GEM 2023

GENERATIVE EPISODIC MEMORY

Interdisciplinary Perspectives from Neuroscience, Psychology and Philosophy

CONFERENCE BOOKLET

June 12.-14.2023

WELCOME TO GEM 2023

After the resounding success of our first virtual GEM conference in 2021, we are thrilled to announce that the time has finally arrived for our first in-person gathering at the RUB. We have an exciting lineup this year, featuring six renowned keynote speakers, 24 contributed talks across two parallel tracks, and two poster sessions where we can all meet and exchange ideas.

Our program intentionally blends different disciplines, creating a platform for interdisciplinary exchange and the sharing of research findings. We believe that this unique approach will provide a rich and dynamic experience for all participants.

We wish you all a fruitful conference and hope you will join us again for our next GEM in 2025.

The Conference Committee

GREETINGS FROM FOR 2812 CONSTRUCTING SCENARIOS OF THE PAST

On behalf of the DFG-funded research unit "Constructing scenarios of the past: A new framework in episodic memory", it is my pleasure to welcome you to GEM 2023. Our interdisciplinary research unit brings together 33 scientists from philosophy, psychology, neuroscience and computational modeling to advance our understanding of episodic memory. Since 2019 we have developed, studied and tested the scenario construction framework, which forms the backbone of all projects in our unit. I look forward to sharing our insights with you and receiving feedback from you at this conference. More broadly, this conference is meant to facilitate exchange between all scientists working on generative episodic memory. We particularly target the young and currently underrepresented scientists and are therefore happy to see the tremendous interest in our PhD symposium and Women in Memory Research program.

We hope that GEM 2023 will be a stimulating and productive event, and we look forward to engaging with you in lively discussions and fruitful collaborations.

Sen Cheng
Speaker FOR 2812

PhD Symposium
Keynotes
Talks
Poster sessions
Fireside chat
Conference dinner

1 CONFERENCE SCHEDULE

PHD SYMPOSIUM

Monday, June 12th

08:45 **Registration**

Moderator: Xiangshuai Zeng *Saal 1*

09:00 The *trials and tribulations of interdisciplinary research*

John Sutton – Macquarie University, Sydney (emeritus)

Ricarda Schubotz – University of Münster

09:45 **Panel discussion**

10:30 Coffee/Tea Break

11:00 **Lightning meetings**

MAIN CONFERENCE

Monday, June 12th

13:00 **Registration**

Opening Session

Moderator: Sen Cheng *Saal 2a*

13:30 **Opening – Sen Cheng**
Speaker FOR 2812, Ruhr University Bochum

13:40 **Welcome – Günther Meschke**
Vice-Rector for Research and Transfer, Ruhr University Bochum

13:50 **Ken Norman**
Princeton University
Computational principles of real-world memory

14:50 **Coffee/Tea Break**

1.1 – Episodic Memory Traces

Moderator: Robert Schmidt *Saal 1*

15:15 **James Michael Openshaw**
Ruhr University Bochum; Universite Grenoble Alpes
(In defense of) preservationism and the previous awareness condition: What is the theory of remembering, anyway?

15:45 **Nikola Andonovski**
Universite Grenoble Alpes
Engrams as mental files

16:15 **Zoltan Apa**
Universite de Liege
Comparison of representational similarity of episodic memory traces at encoding and retrieval in younger and healthy older adults

1.2 – Episodic Memory and Pathology

Moderator: Pernille Hemmer *Saal 2a*

15:15 **Catarina Gouveia Gaglianone**
University of Edinburgh
Can virtual nature scenes stimulate positive imagination? A proof-of-concept study

15:45 **Tyler Sproule**
University of Illinois at Chicago
Are traumatic memories episodic?

16:15 **Benjamin James Griffiths**
University of Birmingham
Enhancing recall with imperceptible gamma-band sensory stimulation

Poster Session 1

17:00 – 18:30 *Foyer*

01 **Nicolas Diekmann**
Ruhr University Bochum
A model of hippocampal replay driven by experience and environmental structure facilitates spatial learning

02 **Behnam Ghazinouri**
Ruhr University Bochum
Navigation and the efficiency of spatial coding: Insights from closed-loop simulations

03 **Frederik Tollerup Junker**
University of Copenhagen
Is the wandering mind a planning mind?

04 **Pelin Kasar**
Central European University
Belief reconstructed

05 **Chitaranjan Mahapatra**
CNRS/Paris-Saclay Institute of Neuroscience
Computational modelling of the pathway between dopamine receptors and Ca2+ channels in layer ii stellate cells

06 **Simone Malejka**
University of Cologne
Why do tests improve memory? A formal modeling approach to retrieval-based learning

07 **Francesco Pupillo**
Goethe University Frankfurt
The neural basis of learning and memory in changing environment

Poster Session 1

Foyer

18 **Simge Saricicek**
Kadir Has University
Collective retrospective future thinking

19 **Marcel Raphael Schreiner**
University of Mannheim
Social status does not facilitate memory integration

20 **Sander van Bree**
University of Glasgow
Evaluating visual pings as a method to enhance the readout of long-term memory contents

21 **Ilona Vieten**
University of Bonn Medical Center,
Ripple activity in medial temporal lobe during sleep is modulated by previous awake experience

22 **Victoria Wardell**
University of British Columbia
Shifts in visual perspective predict the consistency of autobiographical memory

P01 **Nina Liedtke**
University of Münster
Learning from quantified episodic prediction errors: Individual biases in gist revision

P01 **Sophie Siestrup**
University of Münster
Relevant or irrelevant? The influence of gist- and surface-level episodic prediction errors on brain activity and memory

P02 **Xiangshuai Zeng**
Ruhr University Bochum
Modeling the function of episodic memory in spatial learning

P03 **James Michael Openshaw**
Ruhr University Bochum
Heteronoesis: episodically remembering vicariously experienced events

P04 **Henry Soldan**
Ruhr University Bochum
The impact of semantic information on memory for temporal sequences

P04 **Carina Zoellner**
Ruhr University Bochum
Remembering while being clueless: The neural basis of constructive episodic memory retrieval

P05 **Aya Altamimi**
Ruhr University Bochum
Effects of social interactions on generative episodic memory

P06 **Francesca Righetti**
Ruhr University Bochum
Situating trace minimalism: The role of protentional intentionality in remembering

P07 **Roy Dings**
Ruhr University Bochum
Situated authenticity in episodic memory

P08 **Alicja Malgorzata Wicher**
Ruhr University Bochum
Semantic aspects of shameful memory

P09 **Ullrich Wagner**
University of Münster
Memory bias in the service of shared reality creation with an audience: Is the effect different if the communication target is the self?

P09 **Huan Zhang**
University of Münster
The influence of intimate relationship on the "saying is believing" effect

Poster Session 1

Foyer

P10 **Emil Eva Rosina**
Ruhr University Bochum
*"Noch genau wissen" in memory reports: Still knowing for sure **and** remembering vividly*

18:00 **Conference Dinner**

Tuesday, June 13th

Keynote

Moderator: Yee Lee Shing — *Saal 2a*

09:00 **Maria Wimber**
University of Glasgow, UK
Tracking the reconstruction of visual memories in human brain and behaviour

10:00 **Coffee/Tea Break**

2.1 – Episodic Memory in (Social) Context

Moderator: Scott Nicholas Cole — *Saal 1*

10:15 **José Carlos Camillo**
Universidade federal de goiás; Université grenoble alpes
A contextualist view of episodic memory's accuracy

10:45 **Géza Gergely Ambrus**
Bournemouth University
Exploring generalizability in recognition memory signals through multivariate cross-classification

11:15 **Aya Altamimi**
Ruhr University Bochum
Effects of social interactions on generative episodic memory

2.2 – Episodic Memory across the Lifespan

Moderator: Sophie Siestrup *Saal 2a*

10:15 **Daniela Czernochowski**
RPTU Kaiserslautern-Landau
The developmental trajectory of recognition memory: Electrophysiological and behavioral evidence for distinct but complementary roles of semantic elaboration and perceptual binding during episodic memory encoding and retrieval in children, adolescents and young adults

10:45 **Sophie Nolden**
Goethe-University Frankfurt am Main
Mnemonic effects of violated expectations: Electrophysiological correlates and a lifespan comparison

11:15 **Juan F. Alvarez**
Université Grenoble Alpes
Remembering and relearning: A compatibilist view

11:45 **Lunch Break**

Keynote

Moderator: Markus Werning *Saal 2a*

13:15 **Felipe De Brigard**
Duke University
Reconstructive memory as reverse inference

2.3 – Phenomenological and Epistemological Aspects of Scenario Construction

Moderator: Roy Dings *Saal 1*

14:25 **Francesca Righetti**
Ruhr University Bochum
The embodied resonance in episodic memory

14:55 **Nathália de Ávila**
Universität zu Köln
From procedural memory to the phenomenological lived body: What does "reconstruction" mean in a 4e approach of emotional remembering?

15:25 **Jay Richardson**
Institut Jean Nicod
Confabulation is a mnemonic phenomenon

2.4 – Directive Function of Episodic Memory

Moderator: John Sutton *Saal 2a*

14:25 **Xiangshuai Zeng**
Ruhr University Bochum
Modeling the function of episodic memory in spatial learning

14:55 **Sofiia Rappe**
Ruhr University Bochum
Episodic memory and causal reasoning through counterfactuals

15:25 **Johanni Brea**
EPFL
Modeling Episodic-Like Memory in Food Caching Birds

Poster Session 2

15:55 - 17:30 *Foyer*

01 **Mahdi Bagheri**
Ruhr University Bochum
Investigating the causal role of mental imagery in the experience of involuntary memories

02 **Nawël Cheriet**
University of Liège
What do we remember about the past to anticipate the future: The covid-19 pandemic analyzed with behavioral and natural language processing approaches

03 **Nikolaos Chrysanthidis**
KTH Royal Institute of Technology
Item-in-context episodic memory in a spiking neural network model with hebbian plasticity

04 **Scott Nicholas Cole**
York St John University
Erp correlates of involuntary and voluntary eclosing sessionpisodic memories

05 **Vassilis Cutsuridis**
University of Lincoln
Memory retrieval enhancement in a CA1 microcircuit model of the hippocampus

06 **Nathan Leroy**
University of Liège
Effects of the number and duration of events in the temporal compression of experience in memory

07 **Catarina Gouveia Gaglianone**
University of Edinburgh
The impact of soothing media and the anxiety and depression traits on the content of prospective mental imagery. A qualitatively driven photo-elicitation study.

Poster Session 2

Foyer

08 **Janika Denise Pelz**
Ruhr University Bochum
Do naps promote selective memory consolidation in the context of expectation violation in infants?

09 **Christopher Postzich**
University of Glasgow
Tracking the reconstruction of naturalistic images from memory using similarity-based fusion of MEG and fMRI data

11 **Aiswarya PS**
Indian Institute of Science Education and Research
Spike and rate-based dynamics for neural systems

13 **Michaela Anne de Kock**
Stellenbosch University
An investigation on the role of oxytocin in chronic neuropathic pain in a wistar rat model

14 **Rebecca Michelle Dreier**
University of Tübingen
Self-enhancement: How reliable are our episodic memories?

15 **Weronika Dziarnowska**
Delft University of Technology
Data-driven modeling and analysis of dynamics of emotional associative memory encoding

16 **Chiara Ferrandina**
Goethe University Frankfurt
Memory in flux: Investigating the effects of changing environments on episodic memory

17 **Elsa Kolbe**
MPI for Human Development, Berlin
Consolidation of sequential memories in humans

18 **Joel Reithler**
Maastricht University
Probing peri-encoding activity linked to subsequent memory of narrative episodes using multi-echo fMRI at 7T

19 **Iryna Schommartz**
Goethe Universitaet Frankfurt
Neural reinstatement of memories across immediate, short and long delays : A comparison between children and young adults

20 **Tristan M. Stöber**
Ruhr University Bochum
Silencing hippocampal CA2 reduces behavioral flexibility in spatial learning

21 **Marije ter Wal**
University of Birmingham
Theta phase separates object features in human hippocampus during an associative memory task

22 **Anna M. A. Wagelmans**
Université Paris-Saclay
Parametric distance effects in mental time travel

P01 **Sophie Siestrup**
University of Münster
Relevant or irrelevant? The influence of gist- and surface-level episodic prediction errors on brain activity and memory

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The influence of intimate relationship on the "saying is believing" effect

P10 **Emil Eva Rosina**
Ruhr University Bochum
*“Noch genau wissen” in memory reports: Still knowing for sure **and** remembering vividly*

Keynote

Moderator: Laurenz Wiskott — *Saal 2a*

17:30 **Christian Leibold**
University of Freiburg
On intrinsic hippocampal sequences

Wednesday, June 14th

Keynote

Moderator: Oliver T. Wolf — *Saal 2a*

9:00 **Peggy St. Jacques**
University of Alberta
Perspective matters: Remembering events from alternative viewpoints

3.1 – Memory and Imagination

Moderator: James Openshaw — *Saal 1*

10:10 **Kristina Liefke**
Ruhr University Bochum
Just simulating? Semantic support for discontinuism

10:40 **Cornelia McCormick**
University Hospital Bonn
Neural correlates of memory and imagination

11:10 **Hang Li**
LMU Munich
The tensor brain: A unified theory of perception, memory and semantic decoding

3.2 – Relationship Between Semantic and Episodic Information

Moderator: Carina Zöllner — *Saal 2a*

10:10 **Gerard John Rinkus**
Neurithmic Systems, USA
Semantic memory as a computationally free side-effect of sparse distributed generative episodic memory

10:40 **Eleanor Spens**
University College London
A generative model of memory construction and consolidation

11:10 **Roni Tibon**
University of Nottingham
Do activations and representations differ during successful retrieval from episodic vs. semantic memory?

11:40 **Coffee/Tea Break**

Closing Session

Moderator: Kristina Liefke — *Saal 2a*

12:10 **Ali Boyle**
London School of Economics
Is artificial episodic memory really episodic memory?

13:10 **Closing Vote of Thanks - Sen Cheng**

FIRESIDE CHAT

Moderator: Zoellner — *Beckmanns Hof*

13:30 **Lunch**

14:30 **Ali Boyle, Pernille Hemmer, Peggy St. Jacques**
Panel discussion

Ali Boyle
Felipe De Brigard
Christian Leibold
Ken Norman
Peggy St. Jacques
Maria Wimber

2 KEYNOTE SPEAKER - BIOS

Ali Boyle

London School of Economics and Political Science

Dr. Ali Boyle is a philosopher of science, specializing in comparative cognitive science - the science of nonhuman minds, from animals to artificial agents. She currently holds a UKRI Future Leaders Fellowship at LSE's Centre for Philosophy of Natural and Social Sciences where she focuses on the nature of episodic memory. She is also involved in the philosophy of biology, where she works on how to count organisms in tricky cases like conjoined twinning, parasitism and pregnancy. Beyond episodic memory, Dr. Boyle has written about self-recognition, self-awareness and mindreading in animals, and more general methodological issues in animal cognition research. She is especially interested in areas where scientists disagree sharply about nonhuman minds, despite having access to the same evidence.

Dr. Ali Boyle received her BA, MPhil and PhD in Philosophy from the University of Cambridge. She is currently an Assistant Professor in Philosophy at the LSE's Department of Philosophy, Logic and Scientific Method.

PUBLICATIONS:

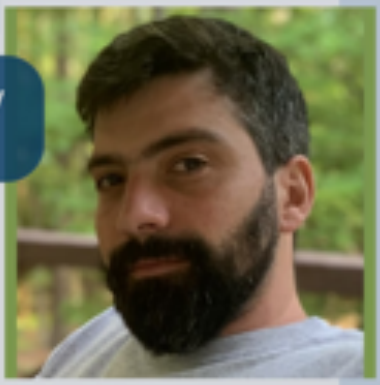
Boyle, A. (2021). The Mnemonic Functions of Episodic Memory. *Philosophical Psychology, 35*(3), 327-349.

Boyle, A. (2020). The Impure Phenomenology of Episodic Memory. *Mind and Language, 35*, 641-660.

Boyle, A. (2022). Do Animals Have Episodic Memory? Current Controversies in Philosophy of Memory. In A. Sant'Anna, C. J. McCarroll, & K. Michaelian (Eds.), *Current Controversies in Philosophy of Memory* (pp. 189-205).

Felipe De Brigard

Duke University



Dr. Felipe De Brigard is a philosopher of the mind with emphasis in cognitive psychology and neuroscience. His work attempts to understand how prior experience helps to constrain the way in which we reconstruct episodic memories. He has investigated ways in which episodic memory both guides and constrains episodic counterfactual thinking and how this interaction affects the perceived plausibility of imagined counterfactual events. He has also studied the differential contribution of episodic and semantic memory in the generation of different kinds of counterfactual simulations, as well as the effect of counterfactual thinking on the memories they derive from.

Dr. De Brigard earned his PhD from the University of North Carolina - Chapel Hill and was a postdoc at Harvard University. He is currently the Fuchsberg-Levine Family Associate Professor of Philosophy, Associate Professor in Psychology & Neuroscience, and Core Faculty at the Institute for Brain Sciences and Center for Cognitive Neuroscience at Duke University, where he also leads the Imagination and Modal Cognition lab.

PUBLICATIONS:

Khoudary, A., O'Neill, K., Faul, L., Murray, S., Smallman, R., & De Brigard, F. (2022). Neural differences between internal and external episodic counterfactual thoughts. *Philosophical Transactions of the Royal Society B: Biological Sciences, 377*(1866).

De Brigard, F., Umanath, S., & Irish, M. (2022). Rethinking the distinction between episodic and semantic memory: Insights from the past, present, and future. *Memory & Cognition*, *50*(3), 459–463.

Christian Leibold

University of Freiburg

Dr. Christian Leibold focuses on the study of memory formation through data analysis and theory building. He is interested in the research areas of learning and memory formation in the mammalian hippocampus, neural basis of spatial hearing and statistical analysis and modeling of spatiotemporal neural activity patterns. Dr. Leibold's research group uses data analysis and models, to correlate, data from different measurement methods in order to combine their advantages. Some of his current research areas are focused on the low-frequency binaural system which encodes the position of a sound source by means of interaural time differences, and on the neural network interactions to offer insights on how the hippocampus and related brain areas such as the entorhinal and medial prefrontal cortices wire up to perform the computations necessary for representing, memorizing, and planning trajectories in space.

Dr. Leibold completed his diploma, PhD and postdoc at TU Munich. He is currently the Professor of Theoretical Systems Neuroscience at the Faculty of Biology, Bernstein Center, Freiburg.

PUBLICATIONS:

Yiu, Y.H., & Leibold, C. (2023). A Theory of Hippocampal Theta Correlations. *bioRxiv 2023.02.05.527133*

Yiu, Y.H., Leutgeb, J.K., & Leibold, C. (2022). Directional Tuning of Phase Precession Properties in the Hippocampus. J *Neurosci., 42*(11), 2282-2297.

Leibold, C. (2020). A model for navigation in unknown environments based on a reservoir of hippocampal sequences. *Neural Netw., 124,* 328-342.

Ken Norman

Princeton University

Dr. Ken Norman is the Huo Professor in Computational and Theoretical Neuroscience, Chair of the Department of Psychology, and co-Director of the NIMH-supported Quantitative Neuroscience Training Program at Princeton University. He received a BS in Symbolic Systems from Stanford University in 1993 and a PhD in Psychology from Harvard University in 1999. Prior to taking his faculty position at Princeton in 2002, Norman was a postdoctoral researcher in Randall O'Reilly's lab at the University of Colorado, Boulder.

Dr. Norman is a fellow of the Association for Psychological Science and the Society of Experimental Psychologists. Norman's lab develops computational models of human learning and memory and tests the predictions of these models using neuroimaging and electrophysiology data; for more information on the lab, see https://compmem.princeton.edu.

PUBLICATIONS:

Lu, Q., Hasson, U., & Norman, K. A. (2022). A neural network model of when to retrieve and encode episodic memories. *ELife*, 11.

Beukers, A. O., Buschman, T. J., Cohen, J. D., & Norman, K. A. (2021). Is activity silent working memory simply episodic memory? *Trends in Cognitive Sciences.*

Peggy St. Jacques

University of Alberta

Dr. Peggy L. St. Jacques is a cognitive neuroscientist whose primary research focus is understanding memory for events, including autobiographical experiences from one's personal past and realistic experiences encoded in a more controlled setting. In particular, she is interested in how long-term representations of memory are modified via retrieval related mechanisms and the influence of visual perspective on memory encoding and retrieval.

Dr. St. Jacques received her PhD from Duke University, and her postdoctoral training at Harvard University. She is currently an Assistant Professor and Canada Research Chair in Cognitive Neuroscience of Memory in the Department of Psychology at the University of Alberta, where she is also the director for the Memory for Events lab.

PUBLICATIONS:

St. Jacques, P. L. (2023). Perspective matters: When visual perspective reshapes autobiographical memories. https://doi.org/10.31234/osf.io/x6eq8

St. Jacques, P. L. (2023). An original perspective: Individuals with an absence of observer-like perspectives are less susceptible to memory reconstruction. https://doi.org/10.31234/osf.io/jvft8

King, C. I., Romero, A. S. L., Schacter, D. L., & St. Jacques, P. L. (2022). The influence of shifting perspective on episodic and semantic details during autobiographical memory recall. *Memory,* 1–13.

Maria Wimber

University of Glasgow

Dr Maria Wimber is a Professor at the Centre for Cognitive Neuroimaging (CCNi), University of Glasgow. Her work is at the intersection of Cognitive Neuroscience and Experimental Psychology, centred around the question how the human brain reconstructs memories of past events, and how these memories adaptively change over time and with repeated use. Her group uses behaviour, EEG/MEG, fMRI, and intracranial EEG to isolate the neural footprints of memories and track their dynamic changes over time. She is also interested in how brain oscillations, and in particular the hippocampal theta rhythm, help orchestrate the reactivation of memories.

Prof Wimber obtained her PhD from the University of Regensburg in 2008, working on the neural mechanisms of forgetting. Following two postdocs, one at the University of Magdeburg and one at the MRC Cognition & Brain Science Unit in Cambridge, she took up a tenure-track position at the University of Birmingham in 2013, before moving to sunny Scotland in 2020.

PUBLICATIONS:

Kerrén, C., van Bree, S., Griffiths, B.J., & Wimber, M. (2022). Phase separation of competing memories along the human hippocampal theta rhythm. *eLife* 11:e80633.

Lifanov, J., Linde-Domingo, J., & Wimber, M. (2021). Feature-specific reaction times reveal a semanticisation of memories over time and with repeated remembering. *Nature Communications, 12*, 3177.

Linde-Domingo, J., Treder, M.S., Kerren, C., & Wimber, M. (2019). Evidence for a reversal of the neural information flow between object perception and object reconstruction from memory. *Nature Communications, 179*, 10.

Aya Altamimi
Juan F. Alvarez
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Nikola Andonovski
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Francesca Righetti
Gerard John Rinkus
Eleanor Spens
Tyler Sproule
Peggy St. Jacques
Roni Tibon
Volker Tresp
Maria Wimber
Xiangshuai Zeng

3 ABSTRACTS - TALKS

Aya Altamimi

Ruhr University Bochum, Germany

Effects of social interactions on generative episodic memory

Social interactions, such as conversations with others who were present during an event, can provide valuable cues and information that can integrate bias and lead communicators to recall the past event in a way that is congruent with the audience's judgement. This study suggests a model of generative episodic memory that addresses the phenomenon of shared reality bias in the recalled memories and shows that errors or distortions in memory, particularly if there is epistemic trust or a shared reality between a communicator and an audience, can have a direct impact on the legitimacy of the recalled memory. The communicators' own memories for information can become biased towards the audience's attitudes after tuning their message to suit the audience. This results in an audience-congruent memory bias, where their recall of the original information is influenced by the biased view expressed in their message. The model reflects that motivational circumstances of message production induces bias that is greater when audience tuning serves the creation of a shared reality, compared to when it serves alternative goals such as being polite, obtaining incentives, being entertaining, or complying with a demand. The model further shows that this effect is mediated by the communicators' epistemic trust in the audience's congruent view, rather than other factors such as rehearsal, accurate retrieval, or the ability to discriminate between original and message information.

We present a model of the generative aspects of episodic memory, that contributes to a deeper understanding of the interplay between episodic memory and semantic information in the generative process of recalling the past and how social interactions can have a direct impact on that. It is based on the central hypothesis that the hippocampus stores and retrieves selected aspects of an episode as a memory trace, which is necessarily incomplete, and can have multiple traces of memory at each time step. At recall, the attractor of these multiple memory traces is retrieved, and the neocortex reasonably fills in the missing parts based on general semantic information and social interaction bias in a process we call semantic completion. The model combines two neural network architectures known from machine learning, the vector-quantized variational autoencoder (VQ-VAE) and the bidirectional encoder representations from transformers (BERT). As episodes, we use images of

digits and fashion items (MNIST) that are ambiguous in a sense that each digit can be mistaken between two digits. The model is able to complete missing parts of a memory trace in a semantically plausible way that also reflects the context in which these memory traces were saved.

Juan F. Alvarez

Université Grenoble Alpes, France

Remembering and relearning: A compatibilist view

At least to a first approximation, remembering involves encoding, storing, and retrieving information about personally experienced events. Relearning involves encoding, forgetting, and re-encoding information about personally experienced events. Martin and Deutscher (1966) viewed remembering and relearning as incompatible. This view—call it "incompatibilism"—is widely endorsed in philosophy of memory. It is endorsed by causalists (Bernecker 2010), simulationists (Michaelian 2016a), and functionalists (Fernández 2019) alike. In this paper, I argue for two claims. First, incompatibilism is a dogma; that is, it is a view held by philosophers without any proper argument supporting it. Second, "compatibilism", the view that remembering and relearning are in principle compatible, is a preferable option.

I argue that incompatibilism is a dogma in §1. While philosophers endorse incompatibilism, there is no proper argument for this view in the literature. Incompatibilism is rather an intuition that has motivated the construction of the causal theory of memory. In short, the intuition is that the causal-aetiological requirements of remembering are incompatible with relearning. Based on this intuition, causalists analyze remembering in such a way that cannot possibly co-occur with relearning. However, since it is unclear whether this intuition is universal and there is no other argument for the view, incompatibilism is a substantive claim in need of closer examination.

In §2, I argue for compatibilism by advancing three conditional arguments. I argue that compatibilism follows if certain empirically-oriented theories of memory are right. First, if the causal theory of constructive memory (Robins 2016; Sutton and O'Brien 2023) is right, then memory traces are distributed event features. Importantly, if traces are distributed event features, then the causal history of remembering

that makes it incompatible with relearning does not always obtain. Second, if trace minimalism (Werning 2020) is right, then vicarious experiences can ground remembering. Once one accepts the possibility of vicariously grounded remembering, one must also accept that "vicarious memories" (Pillemer et al. 2015) and indeed some cases of relearning constitute instances of genuine remembering. Third, if the simulation theory of memory (Michaelian 2016b) is right, then memories can be formed on the basis of non-experiential sources. If non-experiential remembering is possible, the compatibility between remembering and relearning is also a serious possibility.

Of course, for those who reject these theories of memory, these three arguments may be unconvincing. To provide a more persuasive argument, I discuss empirical work on "distributed memory" (Sutton et al. 2010) and "collaborative remembering" (Meade et al. 2018) in §3. The basic idea is that this work is part of a well-established research program in psychology in which the very distinction—let alone the question of (in)compatibility—between remembering and relearning plays no role.

In §4, I sketch some consequences of compatibilism for two debates in philosophy of memory: the causalism-simulationism debate and the memory error debate. If compatibilism is right, then, on the one hand, causalism rests on shaky ground and, on the other, taxonomies of memory errors that include relearning are mistaken—pace Robins (2020).

Géza Gergely Ambrus

Bournemouth University, UK

Exploring generalizability in recognition memory signals through multivariate cross-classification

This talk will present a series of studies that explored memory processes, investigating the spatio-temporal dynamics of neural signals of successful memory retrieval. The overarching goal of this research was to better understand the commonalities in mnemonic processes, and how their neural correlates unfold over time, using multivariate cross-classification across EEG datasets. Cross-dataset classification is a data-driven technique that involves training machine learning classifiers on data from one dataset and testing it on data from a different dataset to examine how neural representations of different cognitive processes generalize across different experimental conditions or tasks.

The first set of studies examined the neural correlates of face learning and recognition, and specifically, the role of the type of familiarization (perceptual, media, and personal) in the emergence of neural signals of familiarity. All three datasets yielded significant cross-classification effects, mainly in the right hemisphere between 270-630 milliseconds after stimulus onset, suggestive of general neural indicator of face familiarity, independent of the specific familiarization methods, participants, and stimuli used. Further analyses revealed that neural patterns for passive viewing of personally familiar and unfamiliar faces were useful in decoding familiarity in a matching task where familiarity was attained through a short perceptual task. This indicates that the visual processing of personally familiar and purely perceptually familiarized faces involves similar mechanisms, the neural correlates of which can be decoded across different experimental paradigms. Expanding upon this research, the spatio-temporal properties of the shared familiarity signal for faces were explored. These analyses found that the general face familiarity signal is present for long-term personally familiar faces under passive viewing, as well as for acknowledged and concealed familiarity responses. Importantly, a differential modulation of the signal in the 200–400 ms and the 400–600 ms was observed.

The second set of studies aimed to investigate the extent to which the face-familiarity signal, observed in the previous investigations, could be generalized to non-face stimuli. When training was performed on non-face datasets, an early (around 200-300 ms) to late (post-400 ms) differentiation was found. Successful cross-classification for non-face stimuli (music and object/scene associations) was most pronounced in the late period. Additionally, a striking dissociation between familiar and remembered objects was seen, with shared signals present only in the late window for remembered objects, while cross-classification for familiar objects was successful in the early period as well. These findings suggest that late neural signals of memory retrieval generalize across sensory modalities and stimulus types, and the dissociation between familiar and remembered objects may provide further insight into the underlying processes.

In summary, this research program demonstrated the existence of a generalizable neural signal of recognition memory that transcends variations in tasks, modalities, and stimulus types. The use openly available data has been critical for this work, facilitating the pooling of diverse datasets across studies. These results illustrate the potential of

multivariate pattern classification analysis as a robust technique for exploring the shared cognitive mechanisms underlying memory processes.

Nikola Andonovski

Université Grenoble Alpes, France

Engrams as mental files

The revival of engram research (Tonegawa et al. 2015; Poo et al. 2016; Josselyn & Tonegawa 2020) has coincided with a renewed philosophical interest in the nature of singular reference in remembering (Debus 2014; Perrin 2019; Andonovski 2020). In this paper, I examine this research through the lens of mental files theory (Jeshion 2010; Recanati 2012, 2016). I argue that engrams can be characterized as mental representations with file-like properties, anchoring the capacity for singular reference in remembering. Structurally complex, engrams have a dual function: (1) they secure reference to entities in the environment through non-descriptive (typically: causal) relations; (2) they store information about the attributes of these entities, affording co-predication. Evidence for the proposal comes from the study of mechanisms underlying engram storage and access. Synaptic plasticity has been shown to play a causal role in the formation and behavioral expression of memories (e.g. Nabavi et al. 2014; Xiong et al. 2015). Yet, a number of studies have reported dissociations between memory storage and synaptic integrity (e.g. Chen et al. 2014; Ryan et al. 2015). Moreover, there is now a wealth of evidence for the hypothesis of intra-cellular storage (reviewed by Gershman 2023), leading theorists to restrict the role of synaptic strength to engram encoding and retrieval (Languille & Gallistel 2020; Josselyn & Tonegawa 2020). On the view proposed here, engrams are structurally complex representations, with patterns of strengthened synaptic connections constituting points of access to information stored inside engram cells. Singular reference to entities in the environment is determined relationally and not satisfactionally — via the formation of stimulus-specific patterns of synaptic connectivity. Yet, information about the entities, gained through such “epistemically rewarding” channels (Recanati 2012), is stored inside engram cells. In normal circumstances, the activation of an engram-file involves reinstatement of a specific connectivity pattern, which then triggers access to information about the entity associated with the file. Engrams, in other words, are activated

independently of their descriptive content. This affords information updating — e.g. in cases of reconsolidation and integration (Lee et al. 2017; Schlichting & Preston 2015) — while referential stability is maintained. Integrating evidence from a variety of sources, the engram-as-files hypothesis provides a functional account of "semantic coordination" in memory (Fine 2007), and it does so without recourse to the "metaphorical" aspects of mental files theory (Goodman & Gray 2020).

Zoltan Apa, Florence Requier, Mohamed Bahri, Christophe Phillips, Fabienne Collette

Université de Liège, Belgium

Comparison of representational similarity of episodic memory traces at encoding and retrieval in younger and healthy older adults

Relevant questions of advanced functional Magnetic Resonance Imaging (fMRI) aging studies are lately rather focusing on the investigation of neuronal activity patterns across voxels between younger and older adults. Multivariate Pattern Analyses (MVPA) approaches are gaining ground for the investigation of neural activity by employing voxel-by-voxel variability assessment to explain cognition. One of the MVPA approaches reffered to as Representational Similarity Analysis (RSA) is a relatively novel technique to assess neural pattern similarity across distinct experimental conditions.

For our episodic memory/recognition study aiming to disentangle memory performance differences, if any, between older and younger adults, we have used RSA among age groups and conditions. Fifty-five young (28 men; M age = 23.47 years old; SD = 3.12; range = 18-30) and 45 older (19 men; M age = 67.37 years old; SD = 4.9; range = 60-75) participants were selected from a larger cohort which underwent an fMRI recognition memory task / episodic memory task.

The procedure began with an incidental learning paradigm. During encoding phase participants were successively presented once (hard condition), or twice (easy condition) pictures representing objects, and were asked to determine whether the presented object would fit in a shoebox. During the retrieval phase, participants were presented randomly shuffled previously seen and never seen/new pictures and were

tasked to determine if the object was previously presented [remember (with some contextual detail) / know (without contextual information) /new (unstudied/never presented picture) paradigm].

Employing MVPA searchlight technique, encoding and recognition neural pattern maps were created for each subject and each picture individually, for both study phases. Using RSA we have computed pattern similarity during encoding and retrieval phases for a single image (item level). Then, we have computed pattern similarity of one image at encoding phase and the average activity for the remaining images during recognition phase (set level). Our design matrix consisted of 100x100 elements (similarity values) at item and set levels. Further, neural similarity patterns were analyzed at the level of remember/know responses, item/set level, respectively groups (older vs younger) level. Statistical analyses were conducted by using SPM12 ANOVA 2(Group older/younger) X 2(Level=Set/Item). Additional ANOVAs were carried out for remember/know responses.

At the brain level, larger encoding-recognition similarity patterns are observed in younger by comparison to older in brain regions processing visual characteristics (occipital pole) and embodied cognition (postcentral area). At remember/know level, results denoted reduced neural similarity patterns among older adults. At item/set level, we observed greater neural similarity patterns among younger adults.

Globally, between groups we observed higher similarity patterns among younger adults when compared to older adults. Our findings suggests that older adults' neural similarity patterns were reduced when compared to younger adults. Lower encoding/recognition similarity values constantly observed among older adults indicate less specific reactivation of individual memory traces for pictures between encoding and recognition.

One possible explanation of the observed aging effect on recognition/performance is that poor visual and sensorimotor encoding processes results in less distinctive recognition memory traces.

Ali Boyle

London School of Economics and Political Science, UK

Is artificial episodic memory really episodic memory?

Episodic memory is memory for personally experienced past events – often characterised in terms of 'replaying' or 'reexperiencing' events in the mind's eye. Episodic memory's cognitive and evolutionary functions, as well as its distribution in the animal kingdom, have recently been subjects of intense debate in the philosophy and science of memory. Meanwhile, some striking recent advances in artificial intelligence have resulted from endowing artificial agents with something resembling – and inspired by – episodic memory. Might these artificial episodic memory architectures inform the ongoing debates about episodic memory's functions and distribution? In this talk, I'll develop a framework for addressing that question, and defend a (cautiously) affirmative answer.

Johanni Brea[1], Nicolas S. Clayton[2], Wulfram Gerstner[1]

1: EPFL, Switzerland; 2: Cambridge University, UK

Modelling episodic-like memory in food caching birds

Is episodic memory uniquely human or are there good animal models? Although the behaviour of food caching birds clearly indicates that they can store and recall the what, where and when of experiences, it is unclear if their episodic-like memory system is generative and allows mental time-travel. Indeed, we show with a computational model that the results of 28 behavioural experiments with food-caching birds are explainable without mental time-travel: the birds' behaviour is reproducible with reward-modulated updates of retrieval and caching policies and an associative neural network for remembering caching events with a memory consolidation mechanism for flexible decoding of the age of a memory [1]. We discuss different possibilities for how this memory consolidation mechanism could be implemented [2]. Although this simple model is sufficient to explain the observed behaviour, it does not rule out the possibility of a more generative episodic-like memory system. We show that the experimental data is also consistent with a

model that uses replay from memory and planning to help decision-making. We do not yet have, however, a detailed hypothesis for how this model could be implemented in neural circuits, but the algorithmic description of this model illustrates three problems that a neural implementation of mental-time travel for planning needs to solve: first, what is stored in memory, second, how the memory is queried, and third, how replayed episodes are used for decision-making.

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A contextualist view of episodic memory's accuracy

Episodic memory (henceforth, 'memory') has communicative and epistemic functions. The notion of success and, consequently, of accuracy, should not be detached from these functions. I will argue that, in virtue of this connection, memory's accuracy is context-sensitive. This means that besides being true/authentic/faithful, memory should also be appropriate to the context of retrieval.

I take Werning and Liefke (forthcoming) as a model. In their view, the content of a memory is parasitic on the experiential world by using a topic (referent, from the host world) and comment (predicate related to the topic, from the parasite world). Since the parasitic, experiential and actual worlds are conceptually distinct, the memory of a real event is completely accurate when the topic existed in the actual world (satisfying the existential import presupposition), the comment is satisfied by the topic (satisfying the congruence presupposition), and the memory/host-world is identical to the experience/parasite-world (satisfying congruence).

Considering involuntary memories, Werning and Liefke's proposal is plausible. However, in many other contexts, merely satisfying Werning and Liefke's criteria is not sufficient for success/accurate because the representation must be appropriate to the context, satisfying communicative or epistemic functions. For example, suppose S

remembers a car accident. S remembers how car a crossed the street and hit car b. Suppose that the collision happened as it is represented in S's memory. Therefore, Werning and Liefke's conditions are satisfied. However, if we suppose that S is demanded in court to remember the signal of a nearby traffic light at the moment that car a crossed the street, S's memory could instead be deemed inaccurate. One might argue that this would then be a different memory. Nonetheless, on Werning and Liefke's account, a memory represents an informationally complex scene. The item of requested information could be in that same remembered scene and—in the case of being different from the actual world—the memory would be inappropriate (and, therefore, inaccurate) to the context of its retrieval.

Agreeing that memory is informationally complex, I will argue that the topic and comment are selected by attentional focus at the moment of retrieval. Thus, among the data of the complex scene, the retrieval context guides the selection of what is more important (appropriate) for evaluating memory's accuracy. A coherence between encoding and retrieval's attentional focus may occur in involuntary and other memories, but retrieval attentional focus is the one required for accuracy due to the constructive character of memory, especially given its communicative and epistemic functions.

I will end the talk by dealing with an objection according to which epistemic and empirical memory are different phenomena and, since Werning and Liefke purport to explain empirical memory, using communicative and epistemic roles of memory to argue about its accuracy is misguided. In response, I argue that they are not different phenomena and provide evidence for this claim.

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The developmental trajectory of recognition memory: Electrophysiological and behavioral evidence for distinct but complementary roles of semantic elaboration and perceptual binding during episodic memory encoding and retrieval in children, adolescents and young adults

The development of episodic memory in children is far from understood. Children acquire vast amounts of semantic information, although many cortical areas recruited for these cognitive operations in young adults have not reached functional maturity. Moreover, little is known about the cognitive processes supporting memory across development, for instance at what age children start to consider semantic information along with perceptual item features when forming or retrieving episodic memory traces. Comparable behavioral performance might be based on at least partially distinct cognitive processes, as indexed by ERPs or neuronal oscillations. Specifically, children's performance difficulties during complex memory tasks might reflect failure to monitor response conflict rather than memory development per se. Here, we investigated subsequent memory effects (SMEs) in young (aged 7-8 years) and older children (aged 10-11 years) and young adults using both neural oscillations and event-related potentials (ERPs). Participants explicitly encoded colored line-drawings of every-day objects and indicated (a) which colors were more frequent in the pictures (shallow perceptual task) or (b) whether those objects would fit into a shoe box (deep semantic task). During perceptual encoding, an increased theta activation over mid-frontal electrode sites predicted later successful retrieval of item features across age groups. By contrast, during the deeper semantic encoding task, only young children showed a comparable SME, suggesting that this age group does not flexibly adapt their encoding mechanisms to specific task demands. Older children showed a left (anterior-)frontal SME during item presentation, complemented by a second midfrontal theta modulation leading up to responses in the orienting task. In young adults, we observed only the latter effect, in line with monitoring of response conflict. ERPs revealed age-specific subsequent SMEs in item memory: a midfrontal negativity during item onset predicted successful item memory, in line with attentional

fluctuations. For both groups of children, the critical time period was the offset of item presentations at 1000 ms: a bilateral prefrontal SME was observed for older children in line with ongoing semantic elaboration, whereas a centro-parietal positivity was observed in young children. Together, these results point to qualitative rather than quantitative changes in the cognitive processes critical for later item and feature memory. Replicating and extending earlier findings, we demonstrate that semantic, but not perceptual encoding shows a prolonged developmental trajectory.

Nathália de Ávila

Universität zu Köln, Germany

From procedural memory to the phenomenological lived body: what does "reconstruction" mean in a 4E approach of emotional remembering?

Enactivism and conceptual engineering presuppose what is most fundamentally philosophical about things: that they vary according to context. Behavior, cognition, and concepts change and are shaped according to where and when they happen. In the case of remembering, a distinction between episodic and procedural memory barely seems to make sense within the framework of embodied cognition. Simulative imagining can be explained through perceptual re-enactment as embodied happening. Here episodic recall is explained by attunement with perceptual features of past events through simulating patterns of response that would be activated in situations in which the perceptual object is a present one. As this process is not explained by content (Caravà, 2020), this probably implies the dissolution between procedural and episodic memory as distinct notions. Reconstruction would mean denying the existence of memory traces here.

However, I claim, understanding the body as a merely sensorimotor entity makes radical enactivism less radical than it should. Enactive emotions rely on the phenomenological lived body. Gallagher (1986) shows the example of Dr. Penfield applying an electrode to a patient's cortex and that causes a tingling foot, which represents an immediate change in the lived body, which is always reorganizing itself through physiological responses to stimuli as soon as they happen. Though the example concerns the foot movement specifically, the notion of lived body

shows how no bodily function could be in a specific body region, because diverse movements follow the action of diverse mechanisms in the organism all the time. Because memory itself triggers numerous bodily reactions simultaneously (Berntsen, 2009), it is easy to see that the brain does not have to be the privileged place where rememberivassilisng happens. In simpler terms: those bodily reactions can simply be remembering rather than caused by remembering. Fuchs' taxonomy of embodied memory (2003) also sustains this affirmation by examining habitual inclinations of the lived body that represent the subject-world connection through an operative intentionality (i.e. threads that have been already formed in our earliest contacts with the world).

Given those presuppositions, I engineer/prescribe four concepts of enactivist emotional memories based on:

1. How affect dynamics (i.e. the temporal unfolding of emotional events) and sense-making play a role in a definition of emotion as embodied appraisals.
2. How the phenomenon of emotional inertia, studied by N. Fridja (2007), serves as evidence for claiming that memory recreates a past affective interaction in the present with the same past embodied appraisal using what is now contextually available. Those can conceptually become four different kinds of emotional memory obeying this same principle.

To conclude, I claim that reconstruction is the present articulation of an emotionally-loaded past ocasion similarly appraised then and now, that is bodily given in remembering. In this sense, what also is reconstructed here is the divide between analytic and continental philosophy, which for a 4E Cognition scholar makes even less sense than distinguishing episodic from procedural memory. The enactivist mindset is deeply rooted in classical phenomenology.

Felipe De Brigard

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Reconstructive memory as reverse inference

In the philosophy of memory, it is now common to contrast casualist accounts of memory with simulationist views. This is because simulationist accounts do not have a direct causal link between the experienced and the remembered episodes. Memory, it is said, is

reconstructive, not reproductive. In this talk I argue that this is a false dichotomy. One can be a simulationist and hold a causal role of the experienced episode in retrieval. To do so, however, we need to clarify what it means for memory to be reconstructive. I argue that reconstruction is best understood computationally as a variant of reverse inference.

Catarina Gouveia Gaglianone, Karri Gillespie-Smith, Matthias Schwannauer

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Can virtual nature scenes stimulate positive imagination? A proof- of concept study

In the past few years, the number of individuals with depression and anxiety has increased. It is now a major global concern. Research has identified that individuals with depression and anxiety have deficits in producing, engaging and vividly visualising positive prospective mental imagery. Negative mental imagery increases and maintains the individual's symptoms of depression and anxiety more than verbal thoughts. Nevertheless, positive mental imagery and soothing media have been shown to stabilise and improve mood. Thus, finding ways for individuals with depression and anxiety to engage with soothing media and positive prospective mental imagery is paramount. The study aims to address the following question: Will those with traits of depression and anxiety more easily produce and have more vivid positive prospective visual imagery after experiencing a virtual soothing immersive environment compared to soothing videos displayed on a desktop? The current proposed study will employ a repeated-measure cross-over design. The participants will be recruited from the general population (N = 40). There will be four conditions: two control and two experimental. In the experimental conditions, participants will watch two 10-minute-long videos, one in a virtual, semi-immersive(180-degree) setting using the Oculus Quest VR headset and the other on a desktop setting (PC).

In between conditions, participants will be asked the following:

- To complete a battery of self-reported questionnaires,
- To imagine a mental image based on or inspired by the soothing scenes,

- Imagine a spontaneous scenario of their choosing that is not based on any stimuli, and
- The participants will be enquired about their ability (how difficult it was) to produce the mental image and how vivid the imagined scenario is.

Finally, the interested participants will be asked to keep a diary for a week to note any potential positive mental imagery they experience in the week after the study.

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Enhancing recall with imperceptible gamma-band sensory stimulation

Spikes in gamma-band activity (30-100Hz) coincide with the successful recall of episodic memories, but it remains unknown whether these bouts of gamma activity are a cause or a consequence of the retrieval process. If the former is true, then it would open the door to an array of gamma-focused memory interventions. To explore this idea, we integrated gamma-band sensory stimulation into a paired associates memory task. In Experiment 1 (n=34), 65Hz sensory stimulation significantly enhanced recall above a baseline condition where no sensory stimulation was applied. Notably, only a single participant could differentiate the 65Hz and baseline conditions, suggesting 65Hz visual stimulation was imperceivable to the vast majority of participants. Experiment 2 (n=29) directly replicated these effects, demonstrating that 65Hz sensory stimulation acts as an imperceptible intervention to enhance recall. The absence of a similar memory-enhancing phenomenon when using other stimulation frequencies (i.e., 43.3Hz) or when stimulating during encoding suggests that it is a retrieval-based process that is sensitive to 65Hz stimulation. In sum, these results suggest that gamma-band sensory stimulation acts as an imperceptible intervention that can augment recall in human participants. They may also help establish a causal role of gamma-band activity in human episodic memory.

Christian Leibold

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On intrinsic hippocampal sequences

In the hippocampus, sequence activity is expressed during sleep states, awake quiescence and locomotion and associated with as diverse functions as memory consolidation, memory formation, planning and navigation. Despite many attempts, there is currently no accepted model unifying the different types of sequence expression let alone their function. We suggest to distinguish between external, sensory-motor evoked sequence components reflecting the topology of space, i.e., sequences that reverse their direction upon reversal of the direction of travel, and intrinsic components that retain their correlation structure independent of behavioral state and independent of experience. We introduce a mechanistic computational model that explains the concurrent expression of both types of sequences and hypothesize intrinsic sequences to serve as a scaffold on which to build the cognitive map.

Kristina Liefke, Markus Werning

Ruhr University Bochum, Germany

Just Simulating? Semantic support for discontinuism

Work in neuroscience, psychology, and philosophy has found striking similarities between remembering past events and imagining future events (see, e.g., Schacter et al. 2007). However, this work has failed to decide the question -- framed as the continuism/discontinuism debate in philosophy -- whether episodic remembering is just a kind of imagining. Our talk contributes to the continuism/discontinuism debate by studying a previously neglected source of evidence for discontinuism: the truth-conditions of memory and imagination reports. The latter are sentences like (1) that ascribe an episodic memory or imagination to an agent.

(1) John {a. remembers, b. imagines} how a woman was dancing.

Our evidence for discontinuism stems from the observation that, although memory and imagination reports display a very similar

distribution behavior, they are true in different situations. This even holds for reports of past-oriented imagination (e.g. a variant, (2a-ii), of (1b) in which the referent of a woman is obtained at John's past visual scene from the park). Specifically, unlike the truth of (2a-i), the truth of (2a-ii) does not require that the woman was *dancing* in the park. Attendantly, (2a-ii) is already true in situations in which the woman's dancing results from generativity. This does not hold for the memory report (2a-i), which in such cases would require reformulation in terms of falsely remember or seem to remember (Robins 2020).

(2) Yesterday, John saw a woman at the park.

a. Now, John {i. remembers, ii. imagines} how she was dancing.

The truth-conditional difference between memory and imagination reports is also apparent in reports like (3a) whose embedded clauses contain multiple noun phrases (in (3): she [= a woman] and it [= a child]). While imagination reports allow that the referents of these phrases are obtained in different situations (e.g., in John's visual scene from the park, in the scene from John's dream, see (3a-ii); based on Blumberg 2019), memory reports reject multiple experiential sources (see the deviance, #, of (3a-i) in the context from (3)):

(3) Yesterday, John saw a woman at the park. Later, he dreamt of a child babbling.

a. John {i. #remembers, ii. imagines} how she was singing to it.

Imagination reports even admit that only some -- or none -- of the embedded noun phrases have a referent in a previously experienced scene (see (4)).

(4) John {a. #remembers, b. imagines} how the woman from the park was tangoing with some sailor (or other).

The above illustrates that the requirements on the experiential sources of memory and imagination reports are largely mutually exclusive. We take this observation as evidence for discontinuism: identifying remembering as a kind of imagining would fail to capture the intuitive truth-conditions of (1)–(4). Our talk will corroborate this claim by providing a semantics for episodic memory and imagination reports that captures these truth-conditions.

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Neural correlates of memory and imagination

If we close our eyes, most of us can vividly imagine events from our past or envision never-experienced scenarios set in the future. This type of mental imagery is supported by a key set of brain regions, including the hippocampus, ventromedial prefrontal cortex and visual-perceptual cortices. My research focusses on each region's precise contribution and about their dynamic interactions. Uncovering the neuronal basis of mental imagery offers crucial insights into experiential cognitive functions such as autobiographical memory, future thinking, and navigation, but is also important, for decision-making, emotion regulation and mind-wandering.

In my proposed talk, I will present hippocampal subfield contributions to autobiographical memory from structural and functional magnetic resonance imaging 7 Tesla fMRI. Furthermore, I present studies examining people who complain about their memory and imagination (i.e., due to Aphantasia, limbic encephalitis and various forms of neurodegenerative dementia).

My research suggests that autobiographical memory is crucially dependent on vivid mental imagery. Thus, in line with the constructive memory hypothesis, I propose that episodic autobiographical memory is re-constructed during the retrieval processes building upon visual perceptual details.

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Mnemonic effects of violated expectations: Electrophysiological correlates and a lifespan comparison

Our cognitive system internalizes statistical regularities from the environment and uses this information to make predictions about future events. However, these predictions may not always match incoming sensory information, thus giving rise to a prediction error (PE). Previous research has shown that events that elicit a prediction error can be better memorized than events that do not elicit a prediction error, presumably through enhanced encoding. In the current series of experiments, we aimed to (1) isolate electrophysiological correlates of mnemonic prediction errors and (2) to compare effects of prediction error on memory over the lifespan. Participants implicitly learned associations of visually presented object pairs over two days. On the third day, new objects were shown among the learned pairs, either after the first item of a pair (violating items), i.e., when participants would expect the second item of a pair, or between pairs (non-violating items), i.e., when participants could not make a prediction about the next object. Memory for violating and non-violating items was measured in a recognition test, which additionally comprised similar lures and completely new items. In Experiment 1, electroencephalography (EEG) was recorded on the third day, allowing us to measure brain activity both during encoding and retrieval of violating and non-violating items. Only younger adults (18-30 years old) participated in Experiment 1. We expected to observe a more pronounced P3 component for violating than for non-violating items during encoding, as well as stronger electrophysiological correlates of recollection for violating than for non-violating items. In Experiment 2, behavioral data from children (10-12 years old), younger adults (18- 30 years old), and older adults (66-70 years old) was collected in order to compare the effect of PE on memory over the lifespan. We expected to observe the effect to be greatest in children, followed by younger adults, and to be least pronounced in older adults. Contrary to our hypothesis, the behavioral data of both experiments did not reveal a systematic effect of

prediction error on memory, in none of the age groups. Older adults showed reduced pattern separation compared to the other age groups, and children showed a negative effect of prediction error for detecting similar lures. Preliminary EEG results suggest that recollection plays an important role for both violating and non-violating items. We conclude that the effect of prediction error on memory, as it was observed in younger adults in other studies, may not be as generalizable as previously thought. In addition, children's memory may in some cases even show an opposite effect.

Ken Norman

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Computational principles of real-world memory

Our ability to understand ongoing events depends critically on general knowledge about how different kinds of situations work (schemas), and also on recollection of specific instances of these situations that we have previously experienced (episodic memory); both of these types of stored knowledge affect which representations are currently active (working memory), which in turn shapes which memories are retrieved. While there is broad appreciation of the fact that task performance is shaped by interactions between multiple memory systems, extant computational models have characterized these interactions in a relatively narrow set of circumstances. As a result, the computational principles that govern these interactions in real-world settings are not yet clear: Given richly structured inputs, when do we store and retrieve episodic memory snapshots? How do we curate our library of schemas? How do our inferences about which schemas are relevant shape the contents of episodic memory and working memory, and how does episodic memory (in turn) shape these inferences? I will develop predictions about these interactions using memory-augmented neural network models that learn how to use multiple memory systems in the service of task performance, and I will present results from neural and behavioral studies in support of these predictions.

James Michael Openshaw[1,2]

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(In defence of) preservationism and the previous awareness condition: What is a theory of remembering, anyway?

I argue that the theories of remembering one finds in the philosophical literature—simulationist/functionalist, causalist, and epistemic—are best characterised as answers to questions posed at three distinct levels of inquiry.

(Q1) Under what conditions does remembering occur? (The psychofunctional question.)

(Q2) Under what conditions is there some event in one's personal past e such that one is remembering e? (The reference question.)

(Q3) Under what conditions is there some event in one's personal past e such that one is accurately remembering e? (The accuracy question.)

Simulationist (Michaelian 2016) and functionalist (Fernández 2019) views, whose focus is (Q1), are best seen as theories of psychofunctional process types. Causalist views (Martin & Deutscher 1966), whose focus is (Q2), are best seen as theories of referential remembering. Epistemic views (Hoerl 2022), whose focus is (Q3), are best seen as theories of successful remembering. Insofar as there is conflict between these theories, it is a conflict of integration rather than—as widely presented—head-on disagreement. In short, the leading theories of 'what remembering is' have, as their principal focuses, overlapping but crucially distinct subject matters.

This view of the landscape has two benefits. First, though it does not dissolve disputes about the nature of remembering by casting them as purely verbal, it clarifies the dialectical rules of engagement and illuminates a path to integration. Once these different projects are demarcated and held in view, we can move past seeing the theories as in direct competition, moving the debate forward by pursuing a harmony across these various levels of theorising.

Second, we can see two influential principles, the previous awareness condition and preservationism, as principles concerning reference and accuracy in remembering, respectively.

Previous awareness condition (PAC): One can remember some particular—an event, object, sensation, etc.—only if there is, in one's personal past, an experience in which one was aware of it.

Preservationism: One can remember some particular as having been F only if there is, in one's personal past, an experience in which one was aware of its being F.

Where either principle has been rejected (De Brigard 2014; Michaelian 2022), it is, I argue, due to arguments which slip between these different levels of theorising. PAC articulates a necessary condition for referential remembering. Preservationism articulates a necessary condition for accurate remembering. To say that successful remembering occurs only when these principles are met is not to say that the episodic memory system malfunctions when they are not met. These normative principles are perfectly compatible with constructivist theories of the psychological mechanisms that underpin remembering.

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Sofiia Rappe, Markus Werning

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Episodic memory and causal reasoning through counterfactuals

Over the past several years, there has been a shift in researchers' thinking about the functional role of episodic memory (Klein, 2013).

Rather than focusing on how memory represents the past, recent literature often presents memory as ultimately dealing with the future – helping the organism to anticipate events and increase its adaptive success (Suddendorf & Corballis, 2007). We claim that episodic memory does yield adaptive success because of its crucial role in causal reasoning. To causally rnicoleeason whether event A caused event B, the subject needs to cognitively evaluate a diachronic counterfactual of the following type:

1. If A had not happened at t1, B would not have happened at t.

Such counterfactuals require episodic memory for their evaluation because, according to Lewis (1973), counterfactuals of type (1) are true just in case:

2. The not-A world closest to the actual world (where A and B occurred) is also a not-B world rather than a B-world.

Current associative networks in AI struggle with diachronic temporal reasoning because these networks do not explicitly represent change but rather update representations as new information comes along (Hoerl & McCormack, 2019). Second, they learn by altering the weights/strength of connections through accumulating data over time. This approach significantly differs from human learning, which, in some instances, only requires single examples and allows rapid, radical re-evaluation of the causal relationships between events.

Our paper presents a causal inference model based on the predictive processing framework of brain functioning (Clark, 2013, 2015; Hohwy, 2013; Friston 2005, 2010; Rao & Ballard, 1999) and minimal trace account of episodic memory (Werning, 2020). According to our model, because of its truth condition (2), evaluating counterfactuals of type (1) involves a) episodic memory to construct a scenario of the past (Cheng, Werning, Suddendorf, 2016), b) negation of the target event A in that scenario, and c) evaluation of the closeness relation between the newly attained non-A scenario and the remembered scenario. For example, to understand that the fact that your train was 30 minutes late caused you to miss the flight (rather than a 10-minute queue at the airport), you need to simulate the world as it existed when you expected the train to arrive according to the plan (a). Then, you need to simulate a world where the train did not get delayed by negating that event in the respective scenario (b). Finally, using semantic knowledge, you let the scenario unfold in time and ask yourself whether you would still have missed the flight or not (c).

Jay Richardson

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Confabulation is a mnemonic phenomenon

Intuitively, confabulation can be defined as the post hoc creation of a narrative that serves to either justify or explain one's behaviour or thoughts. In attempting to explain confabulation, different strands of the philosophical and psychological literatures appear to adopt different starting points, and this along many different dimensions. One important divide stems from the question of the normality of confabulatory episodes. Some authors view confabulations as faulty outputs of an episodic memory system (e.g. Robins, 2019), or as involving the violation of some epistemic norm(s) (e.g. Hirstein, 2005). Others suggest that confabulations are beneficial outputs of an adaptive psychological process (e.g. Bortolotti and Cox, 2009; Cushman, 2020; Bergamaschi Ganapini, 2020).

I propose to investigate this divide through the lens of the following question: do the relevant empirical data suggest that there is a psychological mechanism that systematically outputs confabulations under the right conditions? I argue that the empirical literature, on the whole, suggests that the most viable candidate for a systematic confabulation producing mechanism is mnemonic in nature. Indeed, the findings having to do with the generation of false memories (e.g. Loftus & Pickrell, 1995) are much more valid, both externally and internally, than those that suggest that confabulation is a more general phenomenon related to belief formation (e.g. Nisbett & Wilson, 1977; Haidt et. al., 2000).

Furthermore, the proposed empirical argument can help illuminate other questions relating to the nature of confabulation. First, and most clearly, it militates in favour of mnemonic views over epistemic ones. Second, it suggests that we ought to investigate different kinds of memory distortions in order to find the essential features of confabulation, including its (ab)normality. Finally, it can help us cut to the heart of the debate between causal and simulationist theories of confabulation in the philosophy of memory (e.g. Bernecker, 2017; Michaelian, 2018; Robins, 2019). Namely, it affords us a clearer picture of the degree to which

episodic memory is generative, and how each theory of memory can handle said generativity.

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The Embodied Resonance in Episodic Memory

This paper aims to investigate the domain of embodied consciousness in episodic memory from a phenomenologically-informed perspective. Tulving (1985) identified episodic memory with autonoetic consciousness: a form of consciousness that involves the simulative re-enactment of the previous events; and distinguished it from procedural and semantic memory (identified, respectively, with anoetic and noetic consciousness). As Werning and Cheng (2017) pointed out, doubts are emerging about such a strict correspondence between different levels of consciousness

and certain kinds of memory. I will argue that different levels of consciousness are involved in episodic memory: consequently, the previous identification is not sustainable within a phenomenological analysis.

In this paper, I aim to discuss the spectrum of embodied dimensions in consciousness, right in virtue of the simulative nature of episodic memory. Contemporary phenomenological discussions on the 'embodied' state of consciousness usually concern the perceptual experience, by using the notion of the "lived body". The latter lingers in the background of our consciousness and implies a pre-reflective self-awareness of our cognitive states: a minimal, implicit, and non-thematic form of being aware (Zahavi, 2003). Recently, Geniusas (2022) has pointed out that classical phenomenologists were inclined to discuss different modes of pre-reflective self-awareness, involved also in phenomena such as dreaming, imagining, and remembering. For the latter case, Geniusas argues that together with the thematic object of the mnemonic content, any act of recollection is also an implicit recollection of the whole past consciousness, namely including the lived body and embodied consciousness of past experiences.

However, psychological and philosophical literature has emphasised that it is difficult to sustain that the evolutionary role of episodic memory is a faithful replay of our previous consciousness, rather it involves a reconstructive process of simulative scenarios developed to inform future behaviour (Suddendorf and Corballis, 2007). I argue that, if we follow Geniusas in discussing different modes of consciousness, then it would be possible to explain the experiential richness of constructed episodic scenarios of the past (Cheng, et al., 2016; Peeters, et al., 2022) as a multiplication of modes of pre-reflective self-awareness: consequently, an overlap of embodied experiences (simulative and not) that is correlated with different levels of mnemonic immersion. Building upon the discovered relationship between the lived body and pre-reflective self-awareness (Legrand, 2006), I argue that only the operative intentionality (generally understood as our practically-oriented encounter with the world) involved in the grounding experience is re-enacted during constructed episodic scenarios of the past.

More specifically, in episodic memory, the re-enactment of the operative intentionality is both embodied and simulative. Psychological studies and experiments support the previous claim. In fact, they share not just the involvement of the lived body, which implies the sequential re-

enactment of kinaesthetic movements (such as moving hands and eyes in retrieval, see Ianí, 2019 for a review); but also the simulation of the agential aspects of the pre-reflective self-awareness. Studies have shown that such mental simulations recruit motor processes and bodily representations in the brain (see Gallese and Sinigaglia, 2018), creating an "embodied resonance" of the previous experience.

Gerard John Rinkus

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Semantic memory as a computationally free side-effect of sparse distributed generative episodic memory

By generative model, we mean a model with sufficient parameters to represent the deep statistical structure (not just pairwise, but ideally, statistics of all orders present) of an input domain (in contrast to a discriminative model whose goal is to learn only enough information to classify inputs). These higher-order statistics include not just class information, but more generally, the full similarity structure, over the inputs, and constitute the basis for what we call semantic memory (SM). A generative model can be run "in reverse" to produce (in general, novel) plausible (likely) exemplars. By episodic memory (EM), we mean (typically, rich detailed) memories of specific experiences, which, by definition, are formed with single trials in the flow of the experience, apparently with no concurrent goal of learning the class of the experience, or even its similarity relations with other experiences. In a classical storage model of EM, where all inputs (experiences) are stored in full detail, all statistics of the input set are (at least implicitly) retained. This allows retrieval of the precise inputs, but also computations over the stored EM traces, in principle, producing any higher-order statistic of the input set, i.e., any output viewable as the operation of SM.

A key question is: how are the EM traces stored? If they are stored in localist fashion, i.e., wherein the traces of the individual inputs are disjoint, then any higher-order statistic must be computed either at retrieval time or sometime after storage and before retrieval. This "pre-computational" view is essentially consistent with the still-preponderant batch learning paradigm of machine learning. In either case, explicit computational work must be done to produce SM from EM, i.e., additional work beyond the work of storing the EM traces themselves. However, suppose instead that EM traces are stored in distributed fashion, and more specifically, as

sparse distributed representations (SDRs), i.e., each individual input is stored as a relatively small subset of coactive neurons [a kind of cell assembly (CA)], chosen from a much larger field of such. And suppose further that there exists an on-line, single-trial learning mechanism (algorithm) able to cause more similar inputs to be assigned to more highly intersecting SDRs [my prior work (1996, 2010, 2014) describes one, which is moreover not optimization based]. In this case, the (in principle, full) similarity structure over all the inputs is embedded in the intersection structure of the CAs in the act of storing each EM trace. In other words, no additional work beyond the work of simply storing the EM traces themselves is needed in order to produce the physical representations of the statistics that constitute SM. Thus, SM is physically superposed with EM and, crucially vis-à-vis explaining the efficiency of biological learning and cognition, SM is produced as a computationally free side-effect of the operation of EM. Depending on the specificity of subsequent cues, such a model can output verbatim memories (i.e., episodic recall) but allows for the type of semantic (similarity-based) substitutions (e.g., confabulations) that GEM wants to explain.

Eleanor Spens, Neil Burgess

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A generative model of memory construction and consolidation

Human episodic memories are (re)constructed, combining unique features with schema-based predictions, and share neural substrates with imagination. They also show systematic schema-based distortions that increase with consolidation. We present a computational model in which hippocampal replay (from an autoassociative network) trains generative models (variational autoencoders) in neocortex to (re)create sensory experiences via latent variable representations. These generative models learn to capture the probability distributions underlying experiences, or 'schemas'; this enables not just efficient recall, in which the model reconstructs memories without the need to store them individually, but also imagination (by sampling from the latent variable distributions), inference (by using the learned statistics of experience to predict the values of unseen variables), and semantic memory. Simulations using large image datasets reflect the effects of memory age and hippocampal lesions and the slow learning of statistical structure in agreement with

previous models of consolidation (Complementary Learning Systems and Multiple Trace Theory), but also build on generative models of perception and memory (e.g. Fayyaz et al., 2022) to explain imagination, inference, schema-based distortions, and continual representation learning in memory. Critically, the model suggests how unique and predictable elements of memories are stored and reconstructed by efficiently combining both hippocampal and neocortical systems, optimising the use of limited hippocampal storage. Finally, the model can be extended to sequential stimuli, including language, and multiple neocortical networks could be trained, including those with latent variable representations in entorhinal, medial prefrontal, and anterolateral temporal cortices. Overall, we believe hippocampal replay training neocortical generative models provides a comprehensive account of memory construction and consolidation.

Tyler Sproule

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Are traumatic memories episodic?

In his paper 'The remembered: understanding the content of episodic memory', Mark Rowlands argues that the content of episodic memory, while importantly non-propositional in its structure, is necessarily de se and subsumed under the 'mode of presentation' as-encountered-before. This is to say, the episode remembered is necessarily remembered as belonging to one's personal past. In what follows, however, I will first present a potential challenge to this claim by borrowing from research that aims to describe the content of traumatic memories (specifically the traumatic memories associated with Post Traumatic Stress Disorder). It has been proposed that the content of traumatic memories that characterize PTSD (what I will call PTSD memories) are described as precisely lacking the elements that Rowlands claims are necessary structural components of episodic memories. These memories, however, also appear, at least prima facie, to be recollections of episodes, and may themselves be instances of episodic memory. The contents of PTSD memories appear to be characterized by, contrary to Rowlands's account, the elements of nowness (as opposed to pastness), and as not belonging to one's personal past (as opposed to being de se). Thus, PTSD memories appear to be a direct counterexample to Rowlands' notion of episodic memory, presenting a special case of episodic memory that is both

untethered from the past, as well as from the identity of the individual having said memory.

This paper, then, will be divided into three sections. In section one I will present Rowlands' claims about the content of episodic memory. In section two I will present empirical findings concerning the content of PTSD memories, and argue that these findings, if accurate, pose a serious challenge to Rowlands' view of episodic memory. Finally, in section three I will argue that if we table metaphysical concerns about whether or not Rowlands has correctly captured the necessary content of episodic memory, we can put his description to practical use in more precisely characterizing effective therapies that lessen the distressing effects of PTSD memories.

Peggy St. Jacques

University of Alberta, Canada

Perspective matters: Remembering events from alternative viewpoints

Autobiographical memories are not veridical records of the personal past but instead can be retrieved in novel ways from how the past occurred, such as when people adopt alternative visual perspectives that differ from how events were originally experienced. Not only do we experience events from a particular visual perspective, we can also retrieve events from one of two perspectives: 1) an own eyes perspective, from the same viewpoint where the event was initially experienced, and 2) an observer-like perspective, where we might "see" ourselves in the remembered event. In this talk I will discuss how shifts in visual perspective during retrieval reveal the reconstructive processes that reshape our memories over time. I will describe evidence demonstrating that visual perspective alters subjective and objective characteristics of autobiographical memories and how these changes contribute to inconsistencies in how people describe the personal past. Then, I will show how posterior parietal regions support the ability to adopt different visual perspectives during remembering and how these regions differentially support reconstructive changes in memories. Finally, I will discuss the role of individual differences in the ability to adopt multiple visual perspectives and what this implies for reconstructive theories of memory. Together, these findings demonstrate that perspective matters in directing the generative processes that support remembering.

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Do activations and representations differ during successful retrieval from episodic vs. semantic memory?

The distinction between episodic and semantic memory is supported by a large corpus of neuropsychological studies. However, neuroimaging data show considerable overlap between brain regions that are involved in semantic and episodic processing. While this overlap might indicate similar processing, it might also result from confounded task designs. In this registered (accepted Stage 1) fMRI study, we aimed to distinguish retrieval of semantic and episodic memories using closely matched tasks, in which episodic and semantic processes are minimally confounded.

In our task, pictures of logos were paired with their corresponding brand's name and with an unrelated brand. Participants completed two paired-associate cued-recall tasks: in the episodic task, they studied unrelated logo-name pairs, and then viewed logos and recalled the associated studied brand. In the semantic task, a similar recall procedure ensued, but participants retrieved the associated brand from their prior knowledge. The cued-recall phase was then followed by an evaluation phase, in which the brand name was presented and information about the episodically/semantically associated item was retrieved.

To estimate differential processing of episodic and semantic memories, we contrasted activation for recall success vs. failure trials (the "recall success" effect), and predicted that some areas will show a greater recall success effect in the semantic vs. episodic task (e.g., anterior temporal lobe), while others will show the opposite pattern (e.g., hippocampus). To estimate differential content effects (representation), we examined item-specific pattern similarity between recall and evaluation, and contrasted the similarity for trials referring to the same episodic/semantic instant with trials referring to different instances.

Contrary to our prediction, our analyses showed robust evidence against differential processing or representation (conclusive support for the null; BF01>10) in anatomically defined regions of interest. Taken together, our study shows that semantic and episodic memories are processed and represented in a highly similar manner.

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The tensor brain: A unified theory of perception, memory and semantic decoding

We present a unified computational theory of an agent's perception and memory. In our model, both perception and memory are realized by different operational modes of the oscillating interactions between a symbolic index layer and a subsymbolic representation layer. The two layers form a bilayer tensor network (BTN).

The symbolic index layer contains indices for concepts, predicates, and episodic instances known to the agent. The index layer labels the activation pattern in the representation layer and then feeds back the embedding of that label to the representation layer. The embedding vectors are implemented as connection weights linking both layers. An index is a focal point of activity and competes with other indices, but, since it constantly interacts with the representation layer, it is never active in isolation. Embeddings have an integrative character: the embedding vector for a concept index integrates all that is known about that concept, and the embedding vector for an episodic index represents the world state at that instance.

The subsymbolic representation layer is the main communication platform. In cognitive neuroscience, it would correspond to, what authors call, the ``mental canvas'' or the ``global workspace'' and reflects the cognitive brain state. In bottom-up mode, scene inputs activate the representation layer, which then activates the index layer. In top-down mode, an index activates the representation layer, which might subsequently activate even earlier processing layers. This last process is called the embodiment of a concept. The brain is a sampling engine: Only activated indices are communicated to the remaining parts of the brain.

Although memory appears to be about the past, its main purpose is to support the agent in the present and the future. Recent episodic memory provides the agent with a sense of the here and now. Remote episodic memory retrieves relevant past experiences to provide information about possible future scenarios. This aids the agent in decision-making. “Future”

episodic memory, based on expected future events, guides planning and action. Semantic memory retrieves specific information, which is not delivered by current perception, and defines priors for future observations. Our approach explains the great similarity between episodic and semantic memory: Semantic memory is the expected episodic memory of a future instance. From a hierarchical Bayesian perspective, episodic memory corresponds to the modelling of independent instances, whereas semantic memory ignores instance indices and performs global pooling.

Perception is learning: Episodic memories are constantly being formed, and we demonstrate that a form of self-supervised learning can acquire new concepts and refine existing ones. We introduce the one-brain hypothesis, which emphasizes, first, that the brain uses only one representation layer and, second, that perception, episodic memory, semantic memory, and embedded reasoning all rely on the same BTN architecture.

We discuss relationships between our approach to cognitive linguistics and consciousness research. Our key hypothesis is that obtaining a better understanding of perception and memory is a crucial prerequisite to comprehending human-level intelligence.

Maria Wimber

University of Glasgow, UK

Tracking the reconstruction of visual memories in human brain and behaviour

Episodic memories are not exact replicas of the events we originally experience. In this talk, I will give an overview our work investigating how memory systematically differs from perception in terms of its feature processing hierarchy and temporal dynamics. The findings, using pattern analysis of electrophysiological and fMRI data as well as behavioural reaction time analyses, highlight two prominent characteristics of memory recall. First, when the hippocampus reactivates a previously stored visual memory, the information flow in neocortex tends to follow a reverse feature processing hierarchy compared to initial perception, starting with the reconstruction of high-level conceptual image features, and ending with low-level perceptual detail. We also find consistent evidence for a representational shift towards conceptual features ("semanticisation") over longer consolidation periods and with repeated,

active recall. Second, memory reactivation is rhythmic, as visible in brain and behaviour, in line with models suggesting that the hippocampal theta rhythm orchestrates the timing of memory reactivation relative to incoming sensory input. Our most recent findings demonstrate that phase coding along the theta rhythm can help segregate overlapping, competing memories. Together, these findings emphasise the dynamic and reconstructive nature of our memories.

Xiangshuai Zeng, Nicolas Diekmann, Laurenz Wiskott, Sen Cheng

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Modeling the function of episodic memory in spatial learning

Episodic memory has been studied extensively in the past few decades, but so far little is understood about how it drives future behavior. Here we propose that episodic memory can facilitate learning in two fundamentally different modes: retrieval and replay, which is the reinstatement of hippocampal activity patterns during later sleep or awake quiescence. We study their properties by comparing three learning paradigms using computational modeling based on visually-driven reinforcement learning. Firstly, episodic memories are retrieved to learn from single experiences (one-shot learning); secondly, episodic memories are replayed to facilitate learning of statistical regularities (replay learning); and, thirdly, learning occurs online as experiences arise with no access to memories of past experiences (online learning). We found that episodic memory benefits spatial learning in a broad range of conditions, but the performance difference is meaningful only when the task is sufficiently complex and the number of learning trials is limited. Furthermore, the two modes of accessing episodic memory affect spatial learning differently. One-shot learning is initially faster than replay learning, but the latter reaches a better asymptotic performance. In the end, we also investigated the benefits of sequential replay and found that replaying stochastic sequences results in faster learning as compared to random replay when the number of replays is limited. Understanding how episodic memory drives future behavior is an important step towards elucidating the nature of episodic memory.

4 ASTRACTS - POSTERS

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Aya Altamimi **P05**

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Effects of social interactions on generative episodic memory

Social interactions, such as conversations with others who were present during an event, can provide valuable cues and information that can integrate bias and lead communicators to recall the past event in a way that is congruent with the audience's judgement. This study suggests a model of generative episodic memory that addresses the phenomenon of shared reality bias in the recalled memories and shows that errors or distortions in memory, particularly if there is epistemic trust or a shared reality between a communicator and an audience, can have a direct impact on the legitimacy of the recalled memory. The communicators' own memories for information can become biased towards the audience's attitudes after tuning their message to suit the audience. This results in an audience-congruent memory bias, where their recall of the original information is influenced by the biased view expressed in their message. The model reflects that motivational circumstances of message production induces bias that is greater when audience tuning serves the creation of a shared reality, compared to when it serves alternative goals such as being polite, obtaining incentives, being entertaining, or complying with a demand. The model further shows that this effect is mediated by the communicators' epistemic trust in the audience's congruent view, rather than other factors such as rehearsal, accurate retrieval, or the ability to discriminate between original and message information.

We present a model of the generative aspects of episodic memory, that contributes to a deeper understanding of the interplay between episodic memory and semantic information in the generative process of recalling the past and how social interactions can have a direct impact on that. It is based on the central hypothesis that the hippocampus stores and retrieves selected aspects of an episode as a memory trace, which is necessarily incomplete, and can have multiple traces of memory at each time step. At recall, the attractor of these multiple memory traces is retrieved, and the neocortex reasonably fills in the missing parts based on general semantic information and social interaction bias in a process we call semantic completion. The model combines two neural network architectures known from machine learning, the vector-quantized variational autoencoder (VQ-VAE) and the bidirectional encoder representations from transformers (BERT). As episodes, we use images of

digits and fashion items (MNIST) that are ambiguous in a sense that each digit can be mistaken between two digits. The model is able to complete missing parts of a memory trace in a semantically plausible way that also reflects the context in which these memory traces were saved.

Mahdi Bagheri, Marcella Woud, Jürgen Margraf, Simon Blackwell **PS2/01**

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Investigating the causal role of mental imagery in the experience of involuntary memories

Involuntary memories are thought to affect emotion, cognition, and behaviour, and it is often assumed that their impact is amplified when they are rich in mental imagery. However, this assumption has yet to be directly investigated. The current study tested a newly-developed paradigm designed to induce involuntary memories and provide a means to test the role of mental imagery directly. In a within-subject design, an unselected young adult (mostly student) sample (N = 53) participated in a lab-based study. Participants generated emotionally-valenced mental images or sentences via combining ambiguous pictures with positive or negative word captions. They then completed tasks designed to trigger involuntary memories of the previously generated images and sentences. Voluntary retrieval of the picture-word pairs was also assessed. Participants reported experiencing involuntary memories of previously generated images and sentences, but there were no detectable effects of mental imagery on measures of involuntary memory. However, participants recalled more word captions from picture-word pairs used to generate images than those used to generate sentences. Overall, the newly developed paradigm provides a means to test assumptions about the impact and functions of involuntary memories directly via experimental manipulation, opening up a number of opportunities for future research.

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PS2/02

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What do we remember about the past to anticipate the future: the Covid-19 pandemic analyzed with behavioral and natural language processing approaches

Covid-19 impacted the whole world through its social, political, medical and economic consequences. Since one function of memory is to allow us to adapt to future situations, remembering these events is important and should frame how we anticipate a potential similar situation in the future.

In this study, we asked 256 Belgians to recall their memory of the Covid-19 pandemic (during 2020) and their projection of a similar pandemic in ten years (1st interview in 2021). The same questions were asked in Spring 2022 (2nd interview) to assess the evolution of memory and future thinking.

First, results show that, in 2021, almost 80% of Belgians remember the circumstances in which they learned the news of the first lockdown. 55% remember the circumstances in which they heard the first mention of the virus. In 2022, 75% formed flashbulb memories (FBMs) about the news of the first lockdown and 48% formed a FBM for the apparition of the virus.

Topic modeling analyses of Covid-19 pandemic memories suggest several topics shared across Belgians. One year after the events (in 2021), the most recalled memories are related to politics and restrictions, specifically the contact with others. They also recalled details related to hospitals, the virus, professional and school impacts. Two years after the events (in 2022), representations seem to stabilize toward daily life impacts, hospitals and medical consequences, the virus evolution, political restrictions, professional and schools' impacts, and the geo-political level. On note, this time the virus evolution was associated with the political restrictions in one topic. This suggests that two years after the events Belgian citizens share a common memory of the evolution of the virus based on the restrictions imposed by the politics (e.g., if we were on lockdown in September 2020, that means that the Covid-19 virus was

very active at that time). In 2021, when imagining a future similar pandemic, topics revealed the need to learn from the past to have a better management and actions, specifically medical management. Economy and geo-political levels are also discussed. People also imagined a crisis in population, daily life impacts and the need to adapt.

In brief, this study shows that one year after the pandemic, politics, impact on daily life (e.g., work, school, contacts) and hospitals/medical content are recalled. Two years after the events these topics are still recalled. When imagining a similar future pandemic, Belgians share the need to learn from the past to better adapt, which correspond exactly to one of the functions of memory. Personal and collective topics are imagined, based on memories

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Item-in-context episodic memory in a spiking neural network model with Hebbian plasticity

There has been considerable experimental effort invested in demonstrating episodic memory in rats using item-in-context paradigms. To substantiate the animals' impressive memory performance with mechanistic insights into the underlying neural and network phenomena, we propose a mesoscopic neural network model with continuous synaptic learning. We built a spiking dual-network model to simulate item-in-context ("what-where") memory effects observed in a seminal experimental study [1]. In this task, rats were presented with pairs of odors in two contexts, regarded as old and new items-in-context, and rewarded upon identifying the new-in-context odor.

The aim of our computational study was to examine whether long-term Hebbian plasticity effects lead to comparable memory performance as observed experimentally, and to predict outcomes for behaviorally relevant variations of the original task. We demonstrated that our spiking neural network model could reproduce learning and discrimination of novel item-in-context in a continual learning regime.

Model: We use a spiking neural network model consisting of two modular attractor memory networks that store two contexts (A,B) and 16 odor items, respectively, as distributed memory patterns. Context-item association is mediated by Bayesian-Hebbian plasticity [2,3] at long time scales to facilitate episodic long lasting synaptic weight change. To simulate the effect of a reward present in the experimental paradigm, we implemented eligibility traces and upregulated associative plasticity upon the successful task completion in each trial.

Our model reproduces quantitatively experimental data and suggests that long-term Hebbian plasticity enables discrimination between old and new items-in-context. This distinction between new and old odors in the model is based on a comparison of the firing rates during activation of the corresponding memory items in a given context. Old items typically feature higher spiking activity due to the plastic excitatory context-item binding between networks that was learned during previous occurrences of old items-in-context.

The model further predicts outcomes for different variations of the original task that confound context-dependent episodic memory with recency. By task design [1], old items feature low recency (old items were always presented earlier in time than new items before memory assessment), so that retrieval of old items is entirely context-dependent and independent of recency (as recency may increase the sense of oldness). Nevertheless, in an alternative simulated task, we switch the order of the presentation so that old items were instead encoded later than new items (i.e., old items were more recently encoded before memory assessment), and quantify the contribution of recency to task performance. Our model predictes that high recency of old items can improve performance. We further explain how this is reflected in synaptic short-term plasticity (e.g., facilitation and its interaction with long-term Hebbian plasticity).

Overall, we offer a plausible mechanistic explanation for the experimental item-in-context task [1] which suggests that long-term Hebbian processes contribute to recollection. We further evaluated how other dynamic processes (i.e., recency) and their possible synaptic correlates contribute to episodic memory.

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Erp correlates of involuntary and voluntary episodic memories

Involuntary autobiographical memories (IAMs) are a distinct cognitive phenomenon defined as vividly re-experiencing memories from the past without an intention to retrieve. Although there is data from fMRI neuroimaging studies showing increased activation for voluntary versus involuntary memories in prefrontal cortices reflecting greater executive control, few studies exist examining IAMs using EEG which is better able to track rapid cognitive processes. In this study, in one EEG session, participants encoded sound-image pairs (as imagined event re-presentations) and unpaired sounds, followed by two retrieval sessions; an IAM session in which paired and unpaired sounds are played passively, and a voluntary session where participants explicitly retrieve encoded 'events'. In a pre-registered analysis (https://doi.org/10.17605/OSF.IO/2YZJV), we first examined the event-related potentials (ERPs) of voluntary and involuntary memories associated with accurate retrieval, and second, assessed ERPs from encoding associated with subsequently retrieved versus non-retrieved voluntary and involuntary memories (subsequent memory effect). Our findings will be contextualised in relation to current theories of episodic and involuntary memory, recent neuroimaging work and methodological recommendations.

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Memory retrieval enhancement in a CA1 microcircuit model of the hippocampus

Memory retrieval is important in how the already stored information can be accessed. Improving it would help in developing strategies for preventing memory loss. We selectively scaled excitatory and inhibitory responses of key CA1 neurons to evaluate memory retrieval as a function of stored patterns, pattern interference, contexts, network size, and engram cells in a computational circuit model of the hippocampus. Model

excitatory and inhibitory cells fired at specific phases of a theta oscillation imposed by an external inhibitory signal targeting only inhibitory cells, which inhibited compartments of excitatory cells. Sensory and contextual inputs targeting cell dendrites caused cells to fire. Simulation results showed scaling of excitatory synapses in proximal but not basal dendrites of bistratified cells inhibiting pyramidal cells made retrieval perfect. Scaling of inhibitory synapses in pyramidal cells made retrieval worst. Decreases in the number of memory engram cells improved memory retrieval in a pathway-dependent way. Increases in network size and stored patterns had a minimal effect on memory retrieval. Memory interference had a detrimental effect on memory retrieval, which was reversible as the number of engram cells decreased. Changes in contextual information made memory retrieval worse confirming previous evidence that more familiar context facilitates memory retrieval.

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An investigation on the role of oxytocin in chronic neuropathic pain in a wistar rat model

Introduction Chemotherapy-induced peripheral neuropathy (CIPN) is a dose-limiting side effect with ineffective preventative and curative treatment, due to the condition's complexity perpetuated by the extensive central involvement, including the chronic disruption and subsequent dysregulation of the hypothalamic-pituitary-adrenal axis. Currently, only Duloxetine has been recommended as effective treatment for CIPN, which has shown individual-dependent, short-term analgesic effects, with limiting adverse effects and poor bioavailability. The neuropeptide, oxytocin, may offer significant analgesic and anxiolytic potential, as it exerts central and peripheral attenuating effects on nociception. However, it is unknown whether the intervention administered in a model of CIPN is an effective therapeutic alternative.

Materials and Methods The intervention was divided into two phases. Phase 1 aimed to induce CIPN in adult Wistar rats using the chemotherapeutic agent Paclitaxel. Mechanical (electronic von Frey filament) and thermal (acetone evaporation test and Hargreaves test) hypersensitivity testing was used to evaluate changes due to the

neuropathic induction. Phase 2 consisted of a 14-day intervention period with saline (oral gavage), Duloextine (oral gavage), or oxytocin (intranasal) administered as treatment. Analgesic behavioural testing was assessed throughout the intervention period. Following the intervention, anxiety-like behaviour was assessed using the elevated plus maze (EPM) and light-dark box protocols. Analysis of peripheral plasma corticosterone, peripheral plasma oxytocin, and hypothalamic oxytocin concentrations were assessed using ELISA assays.

Results The findings showed that we were able to successfully establish a model of chemotherapy- induced peripheral neuropathy during Phase 1, determined by the increase in mechanical and thermal nociceptive responses following chemotherapy administration. Furthermore, based on this finding, we were able to evaluate the effect of different treatments administered in the presence of CIPN. The animals treated with oxytocin displayed a significant improvement in mechanical sensitivity over the intervention phase, indicative of an improvement in nociceptive tolerance in the presence of neuropathic pain. Animals that received Paclitaxel and treated with oxytocin also displayed significantly greater explorative behaviour during the EPM, indicative of a reduced presence of anxiety-like behavior.

Conclusion Our results support the hypothesis that intranasally administered oxytocin may augment the analgesic and anxiolytic effects of duloxetine in a chemotherapy-induced peripheral neuropathy model in a Wistar rat. Administered in conjunction, oxytocin and duloxetine may provide enhanced therapeutic effects in the treatment of CIPN. Further research is necessary to establish optimal treatment and dosage requirements.

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A model of hippocampal replay driven by experience and environmental structure facilitates spatial learning

Hippocampal replay during awake resting states and sleep is thought to play an important role in learning and memory consolidation. Consistent with this function, recent evidence shows that replay sequences adapt to changing spatial constraints (Widloski & Foster,

2022). However, other studies suggest that replay does not necessarily reflect the animal's previous behavior. For instance, the statistics of replay was found to resemble random walks (Stella et al., 2019), represent shortcuts that the animals had never taken (Gupta et al., 2010), and represent trajectories through regions that the animals had seen, but never explored (Ólafsdóttir et al., 2015). It is unclear how these different types of sequences are generated and what functions they serve. We address these questions in a computational study using reinforcement learning (RL). We propose a mechanism that reactivates experiences stochastically according to their priority ratings based on three variables: 1. Experience strength, which reflects the frequency of experience and reward, 2. experience similarity, which represents the distance between experiences and is based on the Default Representation (Piray and Daw, 2021), and 3. inhibition of return, which prevents the repeated reactivation of the same experience. The relative importance of these variables differs depending on the statistics of experience and the environmental structure. This replay mechanism, together with the stochasticity of replay generates the diverse types of replay mentioned above. Furthermore, it can account for replay entering aversive locations (Wu et al., 2017) and captures well known replay statistics like the over-representation of rewarded locations (Singer and Frank, 2009; Pfeiffer and Foster, 2013). Importantly, this mechanism facilitates learning in spatial navigation tasks. Training an RL agent with replay sequences generated by our model outperforms training with random replay, and performs close to the state-of-the-art, but computationally intensive, model by Mattar & Daw (2018). In conclusion, different types of replay can be generated by a unified mechanism, which is efficient in driving spatial learning.

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Situated authenticity in episodic memory

A recalled memory is deemed authentic when it accurately represents how one experienced the original event. However, given the convincing research in cognitive science on the constructive nature of memory, this inevitably leads to the question of the 'bounds of authenticity'. That is, how similar does a memory have to be to the original experience to still count as authentic? Here, we present a novel account of 'Situated Authenticity'

which highlights that the norms of authenticity are context-dependent. In particular, we show that each of the three core functions of episodic memory (self, social and directive) is correlated with patterned changes in levels of conceptualization (e.g., concrete construal versus abstract construal of the event). We support this theoretical account with existing empirical data. We conclude by providing an outline of how our account, which is currently elaborated targeting a phenomenological level, may also be elaborated on a processing level using the concept of representational format.

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Self-Enhancement: How reliable are our episodic memories?

We generally rely on our episodic memories as accurate representations of the past. This claim is uphold by most philosophical theories on the nature of episodic memory (although in various degrees and kinds) and also in our society. Episodic memories are for example used as integral part as testimonies in court – they are taken to provide truth and (epistemic) justification for subsequent beliefs. One might challenge episodic memories general function in presenting us with an accurate representation of the past. However, I will be accepting the general reliability of episodic memories to produce accurate representations of the past. Nevertheless, there are various times in which our memory system fails us, like forgetting or misremembering. While they might let us wonder about the reliability of episodic memory, I will be considering altered episodic memories which could have been remembered well.

Episodic memories which could have been remembered accurately but are changed through self-relevant thinking constitute a special kind of epistemic worry. Self-relevant thinking is the phenomenon that we tend to remember our good deeds better than they actually were or just more vividly than our morally (slightly) worse actions. For example there is the tendency in children and in adults to remember oneself being nice better than one being mean (Rowell & Jaswall 2021: 266). Additionally, there are studies that show that for generally good students they remember their worse grades better than they actually were (Bahrick et al. 1996). I will be arguing that these changes in the content of episodic memory constitute a

form of irrationality because we do not behave according to epistemic norms in order to get the most accurate representation of the past.

Susanna Siegel (2017) argued that our perceptions can be influenced by our emotions or desires. Perceptions become irrational because our emotions play a bigger role in the production of the representation than does the outside world. Similarly, in episodic memory the self-relevant thinking could constitute the content of the episodic memory more than the information usually used by the episodic memory system. The remembering becomes irrational.

But what can we do to stop ourselves from being irrational? The involvement of self-relevant thinking can be more or less deliberate, the subject can be more or less aware of it. This might make an altered episodic memory more or less irrational. However, in all cases it is possible to work against self- enhancing through reflective thinking. Thus, we can be epistemically rational or irrational in remembering depending on our attitude to get the accurate representations of the past. We become irrational through the negative influence of self-enhancement which takes a bigger role in the content of the episodic memory than does the informations usually used in the episodic memory system. But when we do not engage in self-enhancement or stop ourselves deliberately and successfully through reflective thought we can remember rationally, that is, in accordance with epistemic norms with the goal to produce the most accurate representation possible.

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Data-driven modeling and analysis of dynamics of emotional associative memory encoding

Researchers have been interested in studying the connection between emotion and memory for decades but much remains unknown due to the elusive nature of the human brain. While emotions can help us remember significant events, they can also inhibit or distort our memories. Association learning, which refers to the mechanism of learning the relationship between items, is one of the phenomena where the stimuli's emotional valence has particularly complex consequences. Studies using

pairs of equally valenced images have found evidence for both improved and impaired learning of the emotional pairs compared to the neutral ones. To investigate the root of this discrepancy, the underlying neural mechanisms of the interacting brain regions can be modeled in a mathematical framework. A promising approach for this is using methods at the intersection of computational neuroscience and control theory. Such models give rich insights into how system states respond to external manipulations, influence one another, and collectively give rise to output signals over time.

In this study, we use the Dynamic Causal Modeling (DCM) framework to build a data-driven mathematical model for encoding of emotional associative memories, and use control theory for analysis of the obtained model. The modeled neural substrates are the amygdala, the hippocampus, and the orbitofrontal cortex, which have all been previously found to be crucially involved in emotional learning. We use data collected from a functional magnetic resonance imaging (fMRI) study, where participants were given pairs of images that were either both negative, both neutral, or involved one negative and one neutral item. We model how the differently valenced stimuli affect the way the brain regions interact. Furthermore, the strength of dynamical models lies not only in the potential to fit data but in the ability to analyze the dynamical properties of the identified model. Therefore, analyzing properties such as the equilibria and their stability is a key component of our study. To our knowledge, this is the first DCM study of emotional associative learning in the chosen brain network.

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Memory in flux: investigating the effects of changing environments on episodic memory

Our ability to make sense of the world relies on our capacity to use past experiences to predict what might be likely to happen in the future. However, changes in the environment can disrupt our predictions, forcing us to disregard what we have learned from past experiences in order to learn new information. We are interested in investigating whether the enhanced learning which follows environmental changes translates into an upregulation in episodic encoding and whether this effect is related to

increased hippocampal activation. Our ongoing fMRI study consists of three parts: a probabilistic learning phase on day one, an encoding phase on the following day performed in an fMRI scanner, and a recognition test with confidence rating after scanning. At each trial during learning and encoding phases, participants are shown two cartoon characters followed by a trial-unique object that is probabilistically drawn from one of four specific categories. Participants' task is to predict which category of objects the associated character prefers. At several points during the encoding phase, the characters' preferences unexpectedly change, requiring participants to adapt and relearn the new associations. We hypothesize that the activation of the hippocampus should be enhanced after change points, and that activation for remembered items should be higher after change points compared to before change points. In addition, we expect to find differential involvement of the hippocampal subfields in relation to the changes, with enhanced activation in the DG-CA3 subfields after change points and increased activation in the CA1 subfield before change points, reflecting their distinct roles in pattern separation and completion, respectively. Findings from this study will contribute to our understanding of the interplay between learning of regularities and memory of specific experiences.

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The role of cognitive reserve in episodic memory recall in the ageing brain

Cognitive reserve (CR) plays an important protective role in successful ageing, by maintaining memory performance, in spite of brain changes such as atrophy1.Though there are several established cognitive reserve proxies (CRP), it remains an open question whether they capture specific aspects of CR or rather represent a general advantage in old age. We hypothesized that static proxies, such as years of education or former profession, and dynamic proxies, such as current semantic fluency or mental and physical activity2, could have differential protective effects on

the well-established relationship between age-related brain changes and memory performance. We assessed the effect of grey matter volume (GMV) on complex figural recall and verbal episodic recall of stories, investigating whether these associations are differentially influenced by CRPs. In the context of the scenario construction model (SCM), whereby information is actively constructed during recall3,4, we hypothesize that semantic fluency could be of high importance for successful memory recall.

We analysed 3-Tesla T1-weighted Multi-Echo MPRAGE and cognitive data from cognitively normal adults over 60 years including SuperAgers (individuals aged >= 80 years with superior memory performance) in our new cohort established within the CRC1436 (https://sfb1436.de/). Cognitive tests include the Logical Memory subtest of the Wechsler Memory Scale (WMS), Rey Complex Figure Test (RCFT) and RWT (Regensburg Word Fluency Test). The Lifetime Experience Questionnaire (LEQ) and the Physical-Activity-Questionnaire-50+ (PAQ-50+) provide data regarding CRPs. MRI data was preprocessed and analysed using CAT12. We performed a whole-brain linear regression to first assess age-related differences in grey matter volume (GMV; covariates: sex, total intracranial volume (TIV), education), extracting mean betas for significant regions of interest where higher age related to lower volume. We then investigated the relationship between GMV in age-vulnerable regions and memory using linear regressions (covariates: age, sex, TIV), and assessed CRPs as moderators on this relationship. Furthermore, we tested whether CRPs explain more variance in memory performance over and above that of GMV and age (as weak evidence for CR5).

Preliminary results indicated age-related reductions in hippocampal GMV, a region well-known for learning and memory that is therefore of special interest for further analysis. Further preliminary results indicated a beneficial role of the cognitive reserve proxy semantic fluency, rather than education, in complex figural memory. Nevertheless, mental and physical activity have yet to be investigated as CRPs, as well as the influence of CRPs on verbal memory by the WMS. Gaining more knowledge about the interactions of cognitive reserve and successful ageing will make an important contribution to our understanding of memory processes in old age. Moreover, our cohort is developing and we aim to include additional participants in our future analyses. Furthermore, additional measures of Alzheimer's pathology are currently acquired by means of tau-PET scans alongside multimodal MRI measures, blood

markers of p- tau and amyloid, and genetic markers to study CR in face of hidden pathology. Finally, given that follow-up assessments are also planned, current and future data from this cohort will enable the assessment of longitudinal changes in brain and cognition over time.

Catarina Gouveia Gaglianone, Karri Gillespie-Smith, Matthias Schwannauer, Xiaoyang Li, Raahat Manrai **PS2/07**

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The impact of soothing media and the anxiety and depression traits on the content of prospective mental imagery. A qualitatively driven photo-elicitation study.

Negative mental imagery increases and maintains the individual's symptoms of depression and anxiety more than verbal thoughts (Holmes et al., 2016). Nevertheless, positive mental imagery has been identified as a potential turnaround to combat the impact of negative visual thoughts (Blackwell & Holmes,2017). Unfortunately, participants report difficulties or deficits in constructing positive mental imagery (including prospective mental imagery). Understanding the impact of mental imagery usually is done by administering questionnaires (i.e. SUIS and PIT) and sometimes interviews such as the Imagery Interview (Ivins et al., 2014), the Suicidal Cognitions and Flash-forwards interview (Hales et al., 2011) with commonality instructing participants on what to imagine, rather than focusing on the spontaneous (uninstructed) aspect of mental imagery (Ji et al., 2021). Thus, the current qualitative study explores the content of important and subjective prospective mental imagery(spontaneous) and the impact of soothing environments on the production/construction of spontaneous prospective mental imagery. Twenty semi-structured interviews were conducted, and participants' ages ranged between 18 and 65. The study participants were from different nationalities (Austria, Brazil, Canada, Chile, China, Greece, India, Norway, the Philippines, Portugal, USA, and the UK). In the current study, we used IPA analysis to analyze our data. The current study found that regardless of nationality and age group, the content of the spontaneous mental imagery(Superordinate themes) were regarding: A) Goals, which included life milestones (such as having a family), along with career milestones/success(wanting to be CEO), and B)Travel. Nevertheless, it became clear from the interviews that, more often than not, when asked to imagine a future scenario, participants tended to recall an episodic

memory associated with spontaneous prospective mental imagery. A similar process was also observed when participants used soothing scenarios for the construction/generation of their prospective mental imagery. In which the study concluded that water features were more prominent.

Behnam Ghazinouri, Mohammadreza Mohagheghi Nejad, Sen Cheng **PS1/02**

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Navigation and the efficiency of spatial coding: Insights from closed-loop simulations

Spatial learning is critical for survival and its underlying neuronal mechanisms have been studied extensively. These studies have revealed a wealth of information about the neural representations of space, such as place cells and boundary cells. Despite extensive investigations into how these neural representations emerge, little attention has been paid to their functional role in spatial navigation and spatial learning. We extended an existing computational modeling tool-chain to study the functional role of spatial representations using closed-loop simulations of spatial learning.

The model consists of a two-layer spiking neural network. The input layer contains place cells and boundary cells of the agent. The spiking activity of these cells is modeled as an inhomogeneous Poisson process. The activity (firing rate) of each place and boundary cell varies over time and is a function of the 2D location of the agent in the environment. This input is fed to the output layer containing 40 action selection neurons, which form a ring attractor. Each action neuron represents one direction, distributed homogeneously across 360°. Therefore, the agent is able to move freely in any direction. The output of the network determines the direction and speed of movement. If the agent finds a hidden goal zone within the allocated time, we considered the trial as successful. At the end of successful trials, the learning is reinforced by potentiation of feedforward weights in a symmetric STDP learning rule with eligibility trace. This is similar to dopamine-modulated synaptic plasticity in the brain.

Our findings showed that navigation performance was influenced by the parameters of the place cell input, such as their number, place field sizes, and peak firing rate, as well as the size of the goal zone. We observed a systematic relationship between performance and a new variable, the overlap index, which measured the degree of overlap between two neighboring place cells and incorporated both place cell number and field size. However, this relationship was nonmonotonic. On the other hand, the Fisher information, which describes how informative the place cell population is about spatial location, best accounted for navigation performance in our model. Our results therefore demonstrate that efficiently encoding spatial information is critical for navigation performance[1].

[1]: Ghazinouri, B., Nejad, M.M. & Cheng, S. Navigation and the efficiency of spatial coding: insights from closed-loop simulations. Brain Struct Funct (2023). https://doi.org/10.1007/s00429-023-02637-8

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Is the wandering mind a planning mind?

According to recent proposals, mind-wandering is a form of mental exploration by which agents explore new and potentially better action opportunities (Sripada, 2018) or more rewarding goals (Shepherd, 2019) when the value of exploiting known opportunities or current goals is expected to be low. One possible interpretation of this explorative function is that mind-wandering involves reconsideration of prior intentions. Since we spend up to half of our waking hours mind-wandering (Killingsworth & Gilbert, 2010), this raises the possibility that reconsideration is a regular occurrence. Yet that would contradict the widespread assumption that intentions remain relatively stable over time and reconsideration happens infrequently to facilitate planning for the future (Bratman, 1987). Fortunately, there are other plausible ways of interpreting explorative mind-wandering that avoid this tension.

If mind-wandering leads to reconsideration, it is most likely to cause either nonreflective reconsideration where reconsideration is the product of certain habits or dispositions rather than explicit deliberation about whether to reconsider or policy-based reconsideration where an agent forms a general policy to let her mind wander in the hopes of generating new relevant information when certain conditions obtain (e.g., when

current strategies have proved unsuccessful). However, given the advantages to cognitively limited agents of forming plans ahead of time and sticking to them, it is unlikely that mind-wandering would have evolved in a way that undermines these advantages. More plausibly, the dispositions, habits, and policies that might trigger reconsideration during mind-wandering are limited in frequency and scope so as not to undermine intention stability.

In further support of this account, explorative mind-wandering might have other planning-related functions that do not cause reconsideration. First, mind-wandering might help fill out partial plans by exploring relevant means, preliminary steps, and more specific courses of action. Second, mind-wandering might modify one's reasons for doing as one intends without resulting in reconsideration of the intention itself. In such cases, the agent does not reopen the question of whether to abide by her prior intentions but instead simply incorporates new considerations into her reasons for doing what she intends to do. This might include altering the beliefs and motivational states of the agent as the wandering mind simulates previously unconsidered events and their potential hedonic consequences (Gilbert & Wilson, 2007).

Mind-wandering might then also play a role in practical reasoning. According to recent accounts (Arpaly & Schroeder, 2013; Morton, 2017; Shepherd, 2015, 2022), human agency is characterized by limited cognitive capacity, uncertainty about what to do, and conflict between various desires, intentions, commitments, obligations etc. On this picture, mind-wandering could be construed as a source of new practically relevant content (e.g., goals and action possibilities) which becomes part of the overall pool of content on which the agent enforces a degree of rational coherence through practical reasoning.

Finally, to perform these functions, mind-wandering seems to rely heavily on episodic memory and future thinking. Mind-wandering plausibly evolved to imagine personal future events by relying on episodic autobiographical memory in order to support planning (Baird et al.; 2011; Smallwood & Schooler, 2015).

Pelin Kasar **PS1/04**

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Belief reconstructed

Implicit biases are thought to be mental constructs that lead to discriminatory actions independently of the actor's intentions or awareness. They are taken to be inaccessible to consciousness and automatically activated. In cases of implicit bias, there is often a mismatch between what the subject says to believe and how they behave. This poses a problem for dispositionalist accounts of beliefs because the subject's actions do not match the dispositional profile of the corresponding belief. In my paper, I analyse the notion of implicit bias by focusing on the implicit features of memory systems. Instead of employing the implicit/explicit distinction in memory research, I follow the constructivist views of memory, which blurs that distinction. Constructivists either reject the memory trace requirement in remembering or characterizes them as having non-propositional content. I suggest a constructivist approach to beliefs.

Belief is understood as a standing state, a state of mind that persists through changes in your conscious awareness and even in the absence of consciousness. Once they are formed, they are stored in the subject's mind to be used in the subject's future thoughts, actions, projects, etc. Thus, beliefs are not essentially conscious. Beliefs are either stored in memory or the "belief box." When needed, they are brought to consciousness. Hence, there are at least two important aspects of the phenomenon of belief: types of storage and ways of recollection. It is common to think of beliefs as represented in a propositional form in the mind and recollected with a conscious awareness of the subject. This way of thinking about beliefs parallels the traditional way of thinking about explicit memories. While preservationist models of memory take memory processing as a matter of encoding, storing, and retrieving information, generationist theories of memory suggest that remembering is an active process in which the subject constructs a more or less adequate representation of the past (Michaelian, 2017). There are no individual stored representations corresponding to individual memories. I agree with Sarah Robins (2023) that if memories are constructed rather than stored, then all memories are implicit rather than explicit. I argue that recollection of a belief is similar to remembering it: it is a constructive

process. If recollection is constructive, the content of the belief that is in the unconscious (standing belief) and the content of the thought that is constructed (conscious judgment) could be different. This way of thinking about recollection could explain cases of implicit bias.

Katja Kleespies **PS1/13**

University of Freiburg

Sleep integrates representations across multiple memory systems

Sleep has been linked to memory consolidation and synaptic plasticity. It supports stabilization of explicit, declarative memory and enhances implicit, procedural memory. Moreover, it has been suggested that beyond strengthening, sleep may change the quality of memories. Explicit and implicit memory systems can interact during learning. Whether they continue to interact during off-line periods remains unclear. Here, we show for feedback-driven classification learning that sleep integrates explicit episodic and implicit rule-based aspects of memory. Testing humans in a specially developed behavioral paradigm we find that over sleep, but not wakefulness, the inherent structure of memory representations is modified. In particular, implicit and explicit components of memory become more cooperative after sleep. This sleep-dependent change in the memory representation leads to a conversion between implicit and explicit knowledge of the task. In an additional fMRI experiment we observe that concurrent changes in brain activity reflect a symmetric, bidirectional information exchange between implicit and explicit learning systems. After sleep, the hippocampus, usually linked to explicit memory, contributes to implicit task recall, whereas the striatum, believed to govern implicit, habit-driven responses, becomes involved in explicit recollection. Additionally, both systems cooperate after sleep: correlations between explicit and implicit performance measures change from negative before to neutral after sleep, performance in a task that allows the cooperative use of both types of memory improves. Thus, sleep combines information learned by different routes into an integral structure and helps us respond optimally to contingencies we encounter in everyday life.

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Consolidation of sequential memories in humans

Our everyday life is experienced as a sequence of events. For example, you sit in a café, you drink a coffee and work on your laptop before a friend joins for lunch. Afterwards, you go for a walk in the park. This sequence of events (coffee – work – friend) occurs in a specific context (a café) while changes across contexts likewise follow a sequential pattern (context café is followed by context park). Therefore, experiences not only include a sequential but also a hierarchical structure.

In order to remember these past experiences, they have to be stored to form long lasting memories – a process referred to as memory consolidation. Memory consolidation is proposed to be supported by reactivation of the same neuronal firing patterns activated during learning. Whenever a learning experience holds a sequential order, this order is reflected in the sequential reactivation of the pattern – so-called replay. Replay has been shown to often occur during post-learning periods of waking rest or sleep and across various brain regions. However, while a lot of the findings are based on cell-recordings in rodents, replay has recently been measured in humans using functional magnetic resonance imaging (fMRI).

By combining this novel fMRI approach together with developing a new experimental paradigm, we set out to investigate the consolidation of sequential and hierarchical memories. To operationalise these memories, our paradigm comprises two different types of sequences: (1) slower 'context' sequences which nest (2) faster 'content' sequences (resembling the example given above). During the initial encoding phase of this paradigm, participants learned both types of sequences as visual image series. During a following retrieval phase, participants have to then retrieve elements of these sequences.

First behavioural data suggests sequentiality patterns in reaction times as well as accuracies such that items later in a sequence are retrieved slower and with less accuracy. These results indicate a forward skipping through sequences during retrieval.

To investigate how replay supports memory consolidation of both types of sequences, a fMRI study is planned to be conducted. Here, a

wake-rest period between encoding and retrieval will be introduced. Additionally, we want to test whether the occurrence of replay correlates with retrieval memory performance. Preceding the encoding phase, a non-sequential localiser task containing the same visual stimuli will be conducted to train classifiers on the activation patterns during image presentation. Classifiers will then be tested on the rest period to detect sequentiality patterns (i.e. replay) of both types of sequences. An additional wake-rest period between the localiser and the encoding phase will serve as a baseline.

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PS2/06

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Effects of the number and duration of events in the temporal compression of experience in memory

We remember episodes from our past as sequences of experience units—each representing a moment of the past experience—separated by temporal discontinuities (i.e., moments that are not remembered). Because of these temporal discontinuities, the time taken to mentally relive past episodes is typically shorter than their actual duration: episodic memories are temporally compressed. However, the cognitive mechanisms underlying this compression remain unclear.

In daily life, we segment the continuous flow of experience into meaningful units (i.e., events) based on the perception of event boundaries (EBs; Zacks, 2020). Between EBs, working memory enables us to construct and maintain a mental model of the ongoing situation (i.e., an event model). When an EB is perceived, the current event model is updated and is integrated in a long-term memory representation of the ongoing sequence of events—as an experience unit (EU). We hypothesized that the temporal compression with which we remember past episodes depends on the number and duration of events composing their unfolding.

The maximal duration of an event model that can be fully maintained in mind should be limited by the length of time that information can be held in working memory without rehearsal. When this temporal capacity is exceeded before the perception of an EB, the EU formed at the end of the current event would only partially represent its unfolding, leading to

temporal discontinuities in the long-term memory representation into which this EU is integrated.

However, some authors consider temporal compression as a feature of episodic simulation that allows us to mentally simulate the central elements of an episode while minimizing cognitive and temporal costs of the simulation (Arnold et al., 2016). According to this view, the level of temporal resolution at which we are able to mentally replay EUs composing past episodes is modulated by the total amount of EUs that we have to remember.

To evaluate the contribution these two mechanisms in the temporal compression phenomenon, we asked 72 healthy young adults to watch and mentally replay short movies depicting 1, 2, or 3 continuous events (i.e., without EBs), each lasting 3, 6, 9, or 12 seconds. For each movie, we computed event remembering duration (ERD) by dividing participants' total remembering duration by the number of events composing the movie. When events were presented alone, ERD was close to the actual stimuli duration for short events (3-6 s), but smaller for longer ones (9 or 12 s). We also observed an effect of the number of events, showing that ERD was lower when multiple events had to be remembered. Taken together, these results suggest that both the number and duration of events have a specific influence on the temporal compression of past experience in memory.

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High stakes: the impact of depth induced stress on memory encoding strategies, using egocentric and allocentric frames of reference.

Memories of our experiences are shaped by the frames of reference we use for memory encoding. These memories have important psychological implications in terms of our held beliefs about the world that act as a

basis for decision-making. This study aims to understand the processes behind which frame of reference is adopted for memory encoding and how this is affected by stress in the environment during the encoding period. Research has determined that spatial navigation relies on two distinct frames of reference: egocentric and allocentric (Grech, Nakamura and Hill, 2018). In addition, the negative effects of stress on memory retrieval have been firmly established (Wolf, 2017). However, what remains to be explored is whether these frames of reference are directly reflected in memory retrieval and whether stress favours the adoption of particular frames of reference. Our study examines the effects of depth-induced stress in a naturalistic Virtual Reality Environment in order to assess performance on a targeted frame of reference memory retrieval questionnaire. The study reveals how frames of reference relate to stress and indicate embodied mechanistic links in this process.

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Learning from quantified episodic prediction errors: Individual biases in gist revision

Episodic memory does not only store past experiences but is also used to predict the future. To fulfil this function, memory representations need to be flexibly and dynamically adapted and updated to account for new circumstances in the environment. Previous research has shown that prediction errors signal the need for such changes. However, it remains unknown whether the magnitude of the prediction error is related to the likelihood of memory updating. Furthermore, individual preconditions altering the size of prediction errors have not been taken into account in previous research. This research aims to address these gaps using short dialogues as highly naturalistic and meaningful stimuli in a five-day experimental procedure. On the first two days, participants listen to the dialogues either three or five times, where encoding frequency is a proxy for prior precision. During listening on the second day, several ratings are obtained to measure participants' evaluations and reactions to the dialogues. On the third day, the dialogues are repeated, but with a modification within one utterance. These modifications are either on the surface level (i.e., using synonyms or different phrasings) or on the gist level (i.e., changing the meaning of the utterance) and designed to be

either low or high in degree. For each dialogue, each participant listens to only one modification. Recognition tests and cued recall are conducted on day four to assess memory for both the original version and the heard modification. On day five, participants rate to what extent the original and modified versions differed. We expect to find that especially a prediction error of medium strength leads to memory updating, signified by reduced memory for the original version and good memory for the modification. A small prediction error may not signal a need for updating, while large prediction errors are expected to result in two separate traces representing both the original and modified versions instead of a single updated trace. Behavioral data collection is currently ongoing. Further research will clarify the neural correlates of memory updating and track the memory representations using RSA by obtaining fMRI data during initial encoding, modification, and cued recall. Further projects will focus on the role of pre-existing autobiographical memories and reactions to the dialogues as well as episodic bridges and continuations as alternative triggers for memory updating.

Chitaranjan Mahapatra **PS1/05**

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Computational modelling of the pathway between dopamine receptors and Ca2+ channels in layer II stellate cells

INTRODUCTION/MOTIVATION

Dopamine plays an important role in mediating spatial learning and memory. The firing patterns of stellate cells in layer II of the medial entorhinal cortex are also involved in memory, cognition, and perception. These patterns are largely modulated by the underlying subcellular calcium dynamics within the axon initial segment (AIS). Recent experimental data have suggested a putative coupling between dopamine D2 receptors (D2R) and T-type Ca2+ channels as another biophysical explanation for the firing pattern modulation. This computational study aims to enhance our understanding of the subcellular membrane mechanisms within AIS of the layer II stellate cells and their modulating effects on resting membrane potential (RMP) and action potential (AP) plasticity in pathological conditions.

METHODS

The computational model is established in three folds. First, the biophysical parameters for various ion channels in the AIS region of layer II stellate cells were combined and adapted from previous models and experimental studies. Second, we developed equations for the GPCR pathway to alter the cAMP concentration, which was merged with the maximum conductance of T-type Ca2+ channels in a modified Boltzmann equation. Third, various pharmacological agents are simulated to explore new biological insights from our model. Using the NEURON software platform in a single compartmental isolated cell, the RMP, APs, and T-type Ca2+ channel currents were simulated by utilizing both current clamp (current ramp and current step) and voltage-clamp protocols.

RESULTS AND DISCUSSION

The dopamine agonist bromocriptine (Bromo) of 10 μM is mimicked to investigate the altered internal kinetics of the T- type Ca2+ channel. Then the APs are evoked from the whole cell model. Then, we recorded the modulating effects of Bromo on the steady-state activation and inactivation curves of the T-type Ca2+ channel. It shows approximately zero effects on the steady-state inactivation curve, but a positive shift on the steady-state activation curve. As a result, the half activation potential of the T-type Ca2+ channel is shifted from –36 mV to –32 mV. Our results also demonstrate the effects of a dopamine agonist on the simulated AP generation with a current injection of 400 pA for a duration of 1 s. It clearly indicates the reduced AP frequency under the effects of dopamine agonists. The window current to maintain the RMP was reduced due to the activation of D2R receptors and it was counterbalanced by decreasing the A-type K+ channel conductance. This in silico study suggests that the application of cAMP antagonists and K+ channel agonists could be used to replace dopamine in certain pathological conditions and in studies of spatial memory performance.

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Why do tests improve memory? A formal modeling approach to retrieval-based learning

Although tests are by definition used to assess memory, it has become well-known that tests can also modify memory: Following the study of to-be-learned information, interim testing typically leads to better memory performance on a delayed recall test than restudying the information for the same amount of time. This memory benefit is known as the testing effect (also retrieval-practice effect). Despite the wealth of research on retrieval-based learning, the mechanisms underlying the testing effect are still debated. Previous research has focused on single mechanisms and rarely aimed at dissociating different memory processes that may contribute to the effect. To simplify the theoretical debate, a new family of multinomial processing-tree models is proposed, which disentangles the contributions of encoding, maintenance, and retrieval processes to test-based learning. Initial results suggest that (a) testing primarily creates maintenance benefits (e.g., resistance against forgetting) and that (b) the final retrieval probability of stored information is not affected by testing versus restudying. These initial findings thus lend support to maintenance-based accounts of the testing effect and are difficult to reconcile with explanations assuming different accessibilities for tested versus restudied items at the final test. We discuss how generative processes during testing may contribute to the maintenance benefit.

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Lower visual processing speed relates to greater subjective cognitive complaints in community-dwelling healthy older adults

Introduction: Subjective cognitive complaints in older age may reflect subtle objective impairments in basic cognitive functions that might foreshadow broader cognitive problems. Such cognitive functions, however, are not captured by standard neuropsychological testing. Visual processing speed is a basic visual attention function that underlies the performance of cognitive tasks relying on visual stimuli. Here, we test the hypothesis that lower visual processing speed correlates with greater subjective cognitive complaints in healthy older adults from the community.

Methods: To do so, we assessed a sample of 30 healthy, cognitively normal older adults (73.07 ± 7.73 years old; range: 60–82; 15 females) with respect to individual subjective cognitive complaints and visual processing speed. We quantified the degree of subjective cognitive complaints with two widely-used questionnaires: the Memory Functioning Questionnaire and the Everyday Cognition. We used verbal report tasks and the theory of visual attention to estimate a visual processing speed parameter independently from motor speed and other visual attention parameters, i.e., visual threshold, visual short-term memory storage capacity, top-down control, and spatial weighting.

Results: We found that lower visual processing speed correlated with greater subjective complaints and that this relationship was not explained by age, education, or depressive symptoms. The association with subjective cognitive complaints was specific to visual processing speed, as it was not observed for other visual attention parameters.

Discussion: These results indicate that subjective cognitive complaints reflect a reduction in visual processing speed in healthy older adults. Together, our results suggest that the combined assessment of subjective cognitive complaints and visual processing speed has the potential to identify individuals at risk for cognitive impairment before the standard tests show any abnormal results.

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Effects of re-testing, re-studying, and delayed single-testing on false memory in the conjoint-recognition model

The testing effect is a well-known phenomenon that refers to the finding that taking a test enhances memory for material compared to not retrieving or even re-studying the material (e.g., Chan & McDermott, 2007; Karpicke & Roediger, 2008; Shaffer & McDermott, 2020; Verkoeijen et al., 2011). To date, several studies have investigated the processes underlying this effect, taking a dual-process framework (Yonelinas, 2002) as a theoretical basis. The results of these studies are not clear-cut, with some indicating that testing enhances the recollection process, while the familiarity process remains unchanged (Chan & McDermott, 2007), but other studies have found that testing affects both familiarity and recollection (Shaffer & McDermott, 2020). In the presented study, the basic memory processes underlying recognition memory test performance were defined according to the conjoint recognition model by Brainerd et al. (2022), which distinguishes the processes of semantic familiarity, context recollection and target recollection. At the study phase of our experiment, all participants were presented with the DRM lists (Deese, 1969, Roediger, McDermott, 1995), which contain the most common associations to a critical lure that is not presented during the study to provoke false recognition. At test, participants were instructed to respond to one of three probe questions: a) Was this word presented? b) Is it a new word, but similar those presented? c) Was this word presented or is it similar to those presented? As an experimental manipulation three testing conditions were introduced: (1) an immediate test and re-test condition, (2) a re-study before final test condition, and (3) a delayed single-test condition – with a retention interval filled with simple arithmetic tasks, lasting approximately as long as the re-test or re-study time from conditions (1) and (2). The results showed no effect of the between-subjects condition (re-test vs. re-study vs. delayed single test) on false acceptances of critical lures as targets. However, we found that re-test in comparison with the initial test resulted in higher false acceptances of critical lures. For process-level analyses, we conducted multinomial processing tree modelling. We did not identify any specific effect of re-testing on any of the conjoint-recognition model parameters. Instead, our

experiment showed that both re-testing and re-studying are beneficial in counteracting the effects of delay on memory. A single delayed test with the performance of simple arithmetic tasks as an activity in the retention interval led to a significant decrease in semantic familiarity for targets and recollection rejection compared to the other conditions. In sum, we found no effect of testing on the contribution of basic processes to memory performance in the conjoint recognition paradigm, but we did find effects related to the interfering cognitive activity during retention interval.

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Heteronoesis: Episodically remembering vicariously experienced events

Around 40% of conversation is storytelling [2]. Our lives are socially embedded; it stands to reason that our memory capacities would be, too. From the assumption that we can experience events not only first-hand but also vicariously, we question the individualist dogma that the natural kind—episodic remembering—is sharply limited to events in our own personal past. Despite their representational discontinuities,

there is room for thinking that episodic memories of vicariously experienced events are products of the same underlying causal mechanisms as paradigm, autonoetic episodic memories.

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Does simulating older self increase memory positivity: effects of self-enhancement on the valence of post-simulation memory

Humans can travel across time in their minds. Mental time travel to the past and to the future are respectively referred to as autobiographical memory and future simulation. Mental time travel is accompanied by a sense of self at different time points in life. Thus, a different sense of self

is predicted to affect how the memory is interpreted. After individuals simulate a memory as if another person experienced it, it affects their phenomenological experience of the original memory such that phenomenological characteristics of the original memory start to be more similar to simulated memory. Additionally, individuals wish to enhance their future self, and this is associated with a positivity bias for the future in which future simulations are perceived as more positive than autobiographical memories. Socioemotional selectivity theory proposes that when individuals become older, their goals shift to more positive emotional goals and this results in a positivity effect of increased attention and memory for positive emotional information. Older individuals interpret the past more positively and enhance their emotion regulation strategies. Based on these findings and theoretical propositions, the goal of the present study was to investigate the effects of simulating a memory as an individual's older self versus another older individual on the phenomenological experience of the memory and the affect related to the memory. There were 98 university students (54 males, 44 females) as participants. In the first session of the experiment, participants retrieved an important negative event (the original memory) and then provided phenomenological ratings related to the event and their affect related to this memory. After one week, in the second session, while one group was instructed to simulate themselves as an older person (older-self condition), the other group simulated another older individual (older-other condition). They retrieved and rated the same memory with these simulated older selves (the simulated memory). After that, they were asked to retrieve and rate the original memory once again as their current selves (the post-simulation memory). Lastly, the attitudes toward older individuals were measured to control possible confounds. The positivity of the memories in the older-self condition was found significantly higher than the older-other condition for all memory types. In the simulation memory, negative affect related to the memory decreased and remained at similar levels in the post-simulation. That is, participants, felt less negative about the original memory after the simulation. There were significant differences between the three memory conditions for vividness, observer perspective, field perspective, reliving, emotional valence, and emotional intensity. The results provided support for the theory that individuals wish to enhance their future self. Additionally, the results showed that simulation of a negative memory as being experienced by an older individual could regulate emotions about the memory by reducing negative affect related to this memory. The present study once more highlights the strong relationship between self and memory, showing how

distancing from the self can be reflected in the phenomenological experience of memories.

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Do naps promote selective memory consolidation in the context of expectation violation in infants?

Given the wealth of new information they encounter every day, infants face the challenge of selecting only some of this information for long-term retention. Sleep facilitates memory consolidation in infants (cf. Seehagen et al., 2019). Initial evidence suggests that sleep might preferentially support consolidation of memories that are perceived to be of future relevance (Konrad et al., 2019). The aim of the present study was to assess the effect of napping on selective consolidation of memories related to unexpected events. Our key prediction was that post-encoding naps selectively strengthen memories related to events violating expectations about physical principles compared to events agreeing with physical principles.

Eighteen-month-old infants (final N = 34) watched televised events either agreeing with or violating physical principles (Stahl & Feigenson, 2015). For example, infants saw an event object seemingly pass through a solid wall (violation) or stop in front of the wall (agreement). After a display of the event outcome, infants were given the opportunity to learn a visual association of the event object with a color. After a 24-hr delay, infants participated in two test trials that assessed their memory for the event object and their memory for the learned association of the event object and colour. Retention was inferred by assessing looking times to the event object relative to a distractor.

To assess the effect of a nap after encoding, infants were randomly assigned to either view events shortly before a naturally occurring nap or at the beginning of an extended period of wakefulness. Each infant was shown both types of event outcomes (agreement & violation), each concerning one of two different physical principles (solidity & support).

Preliminary analyses revealed that infants in the nap condition exhibited a familiarity preference for the event object that violated expectations, suggesting retention of the object. They did not show a

familiarity preference for the event object that behaved in agreement with expectations. Infants in the no-nap condition did not show any evidence of retention for either object. Contrary to expectations, there was no evidence of retention of the taught association in either condition.

These results tentatively suggest that a timely post-encoding nap facilitates retention of objects involved in unexpected events. Contrary to expectations, this selective benefit did not extend to retention of a previously learned association between the object and a coloured background. The fate of early memories could hinge on the type and complexity of information encountered and the timing of their occurrence during infants' sleep-wake cycle.

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Tracking the reconstruction of naturalistic images from memory using similarity-based fusion of MEG and fMRI data

Remembering episodic (i.e., event-unique) information is thought to rely on the hippocampus-driven reactivation of cortical patterns that represent various features of an event. Previous work suggests that this neocortical reactivation follows a certain information processing hierarchy: while during initial perception these information patterns follow a perceptual-to-semantic gradient, the information flow appears reversed when visual images are reconstructed from memory, as evidenced by EEG and behavioral data (Linde-Domingo et al., 2019, Nat. Commun.). To generalize these findings to more feature-rich images and to get a spatio-temporally resolved view into the episodic retrieval process, we are

combining MEG and fMRI in a Representational Similarity Analysis (RSA) based fusion approach.

Thirty participants were tested in an MEG scanner. In a cued-recall paradigm, participants associated words together with unrelated naturalistic images. Later, participants were cued with the word and asked to reconstruct the image in front of their mental eye. A memory test was included to verify participant's actual recall performance.

Images were chosen from the Natural Scenes Database (Allen et al., 2022, Nat. Neurosci.), where high-resolution 7T fMRI data are available from 8 independent participants who repeatedly viewed these images. Moreover, the 96 natural scenes are very well characterized behaviorally, including verbal annotations and similarity judgments.

We transformed the activity patterns elicited by these images into representational similarity matrices, with one matrix per time point for the MEG encoding and retrieval data, respectively, and one matrix per brain region for the fMRI data. This transformation allows us to then compute a second-order correlation (fusion) to compare the MEG with the fMRI patterns (Cichy et al., 2014, Nat. Neurosci.), revealing when in time the MEG time courses best match a given brain region's representational geometry. This approach allows us to test for a reversal in the feature-processing hierarchy between initial perception and memory retrieval of naturalistic images.

Initial classification-based analysis of the MEG signal shows a reliable decoding of high-level semantic features such as Animacy. Fusion correlation time courses during perception reveal significant correlation peaks of early visual regions (V1-V3) that precede correlation peaks with later regions along the lateral temporal gyrus. During retrieval, the order of correlation peaks is reversed such that patterns in lateral temporal regions correlate with the MEG patterns earlier than those in early visual regions. Both forward and backward streams were formally confirmed in a regression analysis. These findings, while preliminary, generalize the flip in the processing hierarchy between perception and memory to complex naturalistic images.

Aiswarya PS **PS2/11**

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Spike and rate-based dynamics for neural systems

How the brain computes has been an important question for a long time. Since then, theorists have proposed many models close to the experimental data. Networks of spiking neurons are increasingly used in neuroscience to understand phenomena observed in electrophysiology recordings. While the rate-based models are practical, they lack empirical evidence.

The dynamics of the brain are multiscale, ranging from ion channels and synapses at the molecular level to emergent behavior, like oscillations at the scale of the entire brain. The challenge, therefore, becomes how to create predictions regarding brain dynamics while simultaneously incorporating these various dimensions.

A different starting point is to initially average over neural features to create a neural field theory that models the average dynamics of several neurons. Local instantaneous firing rates are monitored in this instance, but individual neural spike dynamics are not. These methods are substantially less computationally costly than equivalent research based on the direct computation of single-neuron dynamics. They are well suited to studying large-scale phenomena and bridging across scales. They do not, however, directly incorporate the spiking kinetics of individual neurons, as was already mentioned.

Here we try to study different spiking and rate-based neuron networks analytically and through simulations. To find out under what conditions spike-based models can favorably replace rate-based models.

To do this, we studied two well-known spiking and rate-based models, Brunel Network and the Continuous Attractor Network. The Brunel network is a well-studied network of Leaky, integrated, and Fire (LIF) neurons whose network behavior is very close to the theoretical behavior observed in real neurons. Continuous attractor networks are used to explain one of the high-level cognitive tasks: path integration for spatial navigation in grid cells.

Using these networks as templates, we simplified them and found the parameters in which they produce a similar pattern, possibly suggesting similar behavior.

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The neural basis of learning and memory in changing environments

Our brain tries to predict upcoming events by extracting regularities in the environment and forming expectations. In many real-world situations, however, the state of the environment can change unexpectedly, such that the internal model that generates future predictions must also be updated. We are interested in the effects of state changes on episodic memory, a function that is important for updating and is dependent on the hippocampus. Thus, the main goal of this study is to relate learning parameters from state changes that are computationally derived to encoding of events, and the neural correlates therein. In a probabilistic learning task performed inside the MRI scanner (data collection is ongoing), participants predict the category of objects that are probabilistically associated to different cartoon characters. Participants learn these associations through the presentation of trial-unique objects belonging to different categories. At different points during the experiment, the associations unexpectedly changes so that participants have to relearn them. In a separate task, we also measure brain activity while participants think about the object categories to create a multivariate template of patterns of activation related to a specific category. We expect that after change points the increased updating of the internal models characterized by more uncertain predictions would reflect in reduced instantiation of category-specific activation patterns, and that this effect can be linked to a computationally-derived measure of updating. Moreover, we hypothesize that more intensive updating occurring after change points would result in enhanced encoding of the trial-unique objects through the increased activation of the hippocampus, and especially of the dentate gyrus. Preliminary analyses show that the multivariate pattern of activation in the lateral temporal cortex can be used to detect category-specific brain activity.

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Probing peri-encoding activity linked to subsequent memory of narrative episodes using multi-echo fMRI at 7T

Our daily lives consist of a series of diverse events which are perceived as seamlessly evolving, yet tend to be remembered as discretized episodes. This discretization is thought to rely on the detection of event boundaries as supported by the hippocampus, triggering an early consolidation process to store witnessed events as coherent episodes.

Here, we investigated how both online and offset-related brain activity patterns during the encoding of naturalistic episodes are linked to later memory recall. We scanned participants (n=16) while they watched short, trial-unique movie clips using whole-brain multi-echo EPI at 7T. The movie clips were unrelated to each other and either contained an eventful or uneventful sequence of events. Movie clips were interleaved with a simple distractor task to prevent active rehearsal and pro- or retro-active interference effects across successive movie clips. After a 24-hour delay, participants performed a cued recall task and reported what they remembered for each of the eventful movies, allowing post-hoc sorting of the encoding data. Preliminary analyses (n=10; q(FDR)<0.05; FFX) showed stronger activations during stimulus presentation for subsequently remembered compared to forgotten movie clips in a set of cortical regions, including the bilateral fusiform and angular gyrus, as well as the posterior parietal cortex. Conversely, stronger responses at movie offset were observed in the bilateral striatum, cerebellum and the posterior hippocampus when contrasting eventful vs uneventful movies, without additional modulations based on recall performance. Ongoing analyses are aimed at further characterizing the roles these structures play in both the online and offline encoding of naturalistic episodes.

Francesca Righetti **P06**

Ruhr University Bochum, Germany

Situating trace minimalism: the role of protentional intentionality in remembering

Since the classic experiment of context-dependency in free recall by Godden and Baddely (1975), psychological studies have reliably found effects of bodily and environmental states in memory (Smith and Vela 2001): suggesting that the content and the accuracy of episodic memory depend on the situated conditions in which a subject remember. Considering such effects, I propose a situated version of Trace Minimalism (Werning 2020). Building upon an analogy with the predictive processing framework of perception, Trace Minimalism has described the content of constructed scenarios of the past as the result of a top-down prediction that receives an error signal from minimal memory traces. However, this theory has not considered the role of the environment and the body in the episodic reconstruction process. I provide an empirically-informed phenomenological analysis of - what I have called - "protentional intentionality" to account for such dependency. Drawing on the analogy with perception, I suggest that the protentional intentionality (a conative aspect that drives our interaction with the world) distributes meaning to the events and affects the emotional, agential and social salience of the constructed episodic scenarios of the past.

Emil Eva Rosina **P10**

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"Noch genau wissen" in memory reports: still knowing for sure AND remembering vividly

Summary: The way in which we report memories allows conclusions about their episodic vs. semantic nature. I argue that the German construction "noch genau wissen" is illuminating for this distinction in two respects: In semantic memory reports, "noch genau wissen" (corresponding to English "still knowing for sure") (a) is compatible with "noch wissen" as retained knowledge and (b) takes "genau" to modify the

'degree of evidence'. In episodic memory reports, "noch genau wissen" corresponds to "vividly remember", which (a) is compatible with generative content while (b) "genau" describes richness of descriptive detail rather than certainty.

Abstract: When reporting their (episodic and semantic) memories, German speakers often use "noch wissen" ['still know'] instead of "erinnern" ['remember'] (FOR2812, P4 data). Both episodic (2) and semantic memory reports (1) allow modification with "genau" ['exactly']:

(1) Ich weiß noch genau, dass Napoleon 1821 gestorben ist.

'I still know for sure that Napoleon died in 1821.'

(2) Ich weiß noch genau, wie ich um mein Leben gekämpft habe.

'I remember vividly how I was fighting for my life.'

I argue the different translations of the construction "weiß noch genau" in (1) and (2) are symptomatic of two facts about German memory reports that are insightful for the relation between knowledge and episodic vs. semantic memory:

(a) Memory as retained knowledge?

"Noch wissen, dass" in (1) can be described as retained knowledge ('I knew this before and I still do'); "noch wissen, wie" in (2) cannot, since episodic memory is not reducible to fact knowledge about the past. In fact, "noch wissen" in (2) is reducible to plain episodic memory ("remember how") without any additional contribution of "noch" ['still']. That "noch" and "wissen" ['know'] combine to receive this meaning raises the question of how episodic memory is linked to knowledge, if not as directly as in the semantic memory case.

(b) What does "genau" add?

The contribution of "genau" ['exactly'] in "genau wissen, dass p" can often be paraphrased as "having a high degree of evidence for p". Wurm (2020) captures this by claiming "genau" excludes additional not-p worlds. This is compatible with (1), but not straightforwardly with (2): "genau" would exclude more possible worlds where I was not fighting for my life, while the episodic memory statement is not even about (how sure I am about) knowing that I was fighting for my life. (b) is therefore built on top of the problem of "noch wissen" as not always expressing retained knowledge, (a).

Matching intuitions that (2) is unacceptable in an episodic memory scenario where the details have started to fade, I propose "genau" in (2)

modifies the richness of descriptive detail of the recall of the remembered episode instead:

(1)≈ It is still the case that I have more evidence than needed for knowledge for my belief that p → [noch[genau[wissen[p]]]

(2)≈ My recall of the episode where p is detailed. → [genau[noch-wissen[p-event]]

Reference:

Wurm, Valerie. (2020). Distinguishing semantic components of attitude verbs via the German modifier genau. Linguistica Brunensia. 23-40. 10.5817/LB2020-1-3

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Collective retrospective future thinking

Previous methods have measured people's thinking about the past and future by having them consider it from their current perspective and reporting their memories regarding their current self. However, there is limited research on whether people can think about the past or future as if they are not in their current selves and how this could affect how they remember and think about those events. Retrospective future thinking, introduced by Roderer and Bohn (2022), is a framework for imagining the future from the perspective of a person's "100-year-old self" (i.e., an older version of the present self), instead of current selves. However, they mainly focused on the personal events, and no research so far has addressed how retrospective future thinking influence the content and timing of the collective events reported. As such, proposed study seeks to understand how collective and autobiographical memories of individuals in Turkey are utilized in the realm of retrospective future thinking. Hereby, we have two main goals. First, we aim to replicate the evidence on retrospective future thinking over personal events (Roderer & Bohn, 2022). Second, we aim to examine retrospective future thinking in the context of collective events to understand the connection between personal and collective events. We believe that is particularly important in the context of Turkey due to the numerous, unexpected events occurring in Turkey one after the other.

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PS2/19

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Neural reinstatement of memories across immediate, short and long delays : a comparison between children and young adults

Memory consolidation tends to be less robust in childhood than in adulthood. However, little is known about the corresponding functional differences in the developing brain that may underlie age-related differences in remembering of memories over time. The present study examined system-level memory consolidation of object-scene associations after learning (immediate delay), one night of sleep (short delay), as well as two weeks (long delay), in 6-to-7-year-old children (n = 49) in comparison to young adults (n = 39). Particularly, we characterized how the reinstatement of activation patterns (assessed by representational (dis)similarity analysis, RSA) changes over time. Our results showed that memory consolidation in children was less robust (i.e. more forgetting) compared to young adults. For correctly retained memories, there was a decline in scene-specific neural reinstatement (after object cues) from immediate delay to short delay in medial-temporal, neocortical, and cerebellar brain regions, and further decline from short to long delay in prefrontal and posterior brain regions. We also found an overall more attenuated scene-specific reinstatement of neural patterns in children compared to young adults. In contrast, we observed category-based neural pre-activation in medial-temporal, neocortical (prefrontal and posterior), and cerebellar brain regions only in children. Taken together, our results suggest that 6-to-7-year-old children show less robust memory consolidation, attenuated scene-specific reinstatement of neural patterns, and less differentiated, more gist-like category-based neural pre-activation compared to young adults.

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Social status does not facilitate memory integration

Events consist of different elements that need to be bound together in episodic memory to enable the formation of coherent memory representations. Research on moderators regarding such binding processes has been scarce. Given the numerous demonstrations of social motives influencing cognition and preliminary evidence that social status facilitates associative memory, we considered social status as a possible moderator. In two experiments, we thus investigated whether the presence of a person of high social status in an event facilitates binding, thus enabling the formation of more coherent memory representations. Participants were presented events consisting of a person name, an everyday object, and a location, presented as words, and were instructed to imagine these elements as part of a scene and interacting in a meaningful manner as vividly as possible. In Experiment 1 (N = 266), social status of novel groups was manipulated and names were generated to follow group-specific naming conventions. In Experiment 2 (N = 241), US-American first names were selected based on preexisting status associations and status was additionally indicated by vertical screen location (top or bottom) in which the name appeared, aligning with the association between vertical position and status, as well as font color. We analyzed the stochastic dependency of the retrieval of event elements as an indicator of memory integration, using a novel but already validated statistical modeling approach (Schreiner & Meiser, Behavior Research Methods, 2022), which is based on item response theory. We found evidence for memory integration in both experiments, but the stochastic dependency of the retrieval of event elements was not larger for events including a person of high status than for events including a person of low status. This finding suggests that social status does not facilitate memory integration and that memory representations are of comparable coherence independent of whether events include a person of high or low social status.

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Relevant or irrelevant? The influence of gist- and surface-level episodic prediction errors on brain activity and memory

Episodic memories are not always exact copies of past experiences, as they are subject to change. Such memory modifications are potentially fueled by mnemonic prediction errors, i.e. when retrieved memory content does not fit current situational input. It has been suggested that this way of incorporating new information into our memories allows us to maintain valid predictions in a highly dynamic environment. In the present study, we aimed to identify brain regions which respond to different types of mnemonic prediction errors which either challenge the gist of an episode or leave it intact, and to evaluate their influence on subsequent memory. Thirty-seven participants encoded different episodes which showed short toy stories. On the next day, participants returned for an fMRI session, during which they were either presented original or slightly modified episode videos. In modified versions, an object was changed compared to the original, and the change either influenced the gist of the story (gist modification) or only supplementary detail which was not relevant for the episode storyline (surface modification). On the third day, participants went through a post-fMRI memory test to probe memories for originally encoded episodes. For gist modifications, we found strong brain responses in areas we previously identified for the processing of content-based prediction errors, namely ventrolateral prefrontal cortex, intraparietal cortex and (lateral) occipitotemporal cortex. As expected, these responses were substantially weaker for surface modifications. Interestingly, gist modifications also triggered activation in posterior temporal cortex and precuneus, which we had previously identified for predictions errors affecting episode structure. Furthermore, pregenual anterior cingulate cortex and middle/posterior cingulate cortex were downregulated in gist modified episodes in comparison to unmodified ones. As expected, surface modification elicited higher activation in posterior hippocampus than gist modifications. In the post-fMRI memory test, previous experience with modified episodes increased the participants' tendency to erroneously accept the same as truly encoded. However, this effect was only found for surface, but not for gist modifications. In conclusion, we showed that the impact of episodic prediction errors on brain activity and memory depends on their relevance for the overall gist of the episode. While gist

modifications elicited more pronounced brain activation, only repeated encounters with surface modifications induced later false memories.

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P04

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The impact of semantic information on memory for temporal sequences

According to the scenario construction framework, episodic memory retrieval can be conceptualized as a constructive process that relies on the combination of episodic memory traces and stored semantic information (Cheng et al., 2016). In cases where episodic and semantic information are in conflict, this process may introduce a semantic bias in the reconstructed memory as evidenced by previous studies in the domain of spatial episodic memory (Tompary & Thompson-Schill, 2021; Zöllner et al., 2022). The present project aimed to investigate these processes in the domain of temporal episodic memory.

We presented participants with sequences of object images from the THINGS database (Hebart et al., 2019) and asked them to make forced-choice temporal proximity judgments during subsequent memory retrieval. The sequences of images were constructed in a highly controlled fashion, introducing statistical regularities based on the images' semantic categories. Images from the same semantic category tended to cluster in time, allowing for the contrast of participants' retrieval performance on congruent trials – where the cue and the correct choice image were from the same or neighboring semantic categories – with their performance on incongruent trials. A larger error rate was expected on incongruent trials based on the assumption that when participants do not have an exact episodic memory of the event, they would rely on semantic information to reconstruct the encoded temporal sequence. In addition, the study considered the strength of episodic associations and its impact on semantic memory bias. Episodic associations between events are known to be weaker in the backward as compared to the forward temporal direction (Healey et al., 2019). Accordingly, we expected a higher error rate on backward retrieval trials than on forward retrieval trials as

participants would supplement incomplete episodic memory with semantic information. Likewise, error rate was expected to be positively associated with the temporal distance between cue and choice images during encoding owing to weaker episodic associations with increased time between two events. Lastly, cue typicality was expected to be positively related to error rate, as highly typical retrieval cues were thought to evoke stronger semantic representations.

Behavioral data from our initial pilot study with 68 participants supported the project's main hypothesis regarding the impact of semantic information on temporal episodic memory. We found a significantly higher error rate on incongruent trials as compared to congruent trials. Our predictions regarding temporal direction, temporal distance between cue and choice images and cue image typicality were not supported by the behavioral data. Overall, we could show that semantic information biases episodic memory for temporal sequences in a way mirroring previously reported effects regarding episodic memory for spatial associations. Future studies may explore the role of additional influencing variables and the neural basis of these processes.

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PS2/20

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Silencing hippocampal CA2 reduces behavioral flexibility in spatial learning

The hippocampus is a key structure involved in learning and remembering spatial information. However the extent to which hippocampal region CA2 is involved in these processes remains unclear. Here we show that chronically silencing dorsal CA2 impairs reversal learning in the Morris water maze. After platform relocation, CA2-silenced mice spent more time in the vicinity of the old platform location and less time in the new target quadrant. Accordingly, behavioral strategy analysis revealed increased perseverance in navigating to the old location during the first day and an increased use of non-spatial strategies during the second day of reversal learning. Confirming previous indirect indications, these results demonstrate that CA2 is recruited when mice must flexibly

adapt their behavior as task contingencies change. We discuss how these findings can be explained by recent theories of CA2 function and outline testable predictions to understand the underlying neural mechanisms. Demonstrating a direct involvement of CA2 in spatial learning, this work lends further support to the notion that CA2 plays a fundamental role in hippocampal information processing.

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Theta phase separates object features in human hippocampus during an associative memory task

Theta oscillations have been shown to clock memory processing in hippocampus. Recent studies using spatial memory tasks have shown that when the task contains opposing alternatives, e.g., left versus right, the hippocampus represents these alternatives at different theta cycles (Kay et al., Cell, 2020) or theta phases (Kunz et al., Sci. Adv., 2019). It is unclear whether this theta-locked separation extends to non-spatial tasks.

Here, we explore the signatures of encoding and retrieval of associations and how these are impacted by the presence of opposing answer alternatives. We recorded intracranial EEG from the hippocampi of 11 epilepsy patients using Behnke-Fried electrodes, while the patients learned and later recalled cue-object associations. The patients were asked to remember two features about each object, namely whether they were photographs or drawings, and animate or inanimate objects. Across patients and sessions, we identified 372 single units located in hippocampus and parahippocampal cortex. We analysed the representational similarity (RSA) between objects and features using spiking activity of these units and compared it to the theta rhythm detected in the Local Field Potential (LFP).

We report an increased separation during encoding of cue-object association patterns. The cue-object binding patterns were reinstated after the cue was shown in the retrieval phase of the task. Intriguingly, pattern similarity oscillated with frequencies in the theta range. Opposing object features, e.g., photo versus drawing, oscillated out of phase with each other, suggesting task demand influences the representation of objects in hippocampus. These fluctuations in feature representations locked to opposite phases of the theta oscillations detected in the LFP. We identify a subset of units that show phase-locked spiking activity and characterize their contribution to feature representation in the memory task. Our data suggest that representations in hippocampus not only reflect perceptual information, but also capture the mnemonic decision.

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Impact of model-based and model-free agents on spatial memory performance

Spatial Memory is an important cognitive function that allows individuals to remember the location of objects and navigate in an environment. Reinforcement learning is a theoretical framework for decision-making tasks, such as spatial navigation. Reinforcement learning methods can be model-based or model-free. Model-based agents use cognitive models of task structures and environmental variables known as cognitive maps. Model-free agents, in contrast, store cached value estimates. This research intends to examine how well model-based and model-free agents perform on spatial navigation tasks. A better understanding of the mechanisms underlying spatial memory

performance in individuals with spatial memory deficits, such as those with Alzheimer's disease or other neurological conditions.

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Evaluating visual pings as a method to enhance the readout of long-term memory contents

Owed to their high temporal precision, electrophysiology methods have become a staple tool in research on how memory processes unfold in the brain. However, these methods come at the expense of reduced signal fidelity, as the relevant neural representations are partially drowned out by activity unrelated to the process of interest. This is particularly problematic in long-term memory research, where events are conjured up from stored representations, thus exerting only a weak and temporally variable signal compared to visual stimulation or actively maintained information. To enhance the study of long-term memory contents, pattern classification techniques have been developed with increasingly strong readout capabilities. While these techniques have proven useful, additional methods that enhance the fidelity of memory representations are in high demand. In this electroencephalography (EEG) study, we evaluate an experimental manipulation that could further improve classification performance. Specifically, we present a salient visual impulse (a "ping") as memory retrieval processes are ongoing. Building on previous work, we hypothesize that this stimulus induces a burst of activity that interacts with neural activity associated with memory content, thereby increasing its signal fidelity. We tested this prediction in a memory task in which thirty participants learned to associate words and images, which were retrieved from memory following a task to flush out working memory effects. We contrasted classification performance between pinged and non-pinged retrieval trials, evaluating whether there is increased evidence for the representation of retrieved image categories shortly following ping onset. With the analysis still underway, we thus seek to evaluate whether ping-based classification could offer a general tool to facilitate our inquiry into how the brain remembers, or whether there are differences in how visual impulses interact with working and long-term memory that limit its usefulness to actively maintained content.

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PS1/21

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Ripple activity in medial temporal lobe during sleep is modulated by previous awake experience

Memory consolidation stabilizes the neural representation of an experience into a more permanent form that can later be recalled. This process is hypothesized to be closely linked to repeated reinstatement of brain activity present during the initial encoding of the experience. Computational benefits of reactivation for memory consolidation have been demonstrated in well-established models of hippocampus and neocortex. Moreover, research in rodents has extensively shown connections between the encoding of experiences, the reinstatement of their associated activity patterns during both awake rest and sleep, and the endurance of behavioral signs of memory. The hippocampus, along with its associated structures in the medial temporal lobe (MTL), is thought to be central to this phenomenon. Ripple oscillations, short bursts of highly synchronized activity most precisely described in the hippocampus, provide ideal circumstances for reactivation-based memory consolidation, and are indeed often correlated with specific sequence replay in rodents. Exploring the mechanisms of memory reactivation in the human MTL and its role in memory consolidation is one of the central challenges in the field of memory research.

In our current work, we aim to investigate reactivation of awake experience in the electrophysiological activity of the human MTL, using data recorded from intracranial electrodes during deep sleep. Electrodes were implanted bilaterally in amygdala, entorhinal cortex (EC), parahippocampal cortex (PHC), and both anterior and posterior hippocampus of, up to now, four epilepsy patients. Over two separate nights, patients were asked to learn a sequence of images of either objects or scenes in a two-dimensional spatial configuration, and to accurately reproduce the correct sequence and spatial positions of the items post-training and during a retest the next morning. Overnight after the training phase, we measured the ripple activity during deep sleep (stages 2 and 3) in all brain regions under investigation. This allowed us to

investigate the influences of experimental condition (whether the patient studied a sequence of objects or scenes) on ripple rates within the MTL.

Preliminary results suggest increased ripple rates during deep sleep in the left compared to the right hemisphere outside the hippocampus ($p < 0.05$, repeated-measures ANOVA), with ripple rates not affected by hemisphere between hippocampi. Interestingly, ripple rates during deep sleep were slightly increased in the left vs. right EC following the learning of object sequences as compared to sequences of scenes ($p < 0.05$, paired-sample t-test). No other region, particularly not the PHC, showed this divergence with the experimental condition.

The human PHC is known to be involved in the processing of different kinds of stimuli including both scenes and objects, which is confirmed by the condition-invariance of PHC ripple activity in our data. The increased activity of left-hemispheric EC during one night (object stimuli) compared to the other (scene stimuli) suggests a stronger involvement in the memory processing of object- as compared to scene stimuli. This might extend the EC's known preference for object stimulus processing to be relevant not only in visual processing, but also in memory formation.

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Parametric distance effects in mental time travel

Through "mental time travel", humans can project themselves in time, reliving past events or exploring possible futures. This ability requires that events be flexibly mapped on an internal temporal coordinate system - a cognitive map, or a "mental timeline". Such cognitive maps have been described in spatial navigation, where the self can be represented in relation to the landmarks of the environment. The parallels between mental time travel and spatial navigation, on a neural level, suggest that similar mechanisms may underlie temporal navigation. Therefore, we may conceptualize mental time travel in terms of computations of spatial and temporal distances between events and self. As such, cognitive maps can ground the operations underlying the contextualisation of events in space and time, thus allowing to build the multi-dimensional representation necessary for episodic reconstruction. Within this framework, self-projection in mental time travel can be operationalized as a shift of the

temporal cognitive map on a new reference. To behaviourally test this shift of reference, we built a mental time travel paradigm based on previous work by Arzy et al. (2008) and Gauthier et al. (2016). In this task, participants projected themselves at different distances in the past or in the future. They were then presented with historical events, given from a list they had previously learned. They had to choose whether the events had already happened, or had yet to happen, with regards to the moment they imagined themselves to be. Reaction times and errors were collected. We devised two versions of this task by manipulating the conditions of self-projection. In the first version (N = 28), participants always had two seconds to project in time, before the event was presented. As such, the operations of self-projection and event ordering would have been partly confounded. In a second version (N = 35), participants had to press a button to indicate when they were projected. Response times were collected. Therefore, the cost of projection would have been captured by this response, distinct from the cost of event ordering. In line with our working hypothesis, we found that the further the projection, the greater the behavioural cost (as assessed by reaction times). This effect was present both when projecting and when ordering events. Previous work (Arzy et al., 2008; Gauthier et al., 2016) showed a cost of projecting in time, by contrast with being in the present. We expanded on this finding by showing that this cost increases parametrically with the distance of projection. Furthermore, we found two distinct behavioural patterns, partly disentangled by manipulating the conditions of self-projection. Responses to the projection itself showed a quadratic trend with increasing distances of projection. When the projection time was fixed, this cost was partly reported on event ordering. Event ordering itself induced a cost that increased linearly with the distance of self-projection. These two distinct patterns suggest that we were able to disentangle two operations of mental time travel: the initialization of the temporal map, and the ordering of the events on this map.

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Memory bias in the service of shared reality creation with an audience: Is the effect different if the communication target is the self?

A bulk of empirical evidence shows that episodic memory is susceptible to social influence. This influence can be exerted not only intentionally by social agents; it can also emerge incidentally in interpersonal interaction and communication, without any intention or explicit awareness of the participating actors. Such memory biases are often the joint product of cognitive processes and people's needs and motives. One well-known example of a motivated memory bias is the so-called „saying-is-believing" (SIB) effect, in which episodic memory retrieval of a communicator is biased in the service of shared reality creation with his/her audience. In a typical experimental demonstration of the SIB effect, a communicator first reads a text describing ambiguous behaviors of a target person (called Michael) and then describes this person in a personal message to an audience, after having learned that this audience knows Michael and either likes him or does not like him. Finally, the communicator is asked to recall the original text about Michael. The typical finding is that not only the communicator's message valence is biased towards the audience attitude, but – more critically – also his/her individual episodic memory of the original information about the target person. By adapting the own personal memory toward the audience attitude, the communicator not only strategically tunes the own communication due to social demands, but actually creates a shared reality with the audience. This interpretation is underscored by the fact that the extent of the effect depends on the degree of the communicator's epistemic trust and subjectively perceived shared reality with the audience. However, no study has investigated so far whether such shared reality effects on memory are also found when the target person is not a stranger but the communicator her-/himself. In the present study, we addressed this issue for the first time, drawing on the well established "mnemic neglect paradigm" (Sedikides et al., 2016), which allows a direct comparison between the self and a stranger as a target. In this paradigm, memory is assessed for negative and positive behaviors (central=essential for a person or peripheral=nonessential for a person) that are allegedly

likely to occur in oneself vs. in another person on the basis of a bogus personality questionnaire. To include shared reality processes in this paradigm, particioants received additional online feedback from an alleged expert, who served as the communication partner (expressing a positive, negative, or neutral audience attitude about the target's behavior). Initial results (N=361) show an overall audience attitude effect on memory, but with an unexpected pattern: A strong memory advantage for positive compared to negative behaviors was specifically observed after neutral, but not after positive or negative feedback, and this pattern was particularly pronounced for central behaviors and when the target was the self. However, audience attitude effects in the direction of shared reality creation appeared to occur to some extent for peripheral behaviors, regardless of target person. Central behaviors may be less susceptible to shared reality influences because they are generally much better remembered than peripheral behaviors.

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Shifts in visual perspective predict the consistency of autobiographical memory

Background. Memories provide a record of past events, allowing us to replay what we have experienced like a video in our mind. This mental imagery can manifest from different perspectives: we can watch an event from our own eyes or through the eyes of an observer. Unlike a video, however, memory reconstructs the past in adaptive, but not necessarily faithful, ways. Using a naturalistic, prospective design, we asked how the visual perspective adopted in the mind's eye when recalling events from one's personal past relates to the consistency of autobiographical memories. We hypothesized that greater changes in either own or observer visual perspective would predict poorer consistency of mnemonic details over time.

Methods. A total of 178 undergraduate students rated the phenomenology of and freely recalled three self-selected autobiographical memories of everyday neutral events. Approximately 10 weeks later, participants returned to rate and recall the same three events again. Memories were scored for the details provided in accordance with

Levine and colleagues' Autobiographical Interview (AI; 2002, Psychology and Aging), including event (what happened, who was there), perceptual (percepts, sensations during event), emotion/thought (feelings, cognitions during event), and time and place details. The details identified in the two memories for each event were then compared across sessions using a novel consistency scoring procedure, the AI-Consistency Supplement (AI-CONS).

Results. As expected, multilevel linear modeling revealed that greater shifts in self-reported visual perspective predicted lower memory consistency. Changes in both own visual perspective (β=–.13, p=.004, R2= .28) and observer visual perspective (β=–.11, p=.017, R2= .26) were associated with less consistent memories. Examination of consistency of specific detail types being recalled revealed that the relationship between shifts in visual perspective and reductions in memory consistency was driven by poorer consistency of emotion and thought details.

Discussion. Poorer consistency of memory for the emotions and thoughts experienced during past events may indicate that shifts in visual perspective can reshape the subjective experience of events retroactively. Shifting visual perspective when recalling events from one's past may benefit clinical settings in which reappraising or altering the emotionality of a memory is the target of intervention. The ability to change the memory for how one felt during an event in relation to shifting the perspective from which the event is remembered may reflect the very human ability to adopt varied perspectives, literally supporting us in seeing the world from a different point of view.

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Semantic aspects of shameful memory

It is widely assumed that autobiographical memories rely on the integration of memory traces with one's self-model, but the neurocognitive mechanisms underlying this process are still not clear.

We recently demonstrated that experiencing shame or guilt affects memory recall on both semantic and phenomenological levels. Specifically, memories evoking shame, but not guilt, are remembered from

a more pronounced third-person perspective. To further investigate how semantic and phenomenological aspects of memories change when self-incongruence is experimentally manipulated, we conducted a follow-up study. We employed a naturalistic experimental paradigm that induced shame in participants and then manipulated the level of self-incongruence.

After singing a song ("Hello" by Adele) in front of two committee members who maintained a neutral and reserved demeanor, participants were randomly assigned to three experimental groups. They either engaged in a neutral conversation about the singer Adele (control condition), were asked to reinterpret their singing task experience in a positive light (reframing condition) or were encouraged to reflect on positive previous experiences (self- affirmation condition). Finally, participants provided a free verbal recall of the shameful experience. All memory tasks were repeated one week after the initial testing. We used the free verbal reports from week 1 and week 2 to further explore the phenomenological and semantic aspects of the shameful memory recall.

First, we counted the occurrences of self-referencing words, defined as first-person pronouns (e.g., 'I', 'my', 'mine'), for each sentence in the transcripts. Second, we applied a natural language processing (NLP) model in order to analyze the semantic similarities between sentences). The employed transformer-based model can encode sentences into fixed-size, high- dimensional vector representations called sentence embeddings which capture semantic relations from texts by considering contextual relationships between words. We computed sentence embeddings for all free recall reports and analyzed semantic similarities within and between subject reports.

Preliminary results suggest that self-referencing word usage in verbal recall increased over time in self-affirmation and reframing conditions but not for the control condition. This result supports our previous findings regarding the increase in third-person perspective in recalls of shameful episodes. Additionally, only the self-affirmation condition exhibited an increase in overall sentence similarity on week 2 compared to week 1, indicating participants recalled semantically more similar content. In follow-up analyses, we will investigate additional NLP metrics, such as the temporal structure, topic modeling, and valence, to further analyze the neurocognitive basis of self-incongruent memory episodes.

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What is a memory system? A systematic mapping review

Since the 1980s, neurocognitive research has been dominated by a pluralistic view of memory known as the Multiple Memory Systems theory (MMS). The general idea is that memory can be divided into multiple systems that are neurobiologically and phenomenally distinct. Therefore, much of the research was oriented toward finding these systems' characteristics and brain correlates. However, despite the undeniable progress that this approach has made in understanding memory, it has inherited specific problems that remain unresolved to this day. First, there is still an open debate about what should be understood by a memory system and, therefore, how the different systems should be classified. In this work, a systematic mapping study has been performed with 41 rigorously selected primary studies. Our goals are (i) to trace how the theory of MMS was developed, (ii) to present how the concept of "memory system" has been understood, (iii) to review some contemporary models based on MMS, (iv) to raise some difficulties that arise from those conceptualizations and, (v) provide some ideas for a reconceptualization of the theory. The main conclusions are: (i) there is no clear conceptualization of what a memory system is, (ii) the theory has been based, first, on the idea of a structural separation and, later, on a functional separation that inspires the models to defend still different memory systems, and (iii) the epistemological and ontological commitments of the theory are based on a representationalist view that requires a theory of content that does not exist to date. Finally, we suggest some enactive and ecological ideas that may support an alternative framework for studying and understanding the MMS.

Xiangshuai Zeng, Nicolas Diekmann, Laurenz Wiskott, Sen Cheng **P02**

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Modeling the function of episodic memory in spatial learning

Episodic memory has been studied extensively in the past few decades, but so far little is understood about how it drives future behavior. Here we propose that episodic memory can facilitate learning in two fundamentally different modes: retrieval and replay, which is the reinstatement of hippocampal activity patterns during later sleep or awake quiescence. We study their properties by comparing three learning paradigms using computational modeling based on visually-driven reinforcement learning. Firstly, episodic memories are retrieved to learn from single experiences (one-shot learning); secondly, episodic memories are replayed to facilitate learning of statistical regularities (replay learning); and, thirdly, learning occurs online as experiences arise with no access to memories of past experiences (online learning). We found that episodic memory benefits spatial learning in a broad range of conditions, but the performance difference is meaningful only when the task is sufficiently complex and the number of learning trials is limited. Furthermore, the two modes of accessing episodic memory affect spatial learning differently. One-shot learning is initially faster than replay learning, but the latter reaches a better asymptotic performance. In the end, we also investigated the benefits of sequential replay and found that replaying stochastic sequences results in faster learning as compared to random replay when the number of replays is limited. Understanding how episodic memory drives future behavior is an important step towards elucidating the nature of episodic memory.

Huan Zhang[1,2,3], Ziqian Cui[1], Xiping Liu[1,2], Ullrich Wagner[3], Gerald Echterhoff[3] **P09**

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The influence of intimate relationship on the "saying is believing" effect

Communicators adjust their memory information to align with their audience's attitudes, a phenomenon known as the "saying is believing" (SIB) effect. However, the impact of romantic relationships on the SIB effect is not well understood. The current study, based on shared reality theory, aimed to examine the influence of romantic relationships on the SIB effect and its underlying processes in heterosexual couples. In the main experiment, 23 pairs of heterosexual romantic partners were recruited, and asked to communicate with their partners and with opposite-sex strangers separately. To ensure the reliability of the results, a replication study was conducted with 22 additional pairs of heterosexual romantic partners. The results consistently showed that: a) the SIB effect occurred in the group of heterosexual romantic partners but not in the group of strangers; b) relational motivation played a mediating role between romantic relationship and SIB effect (recall bias). These results indicate that under these real-life conditions shared reality is created when romantic partners, rather than strangers, are the audience, and that the strong relational motivation for one's partner appears to play a major role in the SIB effect. These findings have important implications for understanding communication in romantic relationships and the impact that romantic partners can have on one's own opinions and memories.

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Remembering while being clueless: The neural basis of constructive episodic memory retrieval

When retrieving a past episode, several factors influence what is being remembered. The scenario construction model hypothesizes that episodic memory retrieval is a constructive process, in which only the gist of an experienced moment is retrieved, while missing details are complemented by semantic information (Cheng, Werning & Suddendorf, 2016). In previous work, we developed a promising paradigm to investigate semantic construction during episodic memory retrieval (Zöllner, Klein et al. 2021). Specifically, participants experienced and interacted with common household objects in unexpected places in a virtual environment. One day after encoding, participants took part in a retrieval task and were asked to recall the location of objects which were part of the encoded sequence. We found that when incorrectly recalling the location of an incongruently encountered object, participants tended to remember the object in a the semantically fitting location instead, and we thus found a behavioral bias towards pre-existing semantic information during memory retrieval.

In the current study, we combined the paradigm with fMRI data acquisition to further investigate not only the behavioral pattern of scenario construction, but to also look at the underlying neural features. We investigate how encountered objects are represented on a neural level, both pre- and post-encoding. The representational structure pre-encoding is expected to be shaped by semantic relations between objects alone (e.g. Cohen et al., 2017), while post-encoding, it is expected to reflect the experienced episode (Deuker et al. 2016). The representational change is thus expected to be less strong for semantically constructed objects. Indeed, our preliminary analyses show a semantic clustering pre-encoding in higher visual areas. Objects which were remembered, but not necessarily experienced, in close proximity to each other showed higher pattern similarity post-encoding compared to pre-encoding in the hippocampus. This work contributes to our understanding of the scenario construction process in cases of episodic memory retrieval and elucidates its neural basis.

WHERE TO FIND THINGS

Food
Cafés
Office supplies
Printing
Meditation

5 INFORMATION

FOOD

1. MENSA (€)
The "Mensa" is the university's main cafeteria. It offers a diverse range of meals including vegan, vegetarian and halal options. You can chow down on traditional currywurst with fries, go healthy at the salad bar, or fill up on carbs at the pasta bar. We recommend trying it out at least once during your stay.

Location: Directly above the conference center - Level 02
Payment: Plastic only
Opening hours: M-F 11:00 - 14:30

2. KAFFEEBAR (€)
Above the "Mensa" is the Kaffeebar. It offers hot drinks, sandwiches, waffles, muffins etc. You can also get your ice cream fix here.
It's a good place for a light snack if you don't feel like having a full meal or if you are craving something sweet after lunch. Vegan milk alternatives are available.

Location: Directly above the conference center - Level 01
Payment: Plastic only
Opening hours: M-F 08:00-16:30

3. ROTE BETE (€€)
The "Rote Bete" is RUB's vegan cafeteria. It offers new dishes daily. Payment is per plate and you may pile it up as high as you like! Terrace seating is available.

Location: Directly above the Mensa - Level 01
Payment: Plastic only
Opening hours: M-F 11:00-14:30

4. Q-WEST (€€)
Q-West is situated to the west of the main square and is 350 m walk from the conference center. It has out door seating and offers dishes such as pizza, pasta and stir fry. If you are lucky you may find that the grill hut is open! The bar's barista can whip you up your coffee fix, which is great to wash down their tempting German style cakes.

Location: West of the main square
Payment: Plastic only
Opening hours: M-F Lunch 11:30-14:30; Coffee 14:30-18:00; Dinner 18:00-21:30

OTHER CAFES:

KULTUR CAFE (€)
Grab a sandwich and relax in a pub like setting. Meet up after the conference for a beer, a shot or a cup of steaming hot chocolate.

Location: Well hidden! Building SH (see google map)
Payment: Cash only
Opening hours: M-Th. 10:00-20:00, F 11:00-16:00

EDWARDS (€)
A traditional cafe. Rumored to have the best coffee on campus

Location: Main library - ground floor
Payment: Plastic only
Opening hours: M-F 09:00 - 18:00

OFFICE SUPPLIES

Yes, we know that feeling! You arrive at your destination only to realise all the things you forgot to pack. Luckily there are a couple of places near by where you can stock up on those famous German office supplies.

CAMPUS CENTER:
Step into the campus center, which is a building very uncharacteristic for the RUB. It is in front of building GA, between the Mensa and Q-West. It houses a few small shops including a traditional Kiosk, where you can buy cold drinks, snacks, magazines, beer, tabacco etc., an old fashioned record store, in case you are looking to expand your LP collection, a cell phone store, a local SIM anybody?, and the ever important office supply store.

Location: RUB
Payment: Cash or credit
Opening hours: M-F 09:00 - 17:00

UNI CENTER:
After alighting from the U35 and climbing the stairs turn left instead of right and you will be in a small shopping center. There are two stationary stores here. McPaper and Druckhaus Bochum.

Location: Querenburger Höhe 220, 44801 Bochum
Payment: Cash or credit
Opening hours: M-F 8:30 - 20:00 / Sa 9:30 - 18:00

DOWN TOWN:
Tintenfass is a cute locally owned stationary store a stone throw from the Bochum main train station.

Location: Huestraße 12, 44787 Bochum
Payment: Cash or credit
Opening hours: M-F 10:00 - 18:00 / Sa 10:00 - 16:00

PRINTING

COPYSHOP CAMPUS:
Privately owned. Two locations.
They claim to be able to print all sizes.

Location: Uni Center and Campus Center
Payment: Cash or EC card
Opening hours: M-F 09:00 - 17:00

RUB COPY CENTER:
This is the university's official copy shop. It offers high quality printing at reasonable prices. Note that they may need 24 hours to print a poster, but you can also send it to them by email (druckzentrum@rub.de).

Location: Bottom floor of building SSC (SSC 01/219)
Payment: Cash or EC card
Opening hours: M-W 08:00 - 16:30 / Th-F 8:00 - 15:00

MEDITATION

Do you need a quiet place to meditate, pray or just take a few moments for yourself? Try out the Ruhr University's new addition "Raum der Stille" (room of silence). It is conveniently located in the same building as the conference center. Just take the elevator up to level 01 and find it across from the "Rote Bete". Please check out the list of dos and don'ts at https://einrichtungen.ruhr-uni-bochum.de/en/room-silence

Location: Mensa building, level 01
Opening hours: M-F 08:00 - 16:30

Disclaimer

Please note that although we have tried our best to provide you with up to date and correct information we cannot be held responsible errors and changes. Note that the times listed above are only valid until 14.07.2023. There are a plethora of eating places off campus. Please see the conference website for other suggestions and maps.

GEM Coordination Team

Google map of Bochum with above sites and more

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FOR 2812
CONSTRUCTING SCENARIOS OF THE PAST

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