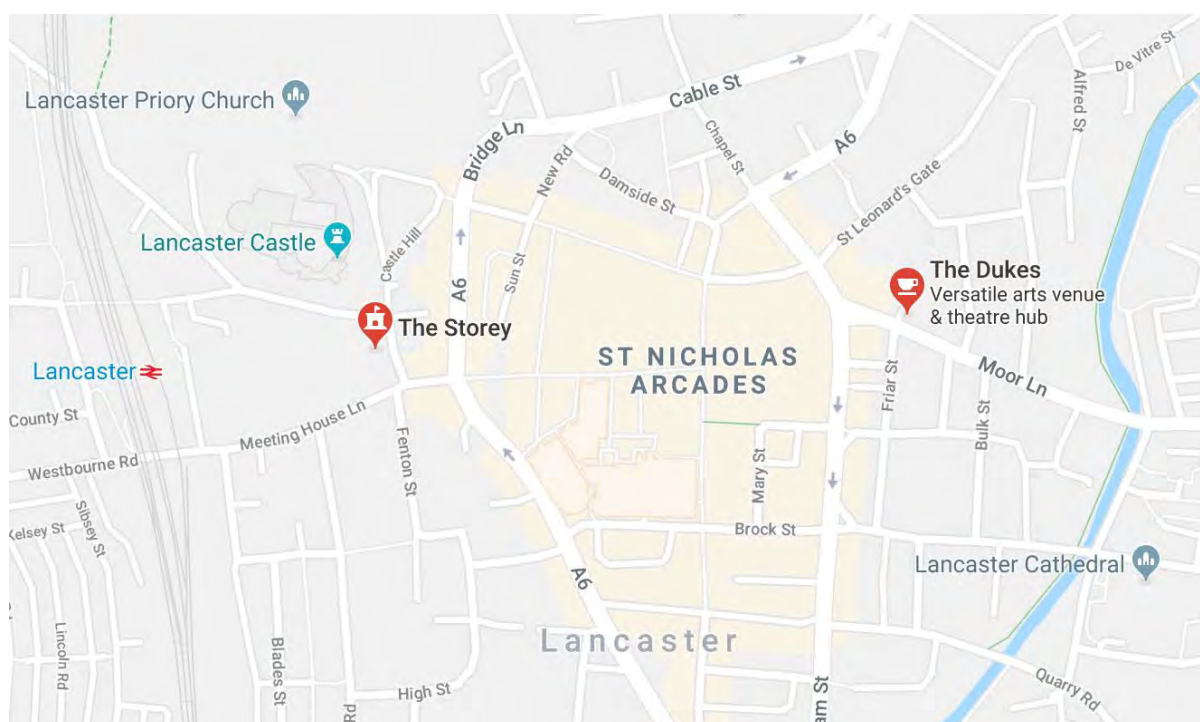
 The Leverhulme Trust Leverhulme Trust Doctoral Scholarship Programme in Interdisciplinary Research on Infant Development (sponsor of the Special Session on Methods & Reproducibility)	 Collabra: Psychology Collabra  frontiers Frontiers	 Lancaster University Department of Psychology, Faculty of Science and Technology, Lancaster University
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VENUES

Conference

The conference venue is **The Dukes** a theatre, arthouse cinema, and arts venue hosted in an 18th century Grade II listed building: <https://dukes-lancaster.org>. Full address: The Dukes, Moor Lane, Lancaster LA1 1QE

The venue will open at 09:00 each morning of the conference for coffee. Since the theatre and cinema operate as usual in the evenings, we ask that ESLP attendees vacate the venue by 18:00 unless attending a performance or showing.



Conference Dinner

The conference dinner takes place in **The Storey** on Saturday 11 August 2018 at 19:30, a striking 19th century Grade II listed building <https://www.lancaster.gov.uk/sites/the-storey>. Full address: The Storey, Meeting House Lane, Lancaster LA1 1TH

The Storey is approximately an 8-10 minutes' walk from The Dukes.

LOCAL INFORMATION

Eating out

(see also conference website for Google Maps with tagged recommendations:
<http://wp.lancs.ac.uk/eslp2018/travel-local/>)

Cheap (£3-6)

- **Full House Noodle Bar**
Very casual Asian cuisine for lunch and dinner, access through Chinese supermarket
Common Garden Street, 01524-842888. 11.00am – 9.00pm
- **Go Burrito** - <http://www.goburrito.co.uk>
Very casual Mexican food, with quick service and large portions
Lower Church Street, 01524-874775. 10.00am-10.00pm
- **Lancaster City Market**
Saturday market with numerous street food vendors
9.00am – 4.30pm

Medium (£7-15)

- **1725** - <https://www.1725lancaster.co.uk>
Tapas restaurant in a cosy setting with live music and sangria
Market Street, 01524-66898. 11.00am-11.00pm
- **Aroma Chef**
Excellent Chinese restaurant with lots of authentic dishes
Market Street, 01524-847300. 12.00am-11.00pm
- **Nami Sushi** - <http://www.nami-sushi.co.uk>
Good sushi and small plates with vegan and vegetarian options
China Street, 01524-33388. 11.30am-9.00pm
- **Pizza Margherita** - <http://www.pizza-margherita.co.uk>
Authentic pizzas, plus pasta dishes in an informal setting
Moor Lane, 01524-36333. 10.00am-10.00pm
- **Red Peppercorn** - <http://www.redpeppercorn.co.uk>
Mezze style dishes and fusion cuisine
Moor Lane, 01524-34916. 5.00pm-11.00pm
- **Siam Balcony** - <http://siambalconylancaster.com>
Authentic Thai cuisine in a relaxing atmosphere
Chapel Street, 01524-383889. 5.00pm-10.00pm

- **The Borough** - <https://www.theboroughlancaster.co.uk>
Nice pub dining serving locally sourced produce, has its own brewery
Dalton Square, 01524-64170. 8.00am-9.00pm
- **The Britannia** - <http://www.thebritannialancaster.co.uk>
Family friendly pub with artisan pizzas, vegan, vegetarian and gluten free options
Ullswater Road, 01524-63691. 5.00pm-10.00pm
- **The Gregson Centre** - <http://www.gregson.co.uk>
Friendly community run venue with food and drink
Moor Gate, 01524-849959. 11.00am-9.00pm
- **The Sun** - <https://www.thesunhotelandbar.co.uk>
Good pub food serving breakfast, lunch and dinner, also nice for drinks
Church Street, 01524-66006. 8.00am-8.00pm
- **The Water Witch** - <https://www.waterwitchlancaster.co.uk>
A canal-side pub in a converted stable block, serving rustic food and drinks
Tow path, Aldcliffe Road, 01524-63828. 12.00am-9.00pm
- **Whaletail café** - <https://whaletailcafe.co.uk>
Vegan and vegetarian café serving breakfast and lunch
Penny Street, 01524-845133. 9.00am-4.30pm

Expensive (£15+)

- **Quite Simply French** - <http://quitesimplyfrench.co.uk>
French cuisine with a chic style. Advanced reservations recommended
St George's Quay, 01524-843199. 5.30pm-9.00pm

Things to do in Lancaster

- **Williamson Park**
Lancaster's favourite park offers beautiful panoramic views of Lancaster and its surrounding areas. It is home to the Ashton Memorial, Butterfly House, Mini Zoo, woodland trails and café. Family friendly with adventure playgrounds.
- **Lancaster Castle and Priory**
Lancaster's most historic building, dating back to Roman times. Guided tours are available and there are plenty of green spaces to sit and have lunch.
- **Morecambe Beach**
Quintessential British seaside resort with sandy beaches, fish and chips and brilliant views over the Morecambe bay area (when the skies are blue, not grey).
- **Lancaster Brewery**
Local award-winning brewery with its own bar and guided tours are available. You can find their beer in many of Lancaster's pubs.

Nearby areas of interest

- **The Lake District**

UNESCO world heritage site, that is easily accessed by train or bus. There are numerous ways to explore the area, either by walking, cycling, on a boat or in the air. Alternatively, you can enjoy the surroundings with afternoon tea in one of the many small villages and towns. <http://www.lakedistrict.gov.uk/home>

- **Cities of Manchester and Liverpool**

Two cities both within a 1-1.30 hour train ride away, and are home to some of England's biggest football clubs, internationally renowned museums, large shopping centres and live music venues.

Useful transport information

- **Local taxi numbers (cash only)**

- +44 (0)1524 848848
- +44 (0)1524 32090
- +44 (0)1524 35666

- **Train information**

<http://www.nationalrail.co.uk>

- **Bus information**

<https://www.stagecoachbus.com>

KEYNOTES

KEYNOTE

GABRIELLA VIGLIOCCO



ECOLOGICAL LANGUAGE: A MULTIMODAL APPROACH TO LANGUAGE LEARNING AND PROCESSING

Gabriella Vigliocco

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The human brain has evolved the ability to support communication in complex and dynamic environments. In such environments, language is learned, and mostly used in face-to-face contexts in which processing and learning is based on multiple cues both linguistic and non-linguistic. Yet, our understanding of how language is learnt and processed comes for the most from reductionist approaches in which the multimodal signal is reduced to speech or text. I will introduce our current programme of research that investigates language in real-world settings in which learning and processing are intertwined and the listener/learner has access to -- and therefore can advantage of -- the multiple cues provided by the speaker. I will then describe studies that aim at characterising the distribution of the multimodal cues in the language used by caregivers when interacting with their children (mostly 2-3 years old) and provide data concerning how these cues are differentially distributed depending upon whether the child knows the objects being talked about (learning vs. processing), and whether the objects are present (situated vs. displaced). I will then move to a study using EEG addressing the question of how discourse but crucially also the non-linguistic cues modulate predictions about the next word in a sentence. I will conclude discussing the insights we have and (especially) can gain using this real world, more ecologically valid, approach to the study of language.

KEYNOTE

LINDA SMITH



LEARNING FROM THE INFANT'S POINT OF VIEW

Linda B. Smith

Indiana University, Bloomington, USA, smith4@indiana.edu

How do infants learn their first words in a noisy environment? How do they progress from being slow incremental learners to rapid learners who appropriately generalize categories and concepts from minimal experience. In this talk, I will present evidence that the answer to these questions lies in the structure of the learning environment itself, which is not like that assumed by most theorists of early word learning and not like that used in language learning experiments. We have used head cameras to collect egocentric views (and parent talk) in the home from the perspective of infants and toddlers (8 month olds to 30 month olds, with no experimenters present, 500 hours of head camera video) and in a naturalistic toy room environment in the laboratory (about 200 hours of head-mounted eye tracking yielding both the ego-centric view and the gaze within that view). Our analyses of the everyday experiences indicate four principles we believe to be key to learning to becoming a rapid learner of object names and a robust learner across domains more generally. The four principles are: (1) Learn a massive amount about very few individual entities (and little bit about lots of other individual things); (2) Learn a massive amount about a very few categories (and a little bit about lots of other categories); (3) Learn about small selective sets at different points in time; (4) Self-generate the data for learning (with some help from mom and dad).

SPECIAL SESSION ON METHODS & REPRODUCIBILITY

DANIËL LAKENS



DESIGNING MORE EFFICIENT, INFORMATIVE, AND RELIABLE STUDIES

Daniël Lakens

Eindhoven University of Technology, NETHERLANDS, D.Lakens@tue.nl, [@lakens](https://twitter.com/lakens)

In this special session on Methods & Reproducibility I will start by briefly summarizing some ways in which recent work in statistics has highlighted research practices that can reduce the robustness of the conclusions we draw in experiments. Then, I'll discuss how we can more strongly integrate theoretical, methodological, and statistical aspects of the research cycle by testing falsifiable predictions and designing informative studies despite uncertainty about the effect under investigation. I'll explain how to evaluate a literature where negative results often remain unpublished, how you yourself can prevent contributing to a biased literature in the future, and how in addition to thoughtful use of statistics and well-designed studies, the greatest improvement in how we perform research will come from improving our statistical questions.

KEYNOTE

LORRAINE TYLER



HOW DO WE UNDERSTAND WHAT WE SEE? FROM VISION TO MEANING

Lorraine K. Tyler

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This talk describes a decade of research on object processing which charts the dynamic transformations from early perceptual representations through to understanding the meaning of an object. It goes beyond vision and argues that different kinds of semantic representations are developed over time, from early categorical [*animals, tools*] representations in the fusiform to object-specific [*dog, hammer*] representations in the perirhinal cortex. In doing so, it integrates models of vision with a feature-based cognitive model of semantics, and finds that feature-based models of object meaning provide a unifying set of principles which account for the different types of semantic representations of objects that evolve over time along the ventral stream.

TALKS

EMBODIMENT IN NARRATIVES: AN EYE-TRACKING STUDY OF PERCEPTUAL SIMULATION, MOTOR SIMULATION AND MENTALIZING DURING NARRATIVE READING

Marloes Mak^{1*}, Roel Willems^{2,3,4}

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*Corresponding author

People engage in simulation when reading literary narratives. In this study, we tried to pinpoint how different kinds of simulation (i.e. perceptual simulation, motor simulation, mentalizing) affect reading behavior.

Eye-tracking (gaze durations) and questionnaire data were collected from 102 participants, who read three literary short stories. All participants read the same stories, in counterbalanced order. In a pre-test, 90 participants that did not participate in the eye-tracking experiment had determined which parts of the stories were high in motor simulation-eliciting content (n=30), perceptual simulation-eliciting content (n=30) or mentalizing-eliciting content (n=30), resulting in scores of 0-30 per type of simulation-eliciting content, per word.

The results show that motor simulation reduces gaze duration (faster reading), whereas perceptual simulation and mentalizing increase gaze duration (slower reading). Additionally, individual differences in the effect of simulation on gaze duration were found, which were related to individual differences in aspects of story world absorption and story appreciation.

These findings suggest fundamental differences between different kinds of simulation, suggesting that the processes leading to simulation differ between kinds of simulation. Additionally, the findings confirm the role of simulation in absorption and appreciation. Future studies should distinguish between different kinds of mental simulation in language understanding. From a methodological point of view this study showcases how eye-tracking can be used to investigate the embodied reading experience that many readers have when they engage with narratives.

CONTINUOUS NEURAL ACTIVATION OF MODALITY SWITCHING COSTS

Pei Q. Liu^{1*}, Louise Connell², Dermot Lynott³

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Modality switching costs (MSCs) are one of the classic effects that support the embodied views of conceptual representations. They are a delay in response time to verify a sensory property of a certain perceptual modality (e.g., visual: SUN – bright), when the previous sensory property has been of a different modality (e.g., auditory: BLENDER – loud) compared to a property of the same modality (e.g., visual: ROSE – red). Such costs indicate that conceptual representations require the recruitment of modality-specific resources. However, MSCs could also result from the distributional pattern of property words: the reason why loud → bright takes longer than red → bright could be because bright and loud do not co-occur in the same linguistic context as frequently as bright and red. In the present study, we examined how well MSCs were predicted by an embodied model (switch / no-switch between perceptual modalities) versus a linguistic model (switch / no-switch between linguistic distributional clusters), in behavioural (RT) and continuous event-related EEG potentials (ERP) paradigms. While results showed no behavioural effects, the ERPs showed that perceptual modality and linguistic distributions contributed distinctly to the neural components of MSCs. Specifically, the embodied model best accounted for activations associated with semantic representation (typically in N400 area), while the linguistic model best accounted for activations associated with prediction and decision making (typically in P2 and LPC areas).

AUDITORY CORTEX SENSITIVITY TO THE LOUDNESS ATTRIBUTE OF BODY-RELATED VERBS

**Valentina Niccolai^{1*}, Anne Klepp¹, Hanneke van Dijk¹, Alfons Schnitzler¹ and Katja
Biermann-Ruben¹**

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There is some evidence that the auditory cortex is activated during the processing of words referring to animal and object sounds as well as to other actions with acoustic features. The present study further examines whether processing words characterised by different levels of loudness such as loud (e.g., to shout) and quiet actions (e.g., to whisper) differentially activate the auditory cortex.

Twenty healthy participants were measured with MEG while semantically processing visually presented verbs. The two conditions were matched for length, word frequency, bi-/trigram frequency, and for number of facial vs. limbs/whole body actions. Verbs were followed by a short 440 Hz tone of stable sound pressure level after a time-interval of at least 600 ms to identify possible word-dependent loudness effects on the tone-related N1 amplitude. To determine brain regions of interest and loudness-related oscillatory patterns, a separate task requiring the processing of loud and quiet tones was used.

The resulting temporal Brodmann areas A22, A41/42, and posterior superior temporal sulcus, which showed stronger alpha suppression following loud compared to quiet tones, were inspected in the word paradigm. Here, an analogous oscillatory pattern emerged consisting in stronger beta suppression following loud compared to quiet actions in the left hemisphere. In line with this, the tone-related N1 showed smaller amplitude after loud than quiet actions in the left but not in the right hemisphere, which hints at N1 suppression as observed after repetitive presentation of a tone. Differential auditory cortex recruitment depending on action loudness points to possible selective auditory simulation mechanisms involved in verb processing.

THE ROLE OF MULTIMODAL NON-LINGUISTIC INFORMATION IN FACE-TO-FACE SPOKEN COMPREHENSION

Ye Zhang¹, Diego Frassinelli², Jyrki Tuomainen¹, & Gabriella Vigliocco^{1*}

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*Corresponding author: Gabriella Vigliocco

In this study, we ask whether and how gestures, prosody and lip movements modulate the predictability of words in context as indexed by the N400 event-related potential response.

103 pairs of sentences (context + target) were extracted from the BNC. Semantic surprisal scores (measuring unpredictability of words in context) were obtained for 604 content words in the target sentences using the language model by Frank et al. (Brain and Language, 2015). Each sentence-pair was video-recorded: an actress was speaking naturalistically while gesturing or not. From the recordings, we extracted the mean pitch of each word (prosody), annotated the gestures (representational) and estimated the information provided by lip movements.

In the EEG experiment, we presented audio-only stimuli (taken from versions with/without gestures) to 24 participants; and the audio-visual versions (with/without gestures) to 23 different participants. Our predictions are: (1) words with higher surprisal will yield more negative N400; (2) non-linguistic cues (gestures) modulate the effect.

Firstly, we tested surprisal across modalities (audio vs audiovisual) using a linear-mixed-effects model. Words with higher surprisal yielded larger N400 amplitude ($\beta_{\text{surprisal}} = -0.91$, $p < .01$). Audiovisual stimuli produced a more positive N400 than audio-only stimuli ($\beta_{\text{audiovisual}} = 0.29$, $p < .01$). Second, analyzing the audiovisual condition, we found that words produced with higher pitch showed more negative N400 ($\beta_{\text{pitch}} = -0.02$, $p < .05$) and more positive surprisal effect ($\beta_{\text{surprisal:pitch}} = 0.11$, $p < .01$), words with meaningful gestures showed less negative N400 ($\beta_{\text{gestures}} = 0.29$, $p < .01$) and words with informative lip movements showed more negative effect of surprisal ($\beta_{\text{surprisal:lips}} = -2.25$, $p < .01$). Thus, non-linguistic information (gesture, prosody, lip movements) modulates semantic comprehension.

STRONGER ACTIVATION OF SPATIAL REPRESENTATIONS OF WORDS BY PRESENTATION OF GESTURES IN ABSENCE OF SPATIAL TASK

Jens Nirme^{1*}

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Speech and gestures express meaning together, connecting lexical and visuo-spatial representations in the speaker's mind. Several studies have demonstrated uptake of spatial information from gestures however usually following explicit instructions to recreate or recall spatial features, deviating from typical listening situations. It remains unclear whether exposure to gestures activates spatial representations of verbal content without an explicitly spatial task. We conducted an online experiment where one group of participants (n=33) watched three videos of native Swedish speakers describing rooms in an audio-visual (AV) condition. Another group (n=32) only heard the same three descriptions without video (audio-only, A). During presentations participants were naïve to the following task, consisting of making either lexical- (*is this a word?*), semantic- (*is this concrete?*), or spatial (*would this fit inside a room?*) decisions on a series of 29 nouns, including seven mentioned in stimuli (with gesture in AV condition).

Assuming that stronger activation of spatial representations facilitates the spatial decision task, we predicted that the AV condition would generate faster reaction times (on included nouns) compared to A in the spatial task, but not in the other tasks. Our analysis of recorded reaction times confirmed our predictions, suggesting a stronger activation of spatial representations of words presented with gesture in the absence of an explicit task demanding spatial processing. The results tally with previous findings suggesting that speech-gesture integration is modulated by content and task, thus contributing to our understanding of the role gestures plays in spatial processing in natural verbal communication.

EMBODIED EMOTION: THE ROLE OF BODILY FEEDBACK IN EXPLICIT COMPREHENSION OF EMOTION IN LANGUAGE

Dimana Kardzhieva^{1*}, Lawrence Taylor²

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*Corresponding author

Research has debated whether emotion is independent of physical states or influenced by them (Prinz, 2005). Manipulation of facial expressions affects emotion recognition in language (Glenberg, Havas, Becker & Rinck, 2005). Positive and negative affect have also shown distinct bodily correlates (Crane & Gross, 2013), with positive emotion characterised by open, and negative – by closed posture. The current research investigates whether these correlates can influence emotion comprehension in language. It is hypothesised that: positive sentences will be facilitated by open and inhibited by closed posture; negative sentences will show converse effects; neutral sentences will not be affected.

A 2x3 repeated measures design investigated the effects of body posture on emotion recognition in sentences. An opportunity sample of 60 participants (mean age=25.08, SD=8.05) took part in a computer-based paradigm. Participants made valence judgments on 90 sentences with positive, negative and neutral affect, while sitting in open and closed posture. The procedure, hypotheses and statistical analyses were preregistered.

Results indicate that accuracy of judgments was not affected for any emotion category. Reaction times (RTs) for neither negative nor neutral sentences were influenced. Positive RTs showed significant differences based on posture, but with a direction opposite to expected – faster for closed than for open posture.

Results contradict the assumption that posture affects emotion comprehension based on congruency. Importantly, these findings support the claim that positive emotion may be cognitively processed in different ways compared to negative (Fredrickson, 1998). This calls for further exploration of the difference between positive and negative language, as well as how bodily feedback interacts with this relationship.

VIRTUAL EXERCISE MAKES ME EAT MORE: THE RELATION BETWEEN EMBODIED NARRATION AND CALORIC CONSUMPTION

Kristina Oldroyd^{1*}, Monisha Pasupathi¹, Cecilia Wainryb¹

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Empirical studies examining the effect of mental simulation show that writing, reading, or thinking a sentence describing physical action is sufficient to produce the same patterns of neural activation as actually performing that action. Thus, when a person writes, “I ran to the store” the neurological pattern of responding mirrors the neurological patterns that occur when the person physically runs. From this perspective, narratives about video game play narrated in the embodied, first-person (e.g., I ran, I jumped) may lead to a distortion of the mind’s sense of energy expenditure and subsequent need for caloric consumption.

This study is a preliminary investigation into the potential relation between the embodied narration of video game play and eating behavior. Specifically we examine whether or not people who narrated their video game play in an embodied, first-person way (e.g. I ran, I jumped, I swam) consumed more calories in a post-game play questionnaire session than did their peers who narrated in a disembodied, third-person way (e.g., He ran, she jumped they swam). A t-test demonstrated that those participants who embodied their avatar during narration ate an average of twice as many calories than their non-embodied peers, mean difference = 182.98, $t(132)=-4.21$, $P<.001$, Cohen’s $d=1.00$. These findings suggest that narration about sedentary activities that convey a sense of physical effort may be interpreted by the brain as actual physical exertion. Thus, within the context of mental simulation, how we construct narratives about our daily activities may ultimately influence how many calories we consume.

WORD LEARNING IS GROUNDED IN NATURALISTIC INTERACTION: A GAMIFIED VIRTUAL REALITY EXPERIMENT

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Sensorimotor interaction facilitates language learning and is presumed to ground conceptual representations. Yet, empirical support for early stages of embodied word learning is sparse. We developed a gamified word learning experiment in virtual reality in which participants learned names of six novel objects with distinct colors and shapes by interacting with them (grasping/manipulating) with either their left or right hand. Participants then completed a word-color match task on the same six words. Participants were faster to respond when the response was performed with the hand that had previously interacted with the named object. In two follow up experiments, we found that observing virtual hands interact with objects was sufficient to produce this compatibility effect, and found that the effect was driven primarily by responses with a compatible hand and not by responses in a compatible spatial location. In additional analyses of the reach trajectories during the training phase of our experiment, we observed improved motor learning (e.g., increase in velocity) as participants learned object labels, with little evidence of continued motor learning once labels were acquired. In other words, signatures of motor learning (e.g. peak velocity increase) correspond to stages of the word learning process. This simultaneous unfolding of action learning and language learning encourages investigation of motor and language learning as a unified process. Our results support grounded acquisition of words through sensorimotor experience, and suggest promising routes to explore the sensorimotor foundations of language using naturalistic movement in virtual environments.

LANGUAGE LEARNING SIMULATIONS WITH AN EMBODIED CONNECTIONIST AGENT

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We present language learning experiments with an embodied agent operating in a simulated 3D (computer-game style) world. The agent is a single artificial neural network comprising language-embedding, visual-processing, core memory and action-policy modules. It observes the world as a stream of raw pixels from a first-person perspective, and must choose fine-grained motor actions that together result in the satisfaction of symbolic (lexical or phrasal) instructions (e.g. *find the red pencil, select the larger object, turn left at the end*). This setting allows us to study the process of symbol grounding from raw sensory input, and to recreate several classic simulations and experiments from the early word learning literature. Specifically, we explore the rate at which the agent's vocabulary grows, the order in which it acquires words of different types (shape vs colour vs directions etc.), the conditions under which the agent develops a *shape bias* and the way in which it learns to interpret negated commands. We further analyse trained agents at the algorithmic level, visualising how language and visual representations at different levels of abstraction combine to inform the action decisions of the agent. We hope that our simulation approach and findings can complement behavioural and imaging experiments (and vice versa) to ultimately yield a better understanding of semantic and linguistic learning and processing in humans, as well as machines.

PREDICTING THE AGE OF ACQUISITION OF CONCEPTS FROM SENSORIMOTOR INFORMATION

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Theories of embodied cognition have highlighted the important role that sensorimotor experience plays during language production and processing. Yet, there is relatively little research on the way sensorimotor experience can influence the development and acquisition of language. Explanations for how concepts are acquired has previously been assessed through linguistic (e.g. frequency, length) and semantic factors (e.g. concreteness, valence), but such findings have been limited in their scope, relying on a relatively small sample of concepts acquired during development. Moreover, the use of suboptimal semantic variables often provides a very vague and shallow picture of how sensorimotor experience influences the acquisition of language, leaving important subtleties still to be explained.

With the availability of megastudy datasets, it is now possible to gain a more coherent assessment of how sensorimotor experience can be used to predict the age at which a word is acquired, and crucially, which sensory modalities/action effectors are contributing to this explanation. Here, I present a comprehensive set of hierarchical regression analyses, which demonstrate how sensorimotor experience reliably predicts AoA ratings for over 13,000 concepts, explaining more variance than previously reported models. Furthermore, the analyses demonstrate the important roles that haptic and interoceptive experiences play in predicting the AoA of concrete and abstract concepts respectively. These results can help to further our understanding of language development through the lens of embodied cognition.

INVESTIGATING LASS THEORY THROUGH WORD ASSOCIATION TASKS

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According to Language and Situated Simulation (LASS) theory (Barsalou, et al., 2008) language processing involves shallow linguistic processes and deeper conceptual activation, conceived as multimodal situated simulations. LASS theory also predicts that linguistic processing is activated more quickly than conceptual processing. This prediction was supported in a neurological study (Simmons, et al., 2008) and a related behavioural study (Santos, et al., 2011).

However, in a replication study of the word association task reported in Santos et al. (2011) several methodological and analytical issues were uncovered. These issues cast doubt over the authors' assumption that word association preferentially activates linguistic processing rather than conceptual processing, and their main claim that linguistic associates were produced earlier than conceptual ones.

I present the results of a new study designed to address these two questions, using different cue words, which were predicted to elicit equal proportions of linguistic and conceptual responses. 54 participants were asked to provide three written responses to 48 cue words, chosen from the Florida norms (Nelson, et al., 1998). This design permitted more rigorous analyses of responses. The results indicated that providing associations to single words frequently involves deeper conceptual processing, which it is argued is necessary to compensate for the paucity of contextual (or co-textual) information. Results also contradicted LASS theory, suggesting linguistic processing and situated simulation are activated rapidly and simultaneously, but that, within the context of a word association task, linguistic processing tends to decrease more quickly, whereas situated simulations remain productive.

WHAT KIND OF LINGUISTIC DISTRIBUTIONAL INFORMATION BEST PREDICTS CONCEPTUAL PROCESSING? A SYSTEMATIC CROSS-TASK COMPARISON

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Humans are sensitive to the distributional patterns of words encountered in language, using this information alongside sensorimotor simulation in conceptual processing across many types of task. To date, computational modelling of linguistic distributional information has tended to focus either on optimising sophisticated prediction vector models for a narrow range of similarity-driven cognitive and information-retrieval tasks, or in utilising relatively simple context-counting models across a broad range of cognitive tasks in distributional-embodied accounts of representation and cognition, relying on complex conceptual associations.

In the present study, we systematically train and evaluate a wide range of model families (predict vector, count vector, n-gram) using a variety of corpora, parameter settings and tasks. The tasks represent an array of cognitive tasks which vary in their conceptual complexity, from simple and similarity-based (e.g. synonym detection, word-pair similarity ratings) to more complex, abstracted judgements (e.g. thematic association production, concrete-abstract semantic decision); and from those whose dependant variable is an explicit (e.g. similarity judgement) or implicit (e.g. reaction time) measure of semantic processing. High numbers of individual comparisons in this systematic, exploratory analysis and model selection make it favourable to a Bayesian rather than frequentist analysis approach.

Results show that different conceptual tasks require different distributional models for optimal modelling, and no model does well at all tasks. We make recommendations for model selection based on task features, in terms of the conceptual complexity involved, and the implicit versus explicit nature of the measure.

SPATIAL DEMONSTRATIVES AND PERCEPTUAL SPACE: TO REACH OR NOT TO REACH IN THE SAGITTAL AND LATERAL PLANES?

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There is much debate regarding the relationship between spatial demonstratives (*'this'* or *'that'*) and perceptual space. While some have argued for a close mapping between the use of demonstratives and the peripersonal/extrapersonal space distinction (Coventry et al., 2008, 2014; Diessel, 2005, 2014), others have argued that distance from a speaker does not affect demonstrative choice (e.g. Kemmerer, 1999; Peeters et al., 2015).

In two experiments we investigated the mapping between the use of demonstratives and perceptual space across sagittal and lateral planes using a variant of the 'memory game' method (Coventry et al., 2008; Gudde et al., 2018) where participants were instructed to use language to memorise object location to elicit the production of demonstratives (without being aware about the real purpose of the study). In Experiment 1, participants were instructed to point at an object with their preferred or dispreferred hand and to name it using a demonstrative and the colour of the disk (e.g. *this/that red disk*). Objects were placed in 30 different locations (6 sagittal X 5 lateral), manipulating distance position in two planes. In Experiment 2, the setting and instructions were the same, but we added one more condition: pointing with a stick to manipulate reaching distance.

Results showed not only the peripersonal/extrapersonal space affects the choice of demonstratives, but also the ease and fluidity with which the pointing hand can interact with objects in both the sagittal and lateral planes affects demonstrative choice. Implications for theories of language and action are discussed.

SEMANTICS OF VISUAL COMMUNICATION

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Both gestures and diagrams are forms of visual-spatial-motor communication with more direct correspondences to meaning than purely symbolic words. Both use a core semantic vocabulary of marks in space as well as place in space (up, down, middle, periphery, left, right) to represent and communicate a wide range of concepts for self and for others. The core semantic marks, both on the page and in the air, are *points* to represent places or ideas, *lines* to represent relations between places or ideas, and *boxes* to represent areas or sets or categories of places or ideas. These spatial forms have context-dependent meanings that can be combined to create gestural or diagrammatic models of thought. Several experiments show that participants use this elementary vocabulary in explanations of space, time, and action both in gesture and on the page, and that creating gestural or diagrammatic models changes one's own thought and that of others. In one set of experiments, people used the core elements, points, lines, and boxes, to produce sketch maps of environments. They spontaneously used the same core elements as gestures while studying descriptions of environments. When they spontaneously gestured while studying, they improved their memory. In other experiments, when people created sketch or gestural models of complex actions or processes in time, they improved their own comprehension and memory as well as that of others. Visual-spatial communications change and augment thought because they map thought about space and about action in space directly.

EXTENDING SYMBOL INTERDEPENDENCY: PERCEPTUAL SCENE VECTORS

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Louwerse (2011) advances the *symbol interdependency hypothesis* by demonstrating empirically the importance of statistical regularities in linguistic surface structures. Symbol interdependency posits that meaning extraction attributed to embodied representations or algorithms should instead be attributed to language.

In a series of seven computational experiments we find that language surface structure best encodes meaning when the structural cues are sufficiently constrained by modeller-determined feature sets, with performance deteriorating for randomly selected language surface cues. We further find that Latent Semantic Analysis' meaning encoding improves as weaker dimensions are removed. These findings collectively indicate that although language is important, increasing the relevance of linguistic statistical regularities is also critical.

We introduce Perceptual Scene Vectors (PSVs), a novel approach that uses object co-occurrences from images to automatically extract strong associative and taxonomic relationships. This approach extracts these associations more successfully than the language-based approaches, measured both qualitatively and quantitatively, with an original application of a cluster-correspondence metric. PSVs encode meaning without modellers hand-coding relevant features. This provides an ecologically valid approach to extending symbol interdependency beyond language and partially solving the relevance problem in semantics by grounding meaning extraction in real-world visual scenes.

SEPARATING HEAVEN AND EARTH: EMERGENT ABSTRACT AND CONCRETE CATEGORIES FROM LATENT STRUCTURE IN SENSORIMOTOR EXPERIENCE

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The distinction between abstract and concrete concepts is arguably the most fundamental of the human conceptual system, and the long-held assumption is that this distinction emerges because concrete concepts reflect more physical, perceivable information than abstract concepts. However, efforts to test this assumption computationally have been hampered by a number of issues, including suboptimal measures of sensorimotor information (e.g., concreteness or imageability ratings), use of abstracted features without clear sensorimotor correspondence, and over-reliance on small samples of concepts from a limited number of categories. Taking a radically different approach, we tested whether the abstract/concept distinction emerges spontaneously from the latent structure of sensorimotor experience by creating a fully-grounded multidimensional sensorimotor space at the scale of a full-size human conceptual system. (i.e., action strength across 5 motor effectors and perceptual strength across 6 sensory modalities x 39,000 concepts).

Agglomerative clustering of this space showed that concepts fell into abstract and concrete clusters with over 70% accuracy compared to human judgements. Concrete concepts such as *animals*, *tools* and *atomic elements* were correctly classified as concrete, and abstract concepts such as *forms of government*, *grammatical parts of speech*, and *discourteous behaviours* were correctly classified as abstract. Critically, the abstract cluster was marked by stronger interoceptive, auditory, head-action, and mouth-action experience than the concrete cluster, suggesting that the abstract/concrete distinction is not driven by simplistic absence/presence of sensorimotor experience. Overall, these findings suggest that the abstract/concrete categorical distinction is grounded in form and spontaneously emerges from complex commonalities in the way we perceive and interact with the world around us.

TO WHAT EXTENT DO ABSTRACT CONCEPTS, METAPHORICITY AND ASPECTUAL FRAMING INFLUENCE SENSORIMOTOR SIMULATION DURING LANGUAGE COMPREHENSION?

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Sensorimotor simulations are relevant for embodied approaches to language which propose that neural systems employed for perception, action and emotion are also used for language comprehension (e.g. Barsalou, 1999; Bergen, 2007a; Glenberg and Robertson, 1999; Zwaan, 2004). Previous research suggests that imperfective aspectual framing results in more detailed simulations and more action conceptualised than the perfective aspect (Matlock, 2011). This increase of conceptualisation of action in the imperfective framing context indicates a finer-grained construal (mental image) of the event as the speaker is focused on the internal structure of the event (Parill et al., 2013). This project addresses a gap in current literature as it investigates whether aspectual framing effects sensorimotor simulations in the context of metaphorical language and abstract concepts, as these two provide different but complimentary insights into language comprehension.

A corpus search helped categorise literal verbs (1), conventional metaphors (2), and novel variations (3) based on the number of hits yielded. Participants were randomly assigned to the perfective or imperfective condition and literal, conventional metaphor, and novel metaphor condition. Abstract concepts such as *kindness*, *happiness*, and *goodness* were central to each question.

- 1) impress
- 2) win over
- 3) captivate fondness

Results demonstrate an interaction between level of metaphoricity and aspectual framing. Specifically, in the context of questions posed using conventional metaphors and imperfective framing, the greatest number of abstract concepts were produced.

Keywords:

Sensorimotor simulation/ Embodiment/ Aspect/ Metaphor

THE ROLE OF WORDS IN A DEVELOPING GROUNDED CONCEPTUAL SYSTEM

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We argue that framing the acquisition of words within a grounded conceptual system offers mechanistic accounts of several developmental processes. These include the emergence of perceivable mental representations and the generation of conceptual structures abstract from concrete sensorimotor experience. Drawing on grounded cognition's accounts of conceptual structure and the representation system and connectionism's mechanisms of statistical learning and parallel processing, we propose the following hypotheses:

First, we argue that without language, multisensory conceptual schemas that emerge via statistical learning are rarely perceived as mental representations, rather they predominantly serve to conceptualise perception (e.g. perceiving a Necker cube as a 3D object) and guide action (e.g. acting in a state of 'flow' with externally directed attention). When the acoustic forms of words are subsequently assimilated into schemas, words are able to cue schemas for structures not currently perceived by the representation system. With the lack of matching external structure to conceptualise, linguistically cued activity within the representation system is perceived as mental representation.

Second, the symbolic cueing of information by words forces the system to represent schemas cued by both environmental structures and linguistic symbols in parallel. Through learning statistical regularities across this parallel representation, new schemas emerge that refer to features shared across structures currently perceived by the sensorimotor systems and structures symbolically cued by language. We hypothesise that this is a mechanism for developing category systems abstract from concrete sensorimotor experience.

POSTER SESSION 1

BUT I CAN STILL SEE YOUR SHADOW: HOW LANGUAGE PROCESSING GUIDES SHADOW PERCEPTION

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Previous reports from the sentence-picture verification task revealed that people are faster to identify perceptual stimuli when intrinsic attributes of depicted objects match those implied by the sentence. To extend these findings, we examined whether simulation system invokes information about extrinsic cast shadows (i.e., shadows cast on one object by another). In Study 1, participants (N=104) first read a sentence that implied a particular shadow cast on a target (blinds vs. open window) and then verified the picture of the object onto which a shadow was cast. Responses were faster when the shadow of the blinds around the pictured target matched that implied by the sentence. However, no evidence was found for simulation of “open window” shadows. A possible explanation could be that perceptual simulation of cast light from an open window does not presuppose the existence of any shadows. Indeed, if one simulates a described object as being placed close to a window opening, then the occlusion of light sources may indeed seem unlikely. Study 2 (N=93) tested this idea with the same stimuli as those used in Study 1, except that pictures depicting light from an open window were this time presented without any shadows. Major result was that both types of pictures were responded to more quickly when preceded by matching sentences. Thus, sensorimotor information may get activated even when processing information about out of sight objects. This insight constitutes a way forward in our thinking about the complexity involved in mental simulation of the visual world.

MEMORY FOR CONCEPTS – LINGUISTIC VERSUS SENSORIMOTOR REPRESENTATIONS IN WORKING MEMORY

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Conceptual representations consist of both sensorimotor and linguistic information, which can be used to store concepts in working memory. However, it is currently unknown to what extent this ability relies on sensorimotor simulation versus linguistic labels. That is, what will happen to our ability to remember concepts if we take away language and rely only on sensorimotor information?

In the current pre-registered study, participants were asked to memorise a set of pictured objects forming a meaningful sequence, such as a recipe for a cake. They then had to remember the objects by choosing a target image out of an array of 6, including 5 distractors. Critically, participants performed an articulatory suppression task by repeating the word “the” at encoding and/or retrieval phase, which blocked lexical access to the names of the objects. Accuracy and response time were measured and analysed using a mixed effects linear model.

Both accuracy and response times were affected by suppression at encoding. Accuracy was most affected by suppression at both encoding and retrieval, when participants had no access to linguistic information, giving an average of 4.5 correct items. Reaction times were slowest when participants had access to linguistic labels at encoding only, and quickest when participants had access to linguistic labels at retrieval only.

A second study has been designed, with a larger number of items per sequence, in order to ensure that the current results do not show ceiling effects, and to see how performance is affected by increased difficulty.

THE ROLE OF LINGUISTIC AND SENSORIMOTOR DISTANCE IN THE BASIC-LEVEL ADVANTAGE

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Does language play a role in fundamental cognitive processes such as categorisation? Cognitive research suggests humans prefer categorising objects at an intermediate level of abstraction, called the basic level. While this effect has frequently been demonstrated, its underlying mechanisms remain largely unexplained. Recent accounts on conceptual processing, which argue that the conceptual system consists of both sensorimotor (i.e., perception-action experience of the world) and linguistic information (i.e., statistical distribution in language), might offer an explanation.

In this pre-registered study, we hypothesise that sensorimotor and linguistic information both contribute to categorical decision-making, and that linguistic information in particular contributes to the basic-level advantage in categorisation. Regularities in language may offer a computationally economical shortcut during conceptual processing, without necessarily activating sensorimotor representations.

Participants will undertake a word-picture categorisation task, where they are shown category labels varying in taxonomic level (i.e., superordinate, basic or subordinate), and make category judgments on subsequently shown pictures. Critically, we used each label-picture pair (e.g., dog-Labrador) to create measures of sensorimotor and linguistic information: sensorimotor proximity (i.e., a similarity measure of grounded representations across 11 dimensions of sensorimotor strength per word), and linguistic distributional proximity (i.e., a corpus-derived high-dimensional measure of word co-occurrence).

Response times and accuracy will be recorded and analysed using Bayesian model comparisons to determine (1) whether linguistic information predicts RT above and beyond sensorimotor information, and (2) whether variance in RT and accuracy is best explained by the taxonomic category model (i.e., specifying subordinate-, basic-, and superordinate-level categories), or by the linguistic-sensorimotor model.

LEARNING MEANING THROUGH STATISTICS AND EMBODIMENT: AN ARTIFICIAL LANGUAGE LEARNING AND EYE-TRACKING PARADIGM

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How connections develop between words and meanings is a fundamental puzzle in the study of cognition. Further complicating the issue, context mediates formation of connections, as well as in-the-moment comprehension. To explore this topic, we developed an artificial language learning paradigm manipulating visual context, linguistic context, and attentional-behavioral context during learning. We measured processing differences (due to learning in different contexts) using eye-tracking. A morphological marker was used to indicate either affirmation or negation, e.g. o-sulto meant “bird”, while an-sulto meant “not the bird” forcing participants to click on the one alternative picture. Negation put emphasis on visual alternatives, and functioned as a proxy for visually-based semantic-relatedness. All non-words used were concrete nouns, put into yoked pairs, and had no/low pre-existing semantic-relatedness. Each word pair was trained with: only the negated prefix, only the affirmative prefix, or both negated and affirmative prefixes. Participants were told the meaning of o- and an- explicitly, then began training. Two pictures were presented, and the non-word was simultaneously heard over headphones. Participants pressed a button to indicate their answer, after which “Correct” or “Incorrect” appeared. After training, participants were tested on the word-stem only, with a third picture present to function as baseline. While participants had more difficulty learning the word-stems in the negated condition, the eye-movement data indicated a stronger connection between the two alternatives. The results will speak to how statistical learning and embodiment can be compatible and integrated to explain how meaning is learned and represented in the mind.

METAPHORICAL MAPPINGS AND MODAL REPRESENTATIONS GROUNDED ON SPACE FOR SPOKEN AND SIGNED LANGUAGES

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The aim of this presentation is to show the on going results of three main studies of our research line devoted to cognitive mechanisms grounded on space as metaphors and image schemes. Our current research has registered by the first time the alternative activation of spatial mappings for time (Temporal tasks: when the events happen) and for potentiality (Potentiality tasks: speaker's certainty about they happen) when processing events. In the scope these abstract domains are strong conflated by Spanish Mood-Tense settings, these results has linguistic and psychological interest. We run additional tasks for better understanding and distinguishing the nature of the Potentiality effect by testing the role of spatial axis on this effect and the interactions Tense-Mood on our current results. The second set of studies discuss a main role of attention endogenous strategies on activating the space-time mappings for concrete verbs and the modal representation of their meaning. We run additional experiments for disentangle factors such as the space salience and task order on a double-task. Finally, the third study suggested mental timeline activation for Uruguayan Sign Language (USL) signers as same as for Spanish speakers by categorizing the time of visual past and future sentences. On the aim of testing the evolutive and cultural roots of this mental timeline USL signers categorized the images of people and cultural artifacts as past or future.

ROLE OF EMBODIED SPATIAL ORIENTATIONS IN THE MEANING OF LIGHT VERB CONSTRUCTIONS (LVC)

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Experimental evidence suggests that meaning of action verbs is grounded in motor processes and embodied spatial orientations (Pulvermüller,2002; Glenberg & Kaschak,2002; Taylor & Zwaan,2008; Kemmerer et al.,2008).

South-Asian languages like Hindi-Urdu, Bengali, etc. possess frequent occurrence of LVCs of (V1+V2) type, where V1 is the main predicator(V1) and the light verb(V2) carries the tense and agreement morphology (Butt & Ramchand,2001; Abbi & Gopalkrishnan,1991). The meaning of V1+V2 construction is composed of- (i) lexical meaning of V1, and (ii) extended meaning component contributed by V2, which has been characterized by forcefulness, suddenness, completion etc. (Hook,1974; Butt & Geuder,2000).

We hypothesize that the role of V2 in the meaning of V1+V2 construction can be derived from embodied spatial properties associated with V2. We explore this hypothesis using five spatial features:-direction(up,toward,etc.), force(control,no_control), speed(sudden,gradual), focus(divergent,convergent), and goal(start,stop). The V1+V2 combinations (n=200) for Hindi and Bengali were annotated with these five features. We found that- (a) suddenness component in the meaning of V1+V2 is determined by spatial direction associated with V2 (sudden~up/down;gradual~towards/away) (p-value= $1.572e^{-15}$ using chi-squared test); (b) Inception/completion component is driven by force(control,no_control) (p-value= $4.495e^{-10}$) and spatial direction associated with V2 (inception~up;completion~towards/away/down) (p-value< $2.2e^{-16}$). In addition, we found that direction and focus associated with V1 and V2 play a major role in determining the combinatory possibilities of V1 and V2 (p-values are 0.00592 and $1.71e^{-12}$, respectively).

Our results indicate that embodied spatial properties can be used to formulate an account which can systematically derive the role of light verb(V2) in the meaning of V1+V2 type LVCs.

SPATIAL DEMONSTRATIVES IN ENGLISH AND JAPANESE: UNIVERSALS OR VARIATION?

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Spatial language is crucial to almost every aspect of our lives, yet there is a considerable cross-linguistic variability in how languages carve up space. In our studies, we used demonstratives as a vehicle to test the relation between spatial cognition and spatial language, and compared two purportedly very different demonstrative systems: English and Japanese.

Native speakers of both languages engaged in a ‘memory game’ (Coventry et al., 2008, 2014; Gudde et al., 2015, 2018), experimentally tapping their use of demonstratives when referring to objects on a table top, the influence of demonstratives on memory for object location, and a within-participant design combining both tasks with a spatial memory task under verbal interference. Results showed that Japanese contrasts both distance from a speaker and from a conspecific, but surprisingly, the position of a conspecific influences English demonstrative production as well - although the effect is weaker - even though English does not explicitly encode the hearers’ position.

In both languages, effects of position are stronger in language production tasks compared to memory tasks, which could suggest that while spatial language production and spatial memory may rely on overlapping mechanisms, there are differences between their respective mechanisms. Concrete parameters (such as distance) may affect both language production and memory; other parameters (like social interaction) might affect only at language production level. Furthermore, when participants are engaged in a language interference task, differences between languages disappear, suggesting that despite superficial differences between English and Japanese, the underlying contrastive use of demonstratives is remarkably similar – even if specific contrasts are not explicitly marked.

PARKINSON'S DISEASE PATIENTS' COMPREHENSION AND PRODUCTION OF CO-SPEECH GESTURES

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Sensorimotor representations emerging from the bidirectional interaction between the body and the physical environment take role in the way we perceive, comprehend, and produce motions as well as language containing motions. Spatial details also accompany these representations and reflect on the linguistic statements explaining motions. Additionally, both abstract and concrete motions simulate similar sensorimotor mechanisms. Thus, it is possible that the spatial details provided in the linguistic statements of concrete motions are also valid for the expressions of abstract motions. These spatial details of different motions are also well expressed in co-speech gestures. However, if the individual possesses a condition resulting in both motor and speech impairment such as in the Parkinson's Disease (PD), co-speech gestures that represent the motions can also be affected. The aim of this study is to expand our knowledge with respect to PD's effect on co-speech gesture comprehension and production. First, we employ a co-speech gesture production task by asking patients to read and retell stories, including concrete and abstract motion verbs. The goal is to explore whether the frequency of co-speech gestures change while explaining either types of motions verbally. Second, we use a co-speech gesture comprehension task in which we ask participants to find the corresponding motion verb with the demonstrated co-speech gesture on the videoclip. This task aims to identify the possible problems in understanding motor motions that imply a message. The data collection is underway. The results of the study will shed light on the interaction between sensorimotor representations and co-speech gesture comprehension and use.

DISCRIMINATING TEXT CATEGORIES IN β -BAND BRAIN ACTIVITY AND THROUGH LINGUISTIC/STYLISTIC ELEMENTS

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Behavioral studies have shown that consuming fiction of award-winning and canonical authors (literary fiction) can instantly improve our aptitude to understand the state of mind of others. Yet, little is known either about the brain mechanisms underlying this remarkable phenomenon or about the linguistic-stylistic elements that trigger this effect. Here we analyze (electroencephalogram) EEG data recorded while participants listened to or read a series of different excerpts and show that principal component analysis based on β -band brain activity from large temporal windows discriminates between literary fiction (novels) and documentaries: Stable β -band activity is seen within and across two parts of the same excerpt, but distinct patterns are observed between excerpts and in particular between excerpts from the two texts categories. Since these patterns persist for more than 30s after the offset of stimulation that differences seen between text categories cannot be attributed to factors related to physical characteristics of the stimulus. Using automated textual analysis we also establish that the use of certain linguistic elements such as words that serve grammatical functions (personal pronouns, auxiliaries, subordinate conjunctions) and words that serve as descriptors (adjectives, adverbs) set literary fiction apart from nonfiction and from other types of fiction. These findings open new venues for approaching a traditional philosophical hypothesis concerning the significance of literature for brain and behavior with methods from quantitative research.

HAVE YOU GRASPED THE IDEA? EMBODIMENT IN FIGURATIVE LANGUAGE PROCESSING DEPENDS ON PERSPECTIVE

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Obligatory motor activity indicates that language is embodied (Glenberg & Kaschak, 2002; Fischer & Zwaan, 2008), including figurative language (Boulenger et al., 2008; Gradinarova & Janyan, 2011). Pronoun-induced implied perspective modulated these embodiment signatures in some studies (Gianelli et al., 2017; Gianelli et al., 2011; Brunyé et al., 2009; Papeo et al., 2011), but not others (Tomasino et al., 2007).

Here we investigated (1) whether motor resonance occurs while processing figurative hand-related expressions (e.g., to grasp the idea, to give an advice), as previously shown for non-figurative ones (Aravena et al., 2012), and (2) whether such embodiment signatures are modulated by a perspective.

Spontaneous grip force fluctuations were recorded (Nazir et al., 2015) while presenting participants with either figurative or literal hand-related German expressions. Abstract hand-unrelated expressions (e.g., to tell the story) were used as controls and pronouns (you vs. I) were manipulated.

Surprisingly and counter-intuitively, there was a significant increase in grip force when processing figurative compared to literal and abstract language but only for the second person (you), $F(5,105)=2.33$, $p=.007$, with no difference between literal and abstract conditions. This result suggests automatic and context-sensitive embodied processing of figurative language, which supports the idea of a functional role of the motor system in language understanding.

TOWARDS A SOCIALLY SITUATED REAL-TIME LANGUAGE PROCESSING ACCOUNT

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It is by now well established that real-time language processing mechanisms can be influenced by both the linguistic and visual context (e.g., information from real/depicted objects or action events). This interplay between visual and linguistic context (and associated representations) during real-time language processing has been specified in the Coordinated Interplay Account (CIA). Recent EEG and eye-tracking studies moreover revealed that socially-interpretable context, such as a speaker's emotional facial expression or voice characteristics, but also comprehender properties such as age and literacy can modulate real-time language comprehension.

We have extended the CIA (Coordinated Interplay Account) by explicitly integrating comprehender characteristics and the comprehender's representation of speaker characteristics, yielding the social CIA (sCIA). An index - ProCom - captures characteristics of the comprehender, such as literacy. In addition, scene-based representations (of objects or a speaker's emotional facial expression) and indices to the interpretation (e.g., of speaker voice characteristics) capture effects of the speaker as part of the context. Sometimes the socially-interpreted context can even elicit expectations which the sCIA (much like the CIA) captures in a (probabilistic) α parameter. We discuss how the sCIA accommodates in this way a number of findings on socially- and contextually-situated real-time language comprehension.

A COGNITIVE ANALYSIS OF CHAINED METONYMIES IN HAUSA COMMON NOUNS

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This study embarks on analyzing the serial structure of chained metonymies in Hausa common nouns. Specifically, the study attempts to find out the metonymic mapping that can frequently be found within chained metonymies of common nouns in Hausa, as well as the most common semantic domains that chained metonymies which can occur regularly in the Hausa common nouns. Chained metonymy model proposed by Hilpert (2005) and conceptual metonymy theory propounded by Lakoff and Johnson (1980) which was later simplified by Radden and Dirven (2007) were employed in analyzing the data in this study. The data for this study was drawn from participants' observations. However, the literal meaning of each common noun expression was identified. Similarly, any other meaning rather than the literal meaning which evoked multiple conceptual shifts were also identified and collected. The study found that the most common metonymic mapping that pertinent to occur regularly is E-E metonymic mapping, followed by E-C metonymic mapping and lastly E-E-C metonymic mapping. Another striking findings of this study is that common nouns are heavily exploited by the Hausa speakers to construct conceptualized expressions through chained metonymies. The findings of this study also attested the assertion made by Hilpert (2005) that chained metonymy begin most of the time if not all with E-metonymies. As it was seen in the analysis of this study, no single chained metonymy begins with C-metonymies, this clearly shows that C-metonymies are infrequently found at the beginning of a chained metonymy of common nouns in Hausa.

LINGUISTIC DISTRIBUTIONAL ASSOCIATIONS PREDICT CATEGORY MEMBER PRODUCTION

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The human conceptual system comprises linguistic and simulated (sensorimotor) information, but the importance of each in conceptual processing is debated. We investigated the extent to which category production performance relies on linguistic distributional associations compared to sensorimotor similarity. 60 native speakers of English named as many concepts as possible for each of 117 categories (divided and counterbalanced across 3 lists), within 60 seconds. For each category-member pair of words (e.g., Fruit -> Apple), we created two critical predictors: sensorimotor distance (a similarity measure of grounded representation across 11 dimensions of sensorimotor strength), and linguistic distributional distance (a measure of word co-occurrence derived from a subtitles corpus). We analysed three explicit measures of category production from our data: 1) how often each concept was named per category; 2) mean ordinal position per concept and category, and 3) how often each concept was named first per category. We also analysed response times for the first concept named per category.

Both sensorimotor and linguistic distributional distance contributed independently to the three explicit measures of category production; that is, responses were based on the similarity of sensorimotor experience, and how often the words co-occurred in similar linguistic contexts. Critically, a model containing both sensorimotor and linguistic distributional distance better predicted these three measures of category production than a sensorimotor-only model. However, neither sensorimotor nor linguistic distance predicted response times. These findings suggest that linguistic associations are important in accessing semantic concepts during category production, but not the time course within which they are accessed.

POSTER SESSION 2

INVESTIGATING THE INNATENESS OF LANGUAGE

Amber Sheldon

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I will explain Ludwig Wittgenstein's "private language argument" in the *Philosophical Investigations*. Then, I will analyze the elements of contrast between Wittgenstein's account of language acquisition and that of Noam Chomsky in his theory of universal grammar. I will additionally address Jerry Fodor's theory that there is a tacit language of mind ("Mentalese") that is translated into a speaker's external language. I will analyze Chomsky's and Fodor's theories in contrast with Wittgenstein's private language argument.

Wittgenstein contends that language is acquired from public interactions. Language is *activity* performed by a community of speakers and hearers. Wittgenstein's account of language as *active* is demonstrated through "games." There are no necessary or sufficient conditions that characterize all instances of "gamehood." You learn a game by actively participating in playing.

Fodor theorizes that the mind has an innate symbolic system of representation. Thoughts are literal sentences in the mind. They are encoded symbolically in a mental language. Some analogize this with the symbolic "language" of computers. The mind is computer-like in that it works according to a system of symbolic inputs and corresponding outputs.

Fodor's "Mentalese" theory (derived from Chomsky's "Universal Grammar") has been an influential contribution to the philosophy of mind. Many philosophers believe that Fodor's theory stands in significant opposition to Wittgenstein's private language argument. Thus, with this project, I will investigate how the private language argument could count against Fodor's theory.

THE EMBODIMENT OF ABSTRACT CONCEPTS: A TMS STUDY

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The representation of concrete concepts such as 'kicking a ball', activates modality-specific areas of the brain to produce a sensorimotor simulation of previous ball-kicking experiences. However, there is no consensus whether embodied representations also occur for abstract concepts. Concrete and abstract concepts can differ in the type of information they activate; sensorimotor for concrete and linguistic for abstract. Indeed, when participants are asked to determine whether target-words match presented definitions, they are faster to respond using their mouth, for abstract compared to concrete concepts, and faster with their hand for concrete compared to abstract (Borghi & Zarcone, 2016). We report a related experiment in which participants were presented with concrete and abstract definitions followed by concrete and abstract target-words while single-pulse transcranial magnetic stimulation (sTMS) was applied to proposed modality-specific areas of the brain (hand and mouth areas of primary motor cortex, for concrete and abstract words, respectively). When TMS was applied to the hand area, response times were slower for concrete compared to abstract words, and when applied to the mouth area, were slower for abstract compared to concrete words. The results are in keeping with embodied theories of cognition and support the proposal that abstract concepts evoke the simulation of linguistic information in modality-specific areas of the brain.

HOW MEANING IS CONSTRUCTED IN THE MIND

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The central argument I present in the paper is built around the premise that meaning as a dynamic feature of an individual mind is deeply woven into the contexts of knowledge and represents a complex process of contexts correlation by virtue of the metaconcepts and the *context-of-sociocultural-knowledge-oriented construal*.

I apply to the Sociocultural Commitment as a comprehensive framework of language use that covers the whole spectrum from how meaning is constructed to what makes representatives of different sociocultures understand each other.

In the talk, I will focus on two perspectives. The first corresponds to the cognitive sphere including the ability to speak languages, to perceive the world, to conceptualize and categorize objects, events, etc. The second is involved with HOW human beings construct meaning through the language they speak in communicative settings, HOW contexts are embedded in our cognition for meaning construction, HOW patterns of behavior human beings acquire as members of sociocultures influence their meaning construction. The latter perspective is culture-specific and depends on the individual knowledge about the society and culture a participant represents.

The aim of the talk is to present the basic results of a research project that has recently been carried out and is likely to encourage interdisciplinary and methodologically rigorous research in the fields of Discourse Studies, Communication and Cognitive Sciences in general.

In the talk, five outcomes for both usage-based theory and empirical linguistic methodology are presented. The approach establishes new findings and authentic contributions to cognitive linguistics.

THE IDIOSYNCRATIC INTERPRETATION OF JAPANESE DEGREE EXPRESSION *MAZI-MANZI* -WITH REFERENCE TO *YABAI*-

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This study investigates the interpretational characteristics of Japanese degree expression *mazi-manzi* (often written as “マジ卍”) or just *manzi* (“卍”), mainly used by younger Japanese. The significant characteristic of construal is that it can describe both brilliant and terrible situations:

- (1) Testo goukaku! Mazi-manzi! “I passed the exam! Woo-hoo!”
- (2) Ame ni nureta. Mazi-manzi. “I got wet. Sucks.”

There is another degree expression *yabai*, which also describes both excellent and horrible situations:

- (3) (When having very delicious meal)
Kore yabai yone! “This is nummers!”
- (4) (When one looks blue)
Kaoiro yabai yo. “You look like death warmed over.”

Then, one might predict that they can occur in the same context. However, their grammaticality may be contrastive:

- (5) (When seeing a good-looking guy):
{*Mazi-manzi / Yabai}! Ano hito kakkoi! “Oh my goodness! That guy is super cool!”
- (6) A: Ronbun owatta? “Have you finished your paper?”
B: {*Mazi-manzi / Yabai}! Wasureteta! “Oh my goodness! I forgot about that!”

This suggests that *mazi-manzi* does not have independent word use and cannot describe instantaneous emotion or evaluation.

This contrast is reduced to their lexical meanings: while *yabai* originally means “unfavorable,” *manzi* is merely a symbol and has little meaning. That is why *manzi* requires more contexts to understand whether it is used in good or bad meaning. *Manzi* functions as, so to speak, “semantic slot.”

This study revealed that *mazi-manzi* strongly depends on the shared situation to construe. This “anti-maxim of quantity phenomenon” is often seen in young Japanese conversation.

INNER SPEECH DURING SILENT READING OF DIRECT QUOTATIONS IS LINKED TO THETA-BAND NEURAL OSCILLATIONS

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Embodied cognition theories propose that language processing may rely on the same modal systems for perception and action (Barsalou, 2008). Speech perception relies on theta-band (4-7Hz) neural oscillations for segmenting and coding continuous speech signals into hierarchical linguistic units for comprehension (Ding et al., 2015; Peelle et al., 2013). Does this theta-band oscillatory mechanism also govern mental simulation of speech (inner speech) during silent reading of direct quotations?

In an EEG experiment, thirty-two native speakers of English silently read 120 short stories that contained either a direct speech (e.g., *Mary said: "This dress is lovely"*) or an indirect speech (e.g., *Mary said that the dress was lovely*) for comprehension. Their EEG data were pre-processed and epoched to the onsets of the speech quotations, followed by time-frequency decomposition.

In the theta frequency band (4-7 Hz), we observed significantly higher phase-locking value (i.e. inter-trial phase coherence) in the right temporal sensors at ~200-400ms when reading direct (relative to indirect) speech quotations. This reflects a phase reset at the start of inner speech processing, similar to that at the onset of speech perception (Giraud & Poeppel, 2012; Luo & Poeppel, 2007). The phase reset was source-localised to the right posterior superior temporal sulcus – areas that are linked to prosodic processing of speech in perception (Belin, Fecteau, & Bedard, 2004). In line with the embodied cognition framework, our results demonstrate that mental simulation of speech may share the same theta-band oscillatory mechanism with perception of actual speech.

READING MINDS THROUGH LANGUAGE? CREATING AN AUTOMATED TEXT ANALYSIS MEASURE FOR MENTAL STATE CONTENT

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Mind reading, or theory of mind, involves understanding and processing information about the internal mental states of others (e.g., beliefs, desires, intentions). This ability underpins much of social cognition and may even have largely driven the evolution of human sociality. Yet, reliable, meaningful and easily administered measures of mind reading are virtually non-existent. To address this issue, we have drawn on language processing to develop an automated tool that analyses text for references to mental states. This is based on a previously-described measure that was found to correlate with cortical thickness in relevant brain areas (Rice & Redcay, 2014). This previous measure laboriously used human coders to identify mentions of mental states. However, the dichotomous nature of scoring words as either 'mental' or 'non-mental' ignores nuances in linguistic representation. For instance, words involving speech production (e.g. 'said,' 'informed'), do not explicitly denote mental states, but they connote contexts in which mental states are deeply important.

To create our automated tool, we first collected (from human raters) a corpus of word norms for "mental state-ness" in over 2000 commonly-used verbs and adjectives. We then applied these norms within a framework of natural language processing to extract measures of how much a piece of text evokes mental states. We will discuss how this automated measure relates to existing word norms of concreteness and embodiedness, and how it compares with laborious human coding, including the situations in which it surpasses human coding, and those in which it falls short.

INDIVIDUALS WITH AND WITHOUT AUTISM SPECTRUM DISORDER INTEGRATE THE SPEAKER AND MEANING: EVIDENCE FROM EYE- TRACKING AND ERPS

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Previous research has shown that when individuals listen to sentences that include a mismatch between meaning and the voice of speaker, a semantic anomaly type response (N400 effect) is observed, indicating that speaker-related mental models were instantly built (van Berkum, et al., 2008). In two pre-registered experiments, we examined the integration and anticipation processes of same effect in adults with and without Autism spectrum disorder (ASD vs. TD-N=24 in each group).

In Experiment 1, employing the visual world paradigm, participants listened to sentences that were consistent or inconsistent between voice and message (e.g. “On my last birthday, I got an expensive electric shaver/car” in a child/adult’s voice). Concurrently, they viewed visual scenes including consistent and inconsistent objects alongside distractors. All participants were slower selecting the mentioned object in the inconsistent condition, and all anticipated the consistent object at least 600ms before the disambiguation point (“shaver/car”).

Experiment 2, explored the integration processes by recording ERP activity. Participants listened to sentences of similar type, time-locked to the onset of the target word (e.g. “I tried to refresh my lipstick in front of the mirror” in a man/woman’s voice). A control condition included a semantic anomaly sentence (e.g. “I tried to refresh my seashell in front of the mirror”). Results showed an enhanced N400 for inconsistent speaker-meaning sentences compared to consistent, that was comparable to anomalous sentences. Further analyses examined the group differences. Overall, contrary to the pragmatic dysfunction suggestions, people with ASD are sensitive to speaker inconsistency effects.

SPATIAL INTERFERENCE AND FACILITATION EFFECTS OF NOVEL WORD AND OBJECT LEARNING ON VISUAL PERCEPTION

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Previous studies investigating effects of language comprehension on spatial processing have used words with preexisting spatial associations, which allow for considerable variability across participants in activation of those representations. Here participants learnt verbally presented novel words paired with novel visual objects that systematically appeared in high or low locations. This allowed us to more carefully control visuo-spatial properties of experience, and potentially provide optimal conditions for the emergence of embodied simulations. Following training in Experiment 1, participants were cued by a word and had to identify if a target visual object matched the word. Objects could match or mismatch the cued word in identity, or on whether the spatial location matched or mismatched the trained location. In Experiment 1 participants were trained and tested on just novel words and objects; in Experiment 2 we compared performance with real words and objects that had existing spatial associations. We found that mismatching but task irrelevant spatial information interfered with judgements of object identity, but only for the recently learnt novel words and objects. In order to manipulate visual correspondence between targets and internal representations, in Experiment 3 we used a target discrimination task, where the visual target (an s or z) had no relationship to the verbal cue. We found the opposite results to when there was a visual object match, where responses to spatially matching targets were slower than spatially mismatching targets. We discuss implications for embodied accounts of these effects, along with non-embodied accounts based on perceptual matching.

EMBODIED ASPECTS OF NON-LITERAL LANGUAGE: A GRIP-FORCE STUDY

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Embodied cognition suggests that conceptual knowledge is grounded in individual sensorimotor experience. This argument extends to action-associated language processing – sensorimotor cortical areas active during concept's acquisition become interconnected with the brain areas underpinning processing language, semantically related to the concept. However, the evidence of the sensorimotor systems involvement in *abstract* and *non-literal* language processing is still controversial. In the study, we use grip force sensor to investigate motor areas involvement in idiom and metaphor processing. We measure spontaneous changes in grip force triggered by the semantic features of hand-related and hand-unrelated action verbs and state verbs, embedded in literal, idiomatic, and metaphoric sentences. Grip strength is hypothesized to be related to the amount of “literal” action-related semantics preserved in a context and available for a mental simulation during meaning processing. Thus, literal meaning, which is more grounded compared with metaphoric, idiomatic or abstract one, should lead to a larger grip force (Boulenger et al., 2009, 2012; Cacciari et al., 2011; Aravena et al., 2012). Compared to literal sentences, we expect a decrease in grip force elicited by metaphoric expressions, because they use motion verbs at a higher level of abstraction. Even more pronounced decrease is hypothesized for idioms, which establish an arbitrary relationship between the literal and the global figurative meaning. Overall, the study deepens the understanding of the embodied and simulation-based aspects of both literal and figurative meaning comprehension.

INFANTS' MAPPING OF NOVEL WORDS ONTO AUDITORY REFERENTS

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Much is known about how infants acquire labels for novel visual objects. Yet, our daily lives are also filled with input from other modalities. How do we learn words for things we cannot see, such as thunder, siren, or lullaby? In an event-related potential (ERP) study, we presented environmental sounds and spoken pseudowords in an associative-learning paradigm to adults and infants between 10 and 12 months of age. To induce learning, the sounds and words were presented sequentially either in a consistent manner, where it is possible to establish an association between specific sounds and words, or in an inconsistent manner precluding one-to-one mapping of sounds and words. In a subsequent testing phase, matching and non-matching combinations of the consistent object-word pairs were presented. The lack of significant ERP effects in adults (N=32) shows that they are ineffective in learning the meaning of the new labels in either active or passive task designs. The analysis of infant ERP data (N=32) shows a significant negativity for non-matching versus matching words in the N400 time window. This is suggestive of successful mapping of the novel labels onto auditory referents; thus, indicating infants are able to acquire novel word meaning irrespective of the modality of the referent. As adults were unable to learn in active or passive tasks, ongoing research is investigating under which conditions adults can map novel words to auditory referents, specifically, what is the impact of modality and timing of the referent to be mapped.

HOW EVENT PROBABILITY IMPACTS SENTENCE COMPREHENSION: MODELING N400 AMPLITUDES IN ROLE-REVERSED SENTENCES

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Traditional accounts hold that during sentence processing, syntax is used to build a linguistic structure, and word meanings are placed into syntactically specified slots within this structure to derive a compositional representation of sentence meaning. Collaborating with J. McClelland, we simulate a broad range of influences on the N400 ERP component using a neural network model implementing a fundamentally different perspective. Specifically, in the Sentence Gestalt (SG) model (St. John & McClelland, 1990), incoming words serve as ‘cues to meaning’ that update a probabilistic representation of sentence meaning, which is jointly constrained by event probability and syntax, and where syntactic cues may be overridden when event probability cues are strong. Here, we focus on the simulation of the finding that the N400 ERP component, which is typically increased in semantically anomalous sentences, has been found to be small for reversal anomalies (e.g., “The fox on the poacher hunted.”; literal translation from Dutch; Van Herten et al., 2005), which has been taken to indicate a temporary plausibility based “semantic illusion”. Simulating reversal anomalies, the SG model captures the empirical data in that simulated N400s are only slightly increased in role-reversed sentences as compared to controls. Probing the model’s internal representations reveals that processing reversal anomalies does not induce a clear-cut “semantic illusion” but instead entails a state of uncertainty due to the conflict between syntactic and semantic cues, which may depend on subsequent controlled processes to be resolved. These findings shed new light on how event probability may impact sentence comprehension.

OVER-RELIANCE ON VERTICAL ASSOCIATION AFFECTS VISUAL ATTENTION DURING SPOKEN WORD CATEGORIZATION IN PARKINSON'S DISEASE PATIENTS

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Parkinson's disease is a neurodegenerative disorder characterized by motor and cognitive deterioration, including altered perception of space. Patients' language is also affected; while lexical access seems relatively intact, later stages of semantic processing appear more compromised. Against this background, we investigated how the association between spatial locations (up, down) and nouns (e.g., 'hawk', 'diver') might affect patients' visual attention.

A clinical sample (n=16, Experiment 1) and another of healthy older adults (n=18, Experiment 2) listened to single words (mean duration = 733,53ms; range: 500-966ms) while their gaze on a blank screen was recorded. On each trial, participants decided whether the word they heard was associated with up/down locations, by verbally responding "up"/"down". If nouns rapidly activate associated locations, an early modulation of visual attention towards the associated regions of the screen (i.e., upper, lower) could emerge. Alternatively, such associations might only meddle in after word comprehension has occurred.

Across experiments, participants' accuracy was high (>65%) and their average response time was ≈1000ms after noun onset. We analyzed participants' eye movements in an early (200-1000ms) and a late time window (1000-1800ms). Parkinson's disease patients exhibited a preference for the upper region of the screen. However, when they heard down-associated nouns, their looks to the lower region were higher, compared to when they heard up-associated nouns in the late time window. The control group showed no reliable effect of region of interest or word categorization. We discuss our results in the context of the strategic use of spatial associations during word categorization.

THE MOTORIC AND PERCEPTUAL BASES OF VERBAL SEQUENCE LEARNING

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The present study tested the view that long-term verbal sequence learning, a fundamental aspect of language acquisition, reflects not the action of a bespoke phonological short-term store but rather the legacy of ‘peripheral’ motoric and perceptual processing. Using the Hebb sequence learning paradigm—in which short-term serial recall is enhanced for a sequence that is repeated amongst otherwise non-repeated sequences—the perceptual-motor account was supported by several convergent findings: First, verbal sequence learning was either attenuated or abolished when vocal-motor planning of the to-be-remembered sequence was impeded, at least with visual sequences. Second, an inconsistent temporal grouping of items across iterations of the repeating sequence also abolished learning but only when that grouping—based on independent evidence from an analysis of output response-times during serial recall—was instantiated within a motor-plan. The results suggest that, like verbal serial short-term memory, long-term verbal sequence learning is a byproduct of processes evolved for motoric interactions with the environment.

SENSORIOMOTOR CHANGE AS A RELEVANT COMPONENT OF EARLY WORD LEARNING

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The answer to how children learn the meaning of words with apparently little feedback is not well understood with competing theories that range from innate conceptual constraints, to social scaffolding, to bottom-up statistical learning. However, a more unified understanding may emerge from theory and experiments focused on how knowledge emerges through real time interactions in the world that create the data for learning and that change as the infant changes. From this perspective, the relevant stimulus for language includes children's behavior and thus sensorimotor experience in modalities beyond audition. Looking behavior is a fundamental component of how children learn the meaning of words and developmental changes in looking behavior is well-documented to play a key role in online language processing, the context through which children learn language. In the present study, we used head-mounted eye trackers to compare looking behavior in children 9 to 24 months old while they play with objects with one of their parents. The results show an increase in the number of short looks with age, and an increase in the overall number of looks to objects, with a more similar distribution to adult's looking behavior, a pattern that also characterizes differences in looking behavior during parent naming events.. The discussion considers the role of these changes in early word learning and the relation of these developmental changes to parent report of vocabulary growth.