ABSTRACTS
Poster Sessions I
Monday
(Order: By number)

Yaoli Du

1 - SITUATED COGNITION IN THE "LOGICAL SPACE OF REASONS" - A SPACE OF WHAT KIND AND WHAT FOR?

Yaoli Du, Institute of Philosophy, TU Braunschweig

Abstract:

Situated cognition emphasizes that cognition and action occur dynamically under environmental conditions (Suchmann 2007). This account concerns embodied, extended cognitive states and processes that are embedded in and enacted within environments (Haugland 1993; Newen 2018). Accordingly, mental states and mental processes cannot be understood in isolation as internal functional states or information processing, but should be placed in dynamic relations among brains, bodies, and environments (Gallagher & Allen 2018). However, how to bring the context-dependent dynamic cognitive processes together with standard representationalist models is a difficulty in the modelling of situated cognition. In standard representationalist models, cognitive processes can be modelled as data structures and computational procedures to simulate mental representations and operations on them (Thagard 2005). Mental representations are often regarded here as being stored internally (Schwitzgebel 2022). It then becomes a challenge to combine "external" environmental resources and "internal" operations of representations into a consistent cognitive model. This paper will draw on the inferentialist notion of the "logical space of reasons" to bridge internal and external distinction, in search of a consistent conceptual framework for context-aware reasoning agents that accounts for how semantics occurs. The term "logical space of reasons" was introduced by Sellars (1956) with the basic idea that if a mental episode or state can be characterized as knowledge, it can serve as a reason as and ask for reasons in a logical space. Here the semantic content is understood in terms of its inferential role. Semantics is not grounded in a correspondence between the internal and the external but is generated in the construction of a logical space expressed through language. Meaning is thus not a referential relation between internal representations and the external world, but rather a use of expressions involving a range of material inferences. Based on this account, operations on representations and access to resources can be incorporated into an inferentialist framework. It will be argued in this paper that this framework is compatible with situated cognition, where action plans are regarded here as resources for action rather than representational scheme or controlling structures.

Furthermore, this paper will elaborate on why the logical space of reasons is necessarily a normative space, and how normative statuses of cognitive agents can replace functional states of cognition in the inferentialist framework. In Brandom's further development of inferentialism, he emphasizes that rational agents with intentional goals are constituted by reciprocally authorizing each other to enter a normative space of shared social practices and to participate in the language game of giving and asking for reasons (Brandom 2007; 2015). Accordingly, the attributions of mental states and the interpretations of representational content can be expressed as normative statuses that are authorized and committed to discursive commitments. This paper will argue for the advantages of modelling information

processing with normative statuses for situated cognition, particularly for socially situated cognition that is intersubjectively engaged in discursive practices. In a normative inferentialist framework, perceptual beliefs are not representations of environmental information but rather take the form of authorizations or expressed as adaptable conceptual labelling of information patterns, identifying, interpreting and utilizing resources. Accordingly, data structures modeling representations are not stably stored internally but are resources in social and physical environments that can be accessed, retrieved and employed for action. The paper concludes by indicating that the normative inferentialist framework does not only model the information processing of cognitive agents but also accounts for the active role of environmental resources. In the logical space that breaks down the distinction between internal and external, access to information patterns and the construction of operating rules are not two separable steps in information processing by cognitive agents. Rational agents with intentional goals and the environments their actions normatively situated are co-constituted. Shaping normatively bound rational agents thus requires engineering and maintaining the availability of resources in the environment to support rational action planning and problem solving.

Dominique Hosch

2 - Dissolving the Interface Problem for Good: Putting the Vehicle-Based Account of Representational Format to Use

Dominique Hosch, University of Basel

Abstract:

For many philosophers, the human mind comprises at least two types of representational format: discrete and iconic. Other proposed formats include mental maps, analog magnitudes or motor representations. However, pluralism with regard to representational format faces a problem: How do mental representations with allegedly different formats (e.g., iconic perception vs. discrete concepts) interact? This "Interface Problem" (IP) poses a significant challenge, particularly for accounts of cognitive penetrability of perception and purposive action. Existing solutions often propose complex interface mechanisms or mixed formats, but I argue they fail because they accept the flawed notion of 'representational format' that generates the problem in the first place.

This paper contends that IP is not a genuine puzzle about mental architecture, but a conceptual artifact stemming from a misunderstanding—specifically, equating format with function or content rather than vehicle. I demonstrate that adopting a vehicle-based account of representational format, which grounds format distinctions in properties of the neural substrate, dissolves IP. Since all mental representations ultimately share a common neural basis, there is no in principle barrier to their interaction. This approach critiques alternative accounts (eliminativist, content-based, function-based), defends the vehicle-based view against key objections (e.g., computational incompatibility), and shows its alignment with cognitive science practice, ultimately dissolving a long-standing philosophical problem. I begin with a critical analysis of (Burnston 2017a) as a representative discussion of IP.

Other approaches to solve IP rely on mixed representational formats or a translation process, both of which beg the question (Burnston 2017a; 2017b; Butterfill and Sinigaglia 2014; Mylopoulos and Pacherie 2017; Ferretti and Caiani 2019; Shepherd 2019). In contrast, Burnston proposes to dissolve IP by describing the causal influence of cognition on perception as associational rather than computational. However, I contend that this merely circumvents the problem as well. Studies in cognitive penetration show that the associative relations between cognition and perception are not arbitrary (for a review, see (Vetter et al. 2024)). For a non-arbitrary link to form between a concept and a perceptual category, perceptual processes must be sensitive to the content of the cognitive state. Therefore, even on the associational view, there is still an interface between cognitive representations and perceptual processes that lacks a theoretically satisfying explanation. I then turn to what I take to be the true source of IP: a misunderstanding of what the notion of ‘representational format’ actually refers to. To address this, it is crucial to scrutinize the term and determine which interpretation best integrates with broader theories of the mind.

Existing accounts of representational format can be broadly categorized into four types: an eliminativist view and three positive accounts emphasizing content, vehicle, or function. I examine each in turn and identify their respective limitations.

In a nutshell, while the eliminativist view (derived from (Rescorla 2017)) rightly criticizes some unhelpful uses of the concept, it overlooks the value of representational formats in accounting for distinctive cognitive and behavioural phenomena, such as the compositionality of human thought or the intricate social behaviour of female baboons (cf. (Quilty-Dunn 2020; Vernazzani and Mollo forthcoming; Camp 2009). Content-based approaches – which construe representational format as medium-independent – succeed in avoiding IP but they fail to account for the constraints imposed by neural computation: unlike digital computing systems, where content can be abstracted from its medium, the contents of neural representations are inherently tied to their physical properties and cannot be fully disentangled from them (cf. (Maley 2021)). The function-based approach is the main source of IP. By encouraging a literal reading of how representational formats are instantiated in physical structure, it suggests that different formats correspond to distinct neural substrates. This, in turn, supports the view that different types of mental representations—such as those involved in perception, cognition, and action—are inherently incompatible and incapable of direct interaction (cf. (Butterfill and Sinigaglia 2014; Mylopoulos and Pacherie 2017; Ferretti and Caiani 2019; Burnston 2017a; 2017b)).

Next, I argue that the vehicle-based approach provides the best framework for navigating these issues. This approach distinguishes representational formats based on properties of their vehicles. The focus is on physical processes that bring about representations rather than on the outcome of such processes (Beck 2019). Since all mental computation is realized in the brain, i.e., by neural computation, all types of mental representations share a common vehicular basis. Therefore, there is no principled barrier to information transmission across different kinds of representations, allowing us to genuinely dissolve IP.

Finally, I address two objections to this solution. The first objection claims that information processing in perception and higher-level cognition involves fundamentally different and, therefore incompatible, types of computation – e.g., classical symbolic computation versus connectionist neural networks (Sterelny 1990; Fodor 1983). Consequently, we are confronted with IP again. However, there are two problems with this objection. For one thing, the debate between symbolic and connectionist computation is ongoing and has been revitalized by recent developments in artificial neural networks as models of cognition (Millière and Buckner 2024a; 2024b; Doerig et al. 2023; Stinson 2018; Griffiths et al. 2010).

Moreover, the objection falls prey to a “literal interpretation fallacy”: the fact that we can describe different brain functions with different computational models does not imply that neural computations themselves instantiate different kinds of computations. Both connectionist network and classical computational models are mathematical models that offer computational explanations of cognition, but neither represents the biological mechanism of the causal process that generate neural responses (Chirimuuta 2021; 2024; Stinson 2020).

The second objection asserts that the vehicle-based account is not sufficient as an account of representational format because it focuses too narrowly on the implementational level. Thereby, the notion loses its distinctive explanatory value because we cannot differentiate between different types of formats within the same brain. In response, I appeal to the

computational account of representational format developed by (Coelho Mollo and Vernazzani 2024), which allows for individuation of representations with the same vehicular basis through their computational profiles – i.e., the constraints on their vehicles. For instance, representational formats can be characterized by their vehicular density and inner repleteness, which in turn help determine degrees of abstraction. Hence, the vehicle-based account of representational format is not only sufficient for describing mental representations; it also aligns more closely with how the term 'representational format' is actually used in cognitive science – typically to refer to the degree of perceptual as opposed to conceptual information a representation contains (Heinen et al. 2023; Epstein et al. 2017; Kwak and Curtis 2022).

Annika Verfers

3 - A COMPARATIVE STUDY ON OBJECT INVARIANCE IN PIGEONS

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Abstract:
Object invariance is the ability to form robust visual object representations in the face of unstable viewing conditions. While object invariance has been extensively investigated in primates, little is known about how birds solve this formidable computational challenge. This is problematic since much is to be learned from the visual system of birds, given their early evolutionary separation from the mammalian lineage. This study has measured object invariance in pigeons using the same behavioral paradigm and stimuli that have previously been established in research with rats (1) and marmosets (2). This high degree of standardization is an important requirement for understanding which common and divergent principles determine high-level vision in mammals and birds.

In our study, pigeons performed a two-alternative forced choice task in which two artificial objects had to be recognized under a range of identity-preserving transformations (i.e., rotations in two orthogonal axes, size transformations, and changes of lighting condition). In line with the original protocol (1), subjects were initially taught to discriminate the objects in their prototypical configuration (Phase I) and across some variation of size and azimuth rotation (Phase II). Subsequently, we tested subjects' generalization to novel conjunctions of object size and azimuth rotation (Phase III) as well as to unfamiliar lighting conditions and elevation rotations (Phase IV).

While pigeons could recognize each size-azimuth conjunctions at a level higher than expected by chance, their performance decreased in the face of azimuth rotation and size manipulation. Most significantly, pigeons' object recognition was modulated by negative elevation rotations, resulting in Iower mean accuracy and flatter generalization gradients. The effect of lighting variation was comparatively small. Crucially, pigeons' performance mirrored some important trends found in rats (1) which showed a qualitatively similar sensitivity to azimuth rotations and rescaling of the objects. Marmosets outperformed both other species and perfectly generalized to all identity-preserving transformations (2).

We conclude that pigeons are able to recognize objects under various viewing conditions and that hence, mechanisms for discriminating identity-preserving from identity-changing variation have evolved in distantly related animal species. Following this line of reasoning, we

are now planning to analyze neuronal data from the tectofugal visual pathway of behaving pigeons to investigate the degree to which the hierarchical principles of the ventral stream translate to the avian visual system. Recently, we also started to train jackdaws on the same two-alternative forced choice task, paving the way for a deeper understanding of the evolutionary and neuronal causes that lead to behavioral variance in this higher domain of vision.

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Muazzez Deniz Barut

4 - A Situational Judgement Test for critical versus dialectical thinking – the role of culture and gender in a Turkish sample

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Abstract:
Critical thinking and dialectical thinking are two distinct modes of higher-order thinking. Critical thinking involves evaluating information based on evidence and logical reasoning, while dialectical thinking involves synthesizing and integrating contradictory viewpoints to form a new understanding. Previous literature suggests that individualistic or Western cultures tend to practise critical thinking, while collectivistic or Eastern cultures tend to practise more dialectical thinking (Nisbett, 2003). The current study aims to explore critical and dialectical thinking skills among Turkish university students and thus evaluating the reliability and consistency of a newly developed Situational Judgement Test (SJT) by Nosheen (2025).

The SJT was designed to measure objectively critical and dialectical thinking simultaneously across different cultures and genders. In the original study, Nosheen (2025) had collected data from Germany (Western culture) and Pakistan (Eastern culture). She found that participants from both cultures preferred dialectical over critical response options (against distractors) in items referring to reasoning in everyday situations (items 6-27). However, in items (1-5) demanding probabilistic calculations, despite generally low correct answers in both cultures, Germans showed more critical responses than their Pakistani peers. The current Turkish sample was deemed beneficial for further understanding the reliability and validity of the SJT because Turkey has a mosaic structure that includes different cultures and groups due to its unique geopolitical location and diverse population. Therefore, Turkey may be considered as a bridge between Germany and Pakistan and provides an excellent test case for evaluating whether dialectical and critical thinking skills are observed less sharply compared to Germany and Pakistan. Additionally, the current study explores the hitherto understudied role of gender in critical and dialectical thinking.

The sample consisted of N=112 Turkish university students (58.0% male, 42.0% female). The comparison of the Turkish sample with the German and Pakistani samples indicates that the Turkish sample results lie exactly between the German and the Pakistani sample, in line with the mosaic characteristic of its culture (see Figures 1 and 2). Across all three cultural groups, performance was lower on the initial mathematical, probabilistic items (1-5) than on the later

items (6-27) involving everyday contexts. More specifically, in the first five items focusing solely on critical versus biased (distractor) thinking, German students showed balanced endorsement rates, while Turkish and Pakistani participants favoured distractor responses (see Figure 1). In the remaining items (6-27) that included critical, dialectical, and distractor options, overall, participants from all three cultures preferred dialectical over critical thinking.

More specifically, Germans preferred dialectical responses, Turks showed more balanced endorsement rates, and Pakistanis leaned slightly toward dialectical thinking but also had the highest distractor rate (see Figure 2). The observed coexistence of dialectical and critical responses among all three samples suggests that higher-order thinking may be context-sensitive and adaptive rather than strictly culturally bound. This aligns with recent literature emphasizing that critical and dialectical thinking are interconnected components of higher-order thinking (Choi et al., 2007). With respect to gender, some previous studies report no significant differences (Choi et al., 2007). In contrast, other studies report higher dialectical or critical thinking in females, respectively (Mehta et al., 2024; Mawaddah et al., 2018), and yet others argue that males demonstrate higher critical thinking skills than females (Andayani et al., 2020). In our study, a cross-cultural comparison of gender indicated that the gender difference – with higher dialectical thinking in females – was significant in the German culture only, but not in Pakistani and Turkish cultures. This finding may suggest that in individualistic cultures, gender differences in cognition emerge more easily, as compared to collectivistic cultures, where both genders have to manage complex social and kin relationships that demand similar thinking styles, irrespective of gender (Guimond, 2008). More broadly, we suggest that recognizing the flexible and context-sensitive nature of higher-order thinking can enhance cross-cultural communication and collaboration, which enables individuals to navigate diverse perspectives more effectively.

Farina Lingstädt

5 - Behavioral mechanisms of cognitive control in jackdaws (Corvus monedula): Investigating attention and working memory

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Abstract:
In complex environments, individuals need to be able to selectively focus on relevant information and to maintain it for later use. Attention and working memory (WM) represent two core cognitive abilities that are involved in cognitive control. Higher cognitive abilities have mostly been demonstrated in primates, yet corvid songbirds show remarkably similar skills. Therefore, we used jackdaws to study these instances of cognitive control.

Two jackdaws were trained on a delayed estimation paradigm, tailored to probe attention and WM processes. One of two simultaneously presented sample colors had to be selected from a continuous color wheel comprising of 64 colors. Visual cues indicated the relevant target color either before (‘pre-cue’) or after (‘retro-cue’) sample presentation. To further probe working memory, delay length was varied. Both birds performed well on this task. Cue type had a strong influence on overall performance, which was mostly unaffected by delay length. The birds consistently showed higher performance in pre-cue trials, indicating that focused attention on the cued sample color significantly improved performance by reducing WM load. This is also reflected in the WM representations of the colors. Higher demands in retro-cue trials were mitigated by a more categorical representation of the colors. In the pre-cue trials, attentional resources were focused on the relevant sample, which lead to a more continuous and thus more precise representation.

All in all, we demonstrated that jackdaws can efficiently use the cues given by their environment to adapt the allocation of necessary cognitive resources in solving a WM task.

Marc Halbrügge

6 - Beyond Heatmaps: Evaluating LIME Visualizations for Human Understandability

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Abstract:
In the omnipresence of artificial intelligence (AI), understanding how an AI system came to its "conclusion" is more important than ever. Methods of explainable AI (XAI) aim at providing the means for this. This paper reviews one such XAI method, namely local interpretable model-agnostic explanations (LIME), and discusses the interpretability of its visualizations from a cognitive point of view.

Introduction and Related Work

Image classification is omnipresent in today's world, and the performance of state-of-the-art frameworks like YOLO (Redmon, Divvala, Girshick, & Farhadi, 2016) are astonishing. But how does a given classifier work? Can it be trusted? Explainable AI promises to answer these questions, for example, by creating visualizations that may answer questions like "why did the AI see a 4 in this picture?"

In order to explain the output of a classifier, it is not sufficient to know how to create a visualization. We also have to consider how humans perceive such visualizations and how they reason about them. As a first step, this paper presents a discussion of different visualizations. This serves as a basis for future studies that will explore the reasoning part.

Explaining Image Classification with Interpretable Visualizations

Ribeiro, Singh, and Guestrin (2016) propose LIME (Local Interpretable Model-agnostic Explanations) as a method to create explanations for classifiers suitable for non-experts. To achieve this goal, local perturbations are added to the input data, and changes in the output are observed. These changes are then used to judge how important the currently perturbed part of the input is for the classification. This procedure can be roughly compared to leverage statistics in linear regression, which denote the importance of a single observation for a given relationship (e.g., Cook, 1977).

How Image Segmentation Contributes to Explanation

A complete description of a classifier could be created by collecting the classifier outputs for the complete feature space, which is not feasible in most real-world cases. LIME solves this problem by reducing the feature space to superpixels created by an image segmentation algorithm.

Masking and Color-Coding

Two general types of LIME plots are considered here: *Masking* of "unimportant" features and *Color-Coding* the relative influence of the features in an image ("heatmaps"). In the original

LIME paper, masked images were presented to non-experts to validate the method's suitability.

Methods

Scikit-learn (Pedregosa et al., 2011) and Scikit-image (van der Walt et al., 2014) were used to create the examples for this paper.[1] To test the usability of LIME out of the box, images of handwritten letters from the MNIST data set (Deng, 2012) were used. A simple Support Vector Machine (SVM with RBF kernel, Vapnik, 2000) was trained on a random subset of the input images (N=1000). The official LIME Python package (v0.2.0.1) was then applied to misclassifications within the remaining images.

Three segmentation algorithms from Scikit-image were used: Quick Shift (Vedaldi & Soatto, 2008), Felzenszwalb (Felzenszwalb & Huttenlocher, 2004), and SLIC (Achanta et al., 2012). SLIC was applied with three different compactness settings, controlling the number of superpixels created. In addition, regular grids of three different sizes were applied.

Results

The SVM achieved an F1 score of 0.983 on the training data. It was then applied to 10000 randomly selected digits, and all cases were reviewed where the true class was the second-best guess of the SVM. Digit 29117 was chosen as an example; it is a 7 with an additional stroke on the left, which adds resemblance to a 4. Removing either the top or left stroke would transform it into a clear 4 or a clear 7.

The SVM classifies this image erroneously as a 4. LIME heatmaps are shown in Fig. 1, with green denoting features (or "superpixels") in line with the classification and red features in opposition to the classification. Brighter colors show a stronger influence of the respective feature. Masked images created from the same data are shown in Fig. 2. Only features in line with the classification are shown, and the weaker the relationship, the lighter the feature's color.

a) Quick Shift b) Felzenszwalb

c) SLIC d) Grids

Figure 1: LIME heatmaps with different segmentations for MNIST digit 29117, which is labeled 7 but looks ambiguous and was in this case wrongly classified as a 4.

[1] The Python source code is available at https://dx.doi.org/10.5281/zenodo.15608360

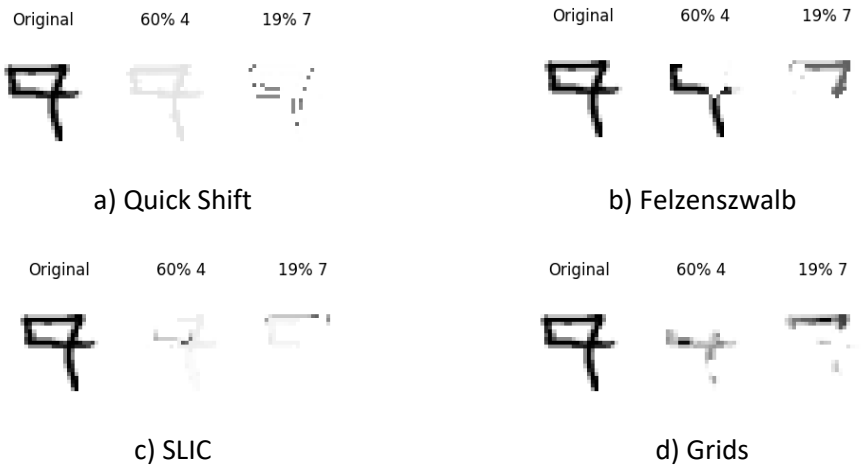

Figure 2: LIME masks with different segmentations for MNIST digit 29117, which is labeled 7 but looks ambiguous and was in this case wrongly classified as a 4.

Discussion

Not all visualizations demonstrate that the upper part is in line with a 7 and the left part in line with a 4, esp. when the digit is only broken into one or two features (Fig. 1, 2 a). Reading the visualizations is generally easier if the classifier's and LIME's technicalities are known. This is in line with Miller, Howe, and Sonenberg (2017), who claim that explainable AI (XAI) is in danger of becoming the "inmates running the asylum," which means that XAI methods tend to be created for XAI professionals only and might become unusable by non-experts.

Comparison of the Image Segmentation Algorithms Felzenszwalb and Quick Shift seem unsuited for small images like those of which MNIST is made. SLIC and grids were better suited. The best results were obtained by averaging across SLIC and grids of different granularities.

Weight Transformations To improve the readability of the plots, it may make sense to decay smaller weights in case of color-coding (make small weights even smaller). For masks instead, it may make sense to boost smaller values to keep a broken shape visually intact.

Pros and Cons of Masking vs. Color-Coding When comparing, e.g., Fig. 1 d) and Fig. 2 d), one could conclude that masked images are more readable. However, there are cases where the masked parts yield important information, e.g., a sharp edge in a 5 misclassified as a 3. Here, color-coding would create a more usable visualization.

LIME Visualizations and Gestalt Laws Especially in Fig. 2 d), we see how human perception fills in missing parts of the 4 and the 7, respectively. This can have upsides and downsides. It might be the case that there are visual features that we as humans need to close the Gestalt of the digit, but the classifier does not rely on them. In this case, the correct interpretation of the visualization would become more difficult.

Conclusions and Future Work

While heatmaps like those created with LIME are interesting, the examples presented here show that the choice of image segmentation algorithm can strongly influence the outcome, and even render correct interpretation impossible. Based on the superior outcomes of

averaging across grids or SLIC segmentations of different granularity, we propose to sample not only from the local neighborhood of the input pixel data (as LIME does) but also from the possible segmentations of the input images.

Interpreting masked images seems cognitively easier when compared to heatmaps. Masks may induce information loss, though. In the future, we are planning user studies to gain further insights into the feasibility of understanding AI systems based on LIME visualizations. A better understanding of how humans interpret those should be based on theoretical models of graph comprehension (e.g., Peebles, 2012). This way, we hope to reach our ultimate goal: *understandable* (Malizia & Paterno, 2023) and *trustworthy* AI systems.

Acknowledgements

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Yulia Chunareva

7 - Bidirectional Adjustment in Price Estimation: Evidence from Eye Movements

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Abstract:

When people are asked to make numerical estimates – for example, determining an appropriate price for a product or service – they often rely on previously suggested values, even when these values are unrelated to the task at hand. This anchoring effect (Tversky & Kahneman, 1974) has been shown to reliably bias judgements in verbal or questionnaire-based estimation tasks (Chapman & Johnson, 1999; Gehlbach & Barge, 2012). While anchoring is typically described as linear adjustment away from the anchor, recent work suggests a dynamic, bidirectional process, i.e., revisiting and reevaluating the anchor during the estimation process (Green & Heekeren, 2009). Eye movements provide insights into the temporal dynamics beyond what can be captured through final judgments alone (Orquin & Mueller Loose, 2013). Although such process-based measures have only recently been applied to the study of anchoring, initial findings suggest that visual attention may reflect underlying cognitive strategies during decision-making (Ceravolo et al., 2022). The present study combines behavioral and gaze data to examine whether anchoring involves bidirectional visual adjustment, and which eye movement features best predict anchor-biased estimates.

Vincent Hsu

8 - BODILY CREATIVITY: AN ECOLOGICAL AND EMBODIED VIEW

Vincent Hsu, Institute of Philosophy of Mind and Cognition, National Yang Ming Chiao Tung University

Abstract:
In my poster, I want to tackle the problem of what role the body plays in scaffolding creativity. To do so, I will demonstrate how conceptual tools from embodied cognition and ecological psychology can help us capture creativity in bodily form.

Research on creativity has long focused on the internal generative process of creative ideas as the main target of inquiry. Especially in cognitive approaches, creativity is deemed a function that manipulates and computes mental representations, to reach a novel combination or transformation. This could be a major form of creativity, yet not the only one. Creative outcomes are not solely or primarily generated as mental representations, such as ideas or thoughts, but also as bodily responses and actions.

There are cases of creativity in the fields of crafts and artistic improvisation, where creative agents strive to explore unforeseen and unexpected possibilities that emerge during real-time practice. These may include new ways of moving one's limb, new crafting patterns, or unorthodox approaches to an instrument. These novel outcomes can be achieved under unique environmental conditions that agents have never experienced before, which are loaded with contingencies. In order to create in this form, agents must be capable of perceiving those possibilities and responding accordingly in rapid fashion. This more body-based and action-based form of creativity may recruit different cognitive mechanisms from the more standard idea-based picture of creative cognition.

Therefore, I would like to examine bodily creativity by using the concept of affordance from ecological psychology and the concept of body schema from embodied cognition. Affordance aims to describe how perception grasps ecological information as possibilities for action provided by the environment, without the intervention of representational manipulation. It fits into the project here by capturing how creative agents perceive those contingencies not only as risks but also as possibilities worth exploring.

Furthermore, such explorative processes of improvisation continue not just by passively encountering happy accidents, but also by depending on how contingencies can be causally generated by agents skillfully. So the bidirectional effect of actions and affordances forms an iterative structure that can operate like a chain reaction over time. I propose the model of the action-affordance chain (AAC) to show how such an iterative process between action and affordance can lead to patterns that are both chaotic and organic.

Since AAC operates through bodily responses, I suggest that the body schema serves as implicit sensorimotor-level know-how that agents utilize in creative processes. Body schema helps agents perform bodily movement without consciously controlling every part of the body, and enables them to cope with the environment and navigate through it. Without the function of the body schema, skill or knowledge could not be applied in real time, habitually and intuitively, in response to the contingencies.

I will illustrate in my poster how the model of AAC and the body schema provide a more detailed analysis of cases of bodily creativity, showing how movements and actions taken in an environment relate to each other across temporal dimensions and generate novel outcomes.

Alexander Hölken

9 - Causal Profiling - A Method for identifying causal constraints across spatiotemporal scales

Alexander Hölken, Ruhr-Universität Bochum

Abstract:
This paper introduces the concept of causal profiles which describe a complex system's characteristic tendencies for development when perturbed at different spatiotemporal scales. For instance, neural activity may be perturbed at the scale of individual neurons through optogenetic means, or on the scale of neuronal populations through means such as transcranial magnetic stimulation (TMS). These different-scale interventions affect behavior and cognition in different ways, and these patterns of differences provide important information as to which neural systems realize different behaviors and mental states. Causal profiles capture these patterns of differences, allowing us to characterize the causal structure of complex systems such as the brain, which cannot be understood in terms of a series of linear cause-effect relations. Rather, a causal explanation of how such systems give rise to a particular phenomenon of interest must identify sets of states and processes that constrain this phenomenon's development to different degrees, which can be quantified by employing a variety of methods that can be characterized as causal profiling.

The act of determining a given system's causal profile consists in a series of systematic perturbances to its realizing subsystems at different spatiotemporal scales and observing the corresponding changes (or lack thereof) in its internal dynamics. This process of causal profiling allows us to determine which kinds of intervention the system is most sensitive to, and in turn, which of its subsystems contribute most to the development of a phenomenon (its control parameters) and which merely provide the boundary conditions for its instantiation. To illustrate the concept of causal profiles, this paper introduces the commonly drawn distinction between modular and distributed control systems (Eisenreich, Akaishi & Hayden, 2017) as one aspect of these profiles, before applying it to an open question in sports psychology: How is an embodied skill, such as being able to ride a Pedalo, realized in human bodies?

Charlotte Pechau & Henry Soldan

10 - Comparing Episodic and Semantic Processing in the Human Brain and Deep Neural Networks

Charlotte Pechau, Ruhr-Universität Bochum

Henry Soldan, Ruhr-Universität Bochum

Abstract:
Investigating the representation of episodic and semantic memory in the brain is central to understanding human cognition. However, if we want to shed light on general principles of cognition, it makes sense to extend research beyond biological systems into the realm of artificial neural networks. In my master thesis, I have chosen a comparative approach, examining commonalities and differences between memory representations in the human hippocampus and feature representations in deep neural networks (DNNs).

Neuroimaging data was acquired during the TempMem project, which forms part of the FOR2812 Constructing Scenarios of the Past. While being scanned with a 3 Tesla MRI, participants viewed sequences of semantically categorized images from the THINGS dataset, followed by a forced-choice retrieval task during which they had to decide which of two images was temporally closer to the cue image.

To compare neural responses for each stimulus at encoding and retrieval, neural activation patterns were fed into a representational similarity analysis (RSA). Average pattern similarity was calculated for different versus same stimuli, at encoding-encoding and encoding-retrieval time points. The RSA results were then used to obtain three different indices to disentangle the interplay of semantic and episodic processing in a memory trace: a semantic encoding index (SEI), a semantic retrieval index (SRI) and an episodic retrieval index (ERI).

The SEI was calculated by comparing the average same category similarity of a trace during encoding with the average different category similarity at the same timepoint, thus retaining only the dimensions of the neural pattern that are repeated for all images of one category. The SRI was computed by comparing the same measures as above but at the timepoint of memory retrieval. This index yields a measure for category membership while accounting for memory decay/changes in between encoding and retrieval. Lastly, the ERI was obtained by comparing average same item similarity with average same category similarity, thus creating a measure for episodic reinstatement of the neural pattern during retrieval.

To compare the structure of episodic and memory processing of the human brain with artificial neural networks, I will employ an analogous approach with a convolutional deep neural network. This DNN will be pretrained on image classification datasets (e.g., ResNet or VGG) to process the images used in the TempMem project and extract representational features. I will then compute the pairwise similarity between stimulus vectors at each layer using RSA and

derive semantic and episodic encoding indices for each stimulus vector at each layer, following the same approach used for the fMRI data. The RSA patterns and encoding indices acquired from the DNN can then be compared to those from the fMRI data, determining which DNN layer most closely aligns with the brain imaging data based on similarity metrics. Following previous literature, I anticipate that early convolutional layers will primarily encode perceptual visual features, while deeper layers, including fully connected ones, will capture category membership. Building on these analyses, I will then assess whether a strong correspondence between earlier or later ANN layers and fMRI data during encoding as well as retrieval is associated with a high episodic, respectively semantic encoding index in both.

Comparing activation in a DNN and human brain networks may generate further insight into where ANNs can serve as models for brain activity and where they have important functional differences. On the one hand, this may hint to biological constraints that shape human cognition, on the other hand, it will elucidate general mechanisms of cognition in biological and artificial cognitive systems. By linking neuroimaging and computational modelling, this poster submission contributes to one of the core themes of KogWis25: illuminating mechanisms of learning and memory through a comparative perspective.

Daan Schetselaar

11 - CONSCIOUSNESS AS THE DISSIPATION OF INFORMATION

Daan Schetselaar, Open University of The Netherlands

Abstract:
A new theoretical framework in which phenomenal consciousness is operationalized based on qualitative properties. These properties result naturally from the perceptual process, described in informational terms as transformations of neural network states.

In this model, conscious experience entails an increase of (Shannon) information[1] produced by concept-related network states while their macrophysical effects decrease. This reduction of efficacy is termed information dissipation, analogously to energy dissipation in thermodynamic systems. It reflects a qualitative difference in perceptual processing, resulting in either actual or potential behavior, the latter corresponding with conscious experience.

The framework is based on five propositions: P1 to P5.

P1: Consciousness is inactionable perception
This proposition results from four premises. 1) Conscious experience is fundamentally non-conceptual[2]. 2) Non-conceptuality implies non-communicability[3]. 3) All behavior is communication and communication always involves some behavior[4], so if conscious experience is non-communicable it does not contribute to behavior in general: it is macrophysically inactionable. 4) Consciousness is always about an object of perception, which in a broad sense entails input from the environment, interoception and other brain systems such as during imagining.

P2: Perception is the continuous transformation of raw stimulus information into a behavioral repertoire
Perception and action can be seen as one continuous process, and as co-constituted by the same circuits[5]. Perception-action can thus be considered the transformation of raw stimulus data into action through neural processing on several hierarchical levels.

P3: Perception is organized in action-specific concepts
The space of possible states of the perception-action system can be divided in regions containing states that are involved in the perception of the same concept as well as its corresponding actions. These are referred to as concepts regions.

P4: Perception requires an increase of entropy in concept regions
Perception of new sensory stimuli requires increasing the number of stimulus patterns that the neural circuits underlying the relevant concept are receptive to. This entails expanding its concept region, which requires broadening selective responses to new input from lower levels, plausibly depending on predictive processing. The resulting increase of the number of

possible concept states and transitions between them can be expressed as an increase of entropy.

P5: The increasing entropy in concepts must be reduced for effective action

Actions are the result of learning and this process can be seen as a reduction of entropy given a certain behavioral category[6]. The motor-end of the perception-action process thus must maintain relatively low entropy, while perception at the same time drives an increase of concept entropy (see P4). This requires that entropy be actively reduced as stimulus information progresses trough the perception-action transformation, to allow effective action.

Synthesis

A greater disparity of entropy between lower and higher levels of a concept region corresponds to more sensitivity to stimuli and greater specificity of the resulting action. When this efficiency decreases, concept-entropy increases and perception becomes inactionable. Given P1 this corresponds to conscious experience. This would occur when behavior is not fixed relative to a stimulus and allows a choice between behavioral options, which coincides with the typical experience of conscious behavior.

Implications and support

The well-documented relation between entropy of brain signals and conscious states7 is in accordance with this framework, as are findings of reduction of entropy in subsequent brain circuits during processing of information for action[8]. Further empirically verifiable predictions can be made. One example is that the quality of conscious experiences arises from potential actions, and may be reflected in efferent signals. Another is that a transition from passive perception to action should be accompanied by a decrease of entropy in relevant brain circuits, as well as a drop in conscious awareness of the stimulus. Tentative support for these claims can be found in results of neuroimaging and behavioral experiments, employing e.g. optical rearrangement devices[9], measures of covert motor activations[10] and the attentional blink paradigm[11]. A philosophical implication is that consciousness might be a macrophysical epiphenomenon but not non-physical, in a way reversing the mind-body problem.

Relevance

The model provides a new mechanism for how consciousness arises from perception. It may ultimately provide a new perspective on how consciousness fits in the physical world.

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Juan Peschken

12 - CONTEXT IS LEARNED, NOT GIVEN

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Abstract:
Is context nothing more than “a backdrop where learning occurs?” In learning theory there is an ongoing debate about what constitutes a context. This implies a strict division between stimuli that act as cues and those that act as context. In extinction learning, a highly context-sensitive learning process, after the cessation of a behavior, its reappearance as renewal occurs after the change of context. In this study, we tested the ability of competing stimuli to act as context in an appetitive extinction learning paradigm in pigeons. The ability of each stimulus to act as a context, was assessed by the number of resulting renewal responses. In contrast to commonly held definitions of context, stimulus contiguity had the biggest effect on renewal. Decreasing stimulus contiguity effectively suspended context-based renewal. In conclusion, context appears to arise from a set of available stimuli, following associative learning properties. Our results, shed light on why many types of stimuli can act as a context and generate renewal, challenging passive definitions of context as ‘a backdrop where learning occurs’, as well as the division between cues and context. Instead, context appears to be the result of an active effort to disambiguate information in the environment.

This work is in the final stages of the publication process and can be reviewed as a preprint at: https://www.researchsquare.com/article/rs-5682968/v1

Liya Zou

13 - Desire in Movement: A Phenomenological Approach to Sensorimotor Relationalism and Embodied Cognition

Liya Zou, Catholic University of Leuven

Abstract:

This paper examines the ontological limitations of sensorimotor relationalism (SR) in explaining conscious experience and argues for integrating the phenomenology of life to address these shortcomings. SR, as developed by Dave Ward, explains perceptual experience by combining relationalism and sensorimotor theory. Relationalism holds that the phenomenal properties of perception are grounded in the mind-independent properties of objects, while sensorimotor theory explains perception as an active engagement with the world through movement and sensory feedback. In SR, perceptual experience arises from the perceiver's practical grasp of sensorimotor contingencies—patterns linking sensation and movement—while being shaped by the objective properties of the environment. By bridging embodiment with objective structures of the world, SR advances the sensorimotor theory to explain the phenomenal aspect of perception beyond sensorimotor regularities. However, while this framework explains how perception unfolds through bodily action and environmental affordances, it fails to address a deeper question: what enables motility—the very capacity for sensorimotor engagement—in the first place? More fundamentally, what motivates perceptual exploration towards the objective properties? Is it merely to refine visual perspective, or does it stem from a deeper impulse to understand and relate to the world? I argue that SR neglects the underlying phenomenological basis that situates perception within the evolving flow of life.

Merleau-Ponty's Phenomenology of Perception is widely considered foundational for the phenomenological account of embodied cognition, particularly through his concept of the body schema. While this paper begins with the discussion of his framework, it ultimately argues that it falls short of providing a sufficient phenomenological foundation for SR. The body schema shapes perception and action through pre-reflective bodily engagement, determining possible interactions with the world and evolving through habit formation. Motricity, as "original intentionality," ensures that perception is guided by embodied skills rather than conscious deliberation, allowing for fluid and meaningful engagement with the environment. However, while Merleau-Ponty proposes the role of embodiment and the pre-reflective body in perception, his framework does not account for perception as an ongoing process that unfolds over time. He treats the body as a constituted whole rather than as an ongoing process of self-constitution. By prioritizing perception over life's intrinsic dynamism, his account fails to address the deeper motility that underlies perceptual engagement. This gap between perception and the ongoing totality, I argue, is where Barbaras' phenomenology of life becomes essential.

Barbaras' phenomenology of life provides a more comprehensive approach by situating perception within the continuous, dynamic movement of life itself, driven by desire. This theory can address the limitations inherent in SR by accounting for the deeper, motivating forces behind perceptual engagement. Barbaras defines life as a dynamic movement fuelled by desire—a movement that continually surpasses itself. This dynamic framework allows for a reimagining of perceptual experience, not as a simple matter of sensorimotor coordination, but as an ongoing striving that connects the organism to its environment. For Barbaras, life is a process of negation—an active, self-transforming movement—that creates the potentiality for both movement and perception. Desire, as the driving force of this movement, enables the organism to engage with the world beyond immediate sensory input, opening the way for exploring possibilities that have yet to be realised. Perception, therefore, should not be viewed merely as a series of sensorimotor interactions, but as an integral part of the ongoing totality of life.

I argue that SR can overcome its limitations related to motility and embodiment only by integrating Barbaras' concept of life, driven by desire. By recognising desire as the dynamic force behind perceptual experience, this approach can better explain the continuity and depth of lived experience. It offers a way to understand perception that acknowledges both its embodied nature and its dynamic, ongoing transformation in response to the organism's interaction with the world. Within this integrated framework, perception becomes a continuous, lived process, not merely shaped by sensorimotor contingencies but deeply rooted in the organism's striving toward the world. Barbaras' idea of life as negation provides a more complete understanding of how perception links the organism to its environment. In this view, desire is not just a psychological phenomenon but a fundamental structure that drives the ongoing negotiation between organism and world. This integrated framework not only acknowledges the embodied nature of perception but also accounts for its ongoing, dynamic transformation, offering a more comprehensive foundation for understanding conscious experience.

Yichu Fan

14 - Do Mechanisms in Neuroscience Have Real Boundaries? Take 2

Yichu Fan, University of Edinburgh

Abstract:

A decade ago, Bechtel (2015) argued that mechanisms in neuroscience did not have real boundaries in nature, and that scientists routinely relied on pragmatic considerations to delineate mechanisms. This paper will reassess this claim in light of both the recent development in the new mechanist literature on the constitutive relevance relation, and the recent scientific studies on oscillatory mechanisms in molecular and cellular neuroscience. My conclusion is affirmative. Although I argue that Bechtel's original argument against the well-bounded mechanisms no longer hold given the recent accounts of constitutive relevance relation, I identify a new blind spot of these accounts – namely the 'modulators with feedback' – which is a group of acting entities with indeterminate constitutive status regarding the phenomena in question. Moreover, I show that in scientific practice, researchers do rely on pragmatic considerations to rule in or out these elements from their mechanistic models. Therefore, I uphold Bechtel's claim that mechanisms – at least certain complex mechanisms with feedback control – do not have real boundaries in nature. First of all, I will show the shortcoming of Bechtel's (2015) argument against the well- delineated mechanisms. In particular, I show that his argument implies an interactionist notion of constitutive relevance relation. Interactionism individuates mechanisms by the strength of causal interactions: it assumes that interactions among the components of a mechanism are generally stronger than the interactions between the components and external factors (cf. Wimsatt, 1974; 2007; Haugeland, 1993). Based on the case of circadian clock, Bechtel argues that many mechanisms have intensive causal interactions with other systems, hence are comparable to modules in a 'scale-free small-world network' which do not have clear boundaries (Bechtel, 2015, p.88). However, most of the new mechanist philosophers shun away from interactionism; instead they highlight the role of explanandum phenomenon in mechanism individuation. As Craver (2007, pp.123) puts, "[t]he boundaries of mechanisms—what is in the mechanism and what is not—are fixed by reference to the phenomenon that the mechanism explains." In other words, they believe that background factors should be excluded from the mechanism of a phenomenon regardless of whether they have strong interactions with the components of the mechanism. Thus, many new mechanists remain realist about the boundaries of mechanisms. That is, they are convicted that once the phenomenon is picked out, there are facts about whether an element is constitutively relevant to the phenomenon or not (cf. Glennan, 2017; Kaiser&Krickel, 2017). Therefore, the crucial task is to find the facts about constitutive relevance relation.

The most well-known account of constitutive relevance is perhaps Craver's (2007) mutual manipulability (MM) account, according to which claims about constitutive relevance are established by interlevel manipulationist experiments. However, this account is criticized for invoking the problematic notion of interlevel causation (cf. Baumgartner&Gebharter, 2016; Romero, 2015; Baumgartner&Casini, 2017). Various accounts of constitutive relevance have

since been put forward to take the place of MM. These include (a) the 'inbetweenness' accounts (Menzies, 2012; Harinen, 2018, Krickel, 2018a; 2018b; Prychitko, 2021; Craver et al., 2021), (b) the regularity accounts (Couch 2011; 2023; Harbecke, 2010; 2015), and (c) the 'fat-handedness' accounts (Baumgartner&Gebharter, 2016; Baumgartner&Casini, 2017). My following argument against the well-bounded mechanisms will take into consideration these three main approaches to constitutive relevance.

The case studies I focus on concern the biological oscillators, which are a group of mechanisms responsible for oscillatory physiological and behavioural phenomena in organisms. For example, the circadian clock is the biological oscillator underlying the phenomenon of circadian rhythms; the central pattern generators (CPGs) are the biological oscillators underlying rhythmic motor behaviours such as walking and breathing. I will first make the descriptive claim that there is significant indeterminacy in the delineation of many biological oscillators in scientific practice: Researchers disagree over the component status of various elements; models with different boundaries are employed for the same mechanism.

After presenting evidence from scientific literature, I delve deeper into the source of this indeterminacy. Specifically, I argue that 'modulators with feedback' are the borderline cases of mechanistic components, which are indeterminate between being inside and outside of the mechanism. Examples of this kind of elements include the commissural projection neuron 2 in the CPG for the gastric mill rhythm in the crab (Norris et al., 1994) and the segmental ganglia in the ventral nerve cord for the swimming pattern in the leech (Friesen&Pearce, 1993; Marder&Calabrese, 1996). Modulators are usually considered as elements external to the mechanism for the phenomenon which effect causal influence on the output of phenomenon. However, when the phenomenon is oscillatory, and such modulators receive feedback from the input of the phenomenon, its relation with the mechanism becomes tricky.

In particular, I argue that the 'inbetweenness' accounts cannot exclude these factors from the mechanism. This is because, like the components, these factors also causally situate in-between the input and the output of the phenomenon. On the other hand, including all of such modulators into the mechanism would make the constitutive relevance relation too permissive such that it diverges from its use in scientific practice.

Moreover, the regularity accounts and the 'fat-handedness' accounts of constitutive relevance are also impotent in restricting the boundaries of biological oscillators. This is because they both presuppose a well-delineated spatiotemporal (or mereological) boundary of the phenomenon, which is inapplicable to the distributed oscillatory phenomena. Therefore, I argue that 'modulators with feedback' amount to a blind spot for the existing accounts of constitutive relevance relation. Further, by showing how scientists are free to draw on different boundaries for different pragmatic needs, I suggest that there is no need to fix the boundaries of mechanisms. I also suggest that my argument is generalisable to non-oscillatory mechanisms by showing that the 'modulators with feedback' are more ubiquitous than it appears. Hence, I conclude that mechanisms, as posited in neuroscience, do not and need not to have real boundaries in nature.

Finally, I will consider an implication of my argument: the blurred boundaries of mechanisms pose a problem for the distinction between causal and constitutive relevance relations.

Specifically, the new mechanists generally assume a clear ontological difference between causation and constitution. In particular, causal relevance relation holds between two occurrences with no spatial-temporal overlap, whereas constitutive relevance relation holds between a whole and its components, with the former spatial-temporally subsuming the latter. The distinction hence depends on the existence of well-delineated boundaries around the relata. However, I argue that if mechanisms are unbounded, the distinction between causation and constitution will also fall apart.

Qiyuan Zeng

15 - Event Segmentation Distorts Subjective Time Perception between Items for Within and Across Events

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Abstract:
A continuous stream of sensory information constantly reaches our sensory epithelium, yet our perception organizes it into discrete, meaningful chunks. In language, for instance, we perceive words, phrases, and sentences even though no physical signals explicitly mark these boundaries. One influential theory suggests that the event boundaries arise from the temporal community structure of items in a sequence resulting in a shift toward closer neural representation similarity for items within events than between them. However, how the formation of event segmentation and the shift in neural representation influence our subjective perception remains unclear.

A common observation is that familiar languages appear to be spoken slowly, while unfamiliar languages often feel rapid and difficult to follow. One potential consequence of the ability to segment continuous streams is the distortion of subjective time perception. However, the exact nature of this distortion remains debated. One study showed that the event boundary may contraction effect on subjective time perception. While another studies suggested that the event boundaries may have expansion effect. Moreover, even current theory claims that the neural representation similarity may be one of neural mechanisms underlying time perception, its validity to time perception distortion by event segmentation is yet to be confirmed.

To explore these questions, we conducted a behavioral study that combined a classical explicit online statistical learning (eSL) task with a newly developed pause adjustment (PA) task.

During the PA task, participants actively manipulated pauses between specific syllable pairs while listening to continuous syllable streams. The goal was to ensure that all pauses were perceived as equal in length, enabling us to investigate the effects of event segmentation on the perception of pauses while minimizing memory-related biases. There were two types of adjustment conditions, one was keeping the pauses within words as reference and asked

participants to adjust the pauses for between words (within words condition), the other was keeping the pauses between words as reference and asked participants to adjust the pauses for within words (between words condition) in order to control possible overall inaccuracy in adjustment. Moreover, to investigate the generalizability of possible distortion effect of pauses, besides the same 35ms pauses as in the eSL task, there were also 3 other pauses including 55ms, 75ms and 95ms served as references. Participants adjusted pauses in two types of streams: a structured stream containing events and a random stream devoid of events.

We applied a Linear Mixed Model (LMM) in the PA task that pooled all reference levels to analyze if event segmentation (structured streams) affects time perception of pauses. Results revealed a significantly significant interaction effect between stream types (structured or random) and the conditions (within or between), further simple effect analysis showed no significant difference between conditions in the random streams but a significantly longer pauses for between words than within words in the structured streams. These results suggested that event segmentation has a distortion effect for time perception, revealed by pause lengths between and within words.

To investigate the generalizability of the distortion effect of event segmentation in different reference levels, we further did an LMM with all reference levels. Results were overall the same as the previous model, with a significant interaction effect between stream types and the conditions and a significant simple effect in structured stream between two conditions. However, the three-way interaction between the reference level, stream types and conditions was not significant, indicating the distortion effect is generalizable between every reference pause level.

Notably, the magnitude of temporal distortion (within-between pause difference) showed no significant correlation with the strength of event segmentation as indexed by reaction time differences (position 1 - position 2 RT in the target detection task), suggesting potential different mechanisms supporting RT enhancement and temporal distortion in event segmentation.

Collectively, these findings demonstrate that event segmentation has a measurable impact on subjective time perception. The temporal distortion effects are different for between- and within-events, lengthening interword pauses and shortening intraword pauses, and this effect can be generalized to different pause levels.

Alina Zaidan

16 - Exploring Brain Asymmetry with Face and Word Priors: An EEG Study

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Debora Nolte, Osnabrück University

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Abstract:
Virtual reality (VR) offers a controlled environment for eye-tracking research, often simulating real-world scenarios. Recent advancements in electroencephalography (EEG) and eye-tracking technology now enable research in even more naturalistic conditions. Building on a previous study by Nolte et al. (2024), we investigate the N170 face-selective event-related potentials (ERPs) as a means to validate our experimental setup and test the observation of saccade-locked ERPs of a recent study (Amme et al. 2024) in a real-world environment.

Participants perform the task of waiting for a friend in the city centre of Osnabrück while being equipped with mobile EEG (Smartfones, mBrainTrain) and eye-tracking (Neon, Pupil Labs) devices. We employ deep learning models, RetinaFace (integrated by Pupil Labs) (Deng et al., 2019) and Yolo (Varghese, 2024), to detect areas of interest (AOIs) in the eye-tracking data, specifically faces and bodies of pedestrians, which allows us to analyse eye behaviour towards these stimuli. Additionally, gaze allocation and distribution are compared between real-world and VR settings.

Preliminary results demonstrate the recording of valid ERPs, with evidence of both partly saccade onset locking and partly fixation onset locking. Ongoing analysis will further explore ERPs and eye behaviour in response to face, body, and background stimuli. This work promises to advance our understanding of face perception in natural environments and provide new insights into the generalisability of neural and behavioural findings across different experimental settings.

Sarah Jähnichen

17 - Feeling vs. Acting: Gender Differences in Affective Experience and Approach-Avoidance Behavior toward Pleasant and Unpleasant Pictures

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Abstract:

Emotions are fundamental to human behavior - positive emotions elicit appetitive and negative emotions aversive action tendencies (Bradley et al., 2001). In experimental approach-avoidance tasks (AATs), participants approach pleasant and avoid unpleasant stimuli faster than vice versa (Chen & Bargh, 1999; Czeszumski et al., 2021; Phaf et al., 2014; Solzbacher et al., 2022), and responses to pleasant tend to be faster than to unpleasant stimuli (Czeszumski et al., 2021; Solzbacher et al., 2022). Altered approach and avoidance tendencies are associated with various psychopathologies (Fricke & Vogel, 2020), and gender differences in the prevalence of mental disorders are well-established (Steel et al., 2014). Nevertheless, potential gender differences in approach-avoidance behaviors have received little attention. Thus, this study aimed to explore potential gender differences in affective responses - in terms of approach-avoidance behaviors and subjective affective experiences - to pleasant and unpleasant picture stimuli.

Sixty participants (30 females; mean age 23.3 years, SD=3.4) took part in the AAT and 59 participants (32 females; mean age 24.05 years, SD=4.15) in the experiment investigating differences in affective experiences. Picture stimuli were taken from the International Affective Picture System (Lang et al., 1997). In order to investigate approach-avoidance responses to valenced pictures, participants performed a classic embodied joystick-based AAT in the laboratory. The subjective emotional experience of participants when viewing affective pictures were assessed in the form of an online survey. Participants rated how they felt when looking at the pictures, using the 9-point Self-Assessment Manikin scale measuring experience of pleasure, arousal, and feeling of control (Bradley & Lang, 1994). For AAT data analysis,

effect-coded linear mixed-effects models for all participants, as well as for male and female participants separately, were fitted with log-transformed RTs as the dependent variable. The models included valence and congruency as fixed effects. The model investigating data of all participants additionally included gender and its interactions with valence and congruency as fixed effects. Random intercepts were specified for participants and pictures. The affective ratings were analyzed using effect-coded generalized linear mixed-effects models, fitted with Poisson distribution and log link, to predict each affective dimension for each stimulus valence. Gender was the fixed effect, and participants and pictures were random intercepts.

The analysis results from the AAT replicated previous findings showing that congruent responses were performed by 11.5% faster than incongruent responses (β=0.0206, SE=0.0012, p<.001) and that positive pictures were overall responded to by 4% faster than negative pictures (β=-0.0089, SE=0.0032, p<.01). Men and women did not differ significantly in RTs overall (β=-0.013, SE=0.0092, p=.16). However, the approach-avoidance bias was more pronounced in women than in men (β=-0.0029, SE=0.0012, p<.05). In addition, the effect of picture valence on RTs differed across genders (β=-0.0051, SE=0.0012, p<.001). While men responded to pleasant pictures 6.7% faster than to unpleasant pictures (β=-0.0139, SE=0.0032, p<.001), this effect was not significant in women (1.4%; β=-0.0037, SE=0.0035, p=.30).

The analysis of affective experience showed no significant effect of gender on affective ratings with pleasant pictures. However, women reported experiencing unpleasant pictures on average as 7.9% more unpleasant (β=0.1342, SE=0.0373, p<.001), 8% more arousing (β=-0.0621, SE=0.0317, p=.05) and felt 7.5% less in control (β=0.085, SE=0.0428, p<.05) when viewing them compared to men.

To summarize, the approach-avoidance bias was present across participants, with women exhibiting the bias to a greater extent than men. Viewing unpleasant pictures elicited more displeasure, arousal and less feeling of control in women than in men. This differential effect on emotional experience across genders was, however, not reflected in behavioral responses, as RTs to unpleasant pictures in the AAT did not differ significantly across genders. Pleasant pictures, on the other hand, amplified response speed in men relative to unpleasant pictures, while this effect was negligible in women. This differential response pattern across genders was not associated with differential emotional experiences, as none of the affective dimensions investigated when viewing pleasant pictures differed across genders.

Rebecca Albrecht

18 - Flexible Categorization in AI? A Case Study of Prevalence-Induced Concept Change

Rebecca Albrecht, Center for Cognitive Science, University of Freiburg

Mikhail S. Spektor, College of Arts and Sciences, VinUniversity

Abstract:

Recent developments in artificial intelligence (AI) have renewed interest in using machine learning models as candidate theories of cognition. In particular, deep neural networks are increasingly viewed as domain-general learners capable of capturing human-like regularities in perception, learning, and decision-making (Binz et al., 2024). However, this ambition raises a fundamental question: To what extent do these models capture the adaptive flexibility underlying human cognition, rather than merely replicating outcomes.

A key test case is categorization—an essential cognitive faculty that supports generalization, abstraction, and efficient decision making. Some accounts treat categorization as governed by fixed and stable decision principles—akin to classical decision-theoretic models of choice (Luce, 1959; Ashby & Maddox, 2005). Others view it as a flexible mechanism that adapts to environmental change and task-specific demands, shaped by statistical input, internal goals, and contextual pressures, in line with efficient coding and sampling-based theories (Bhui & Gershman, 2018; Stewart et al., 2006).

Empirical evidence increasingly supports the flexible view. From perceptual decisions to complex moral and emotional judgments, category boundaries shift in response to changes in task demands and social expectations. For example, people adjust emotion boundaries when the prevalence of emotional expressions changes (Plate et al., 2023, 2019), and they tend to interpret ambiguous images in stereotype-consistent ways (Eberhardt et al., 2004). Understanding the mechanisms that drive such shifts is essential for developing cognitively grounded models, especially if AI systems are to serve not only as behavioral imitators but as explanatory tools for human cognition.

One particularly revealing example of flexible categorization is prevalence-induced concept change, in which the boundary of a category expands when its prevalence decreases (Levari et al., 2018; Levari, 2022). PICC has been interpreted as a domain-general statistical response, but other evidence suggests it is shaped by social meaning and media stereotypes (Devine et al., 2022, 2024). If PICC is truly general, it should emerge in domain-general AI models trained under similar conditions. In this paper, we test this claim using a standard sequential AI architecture: a long short-term memory (LSTM) network. We ask whether PICC-like shifts arise spontaneously from sequential statistical learning, or whether human-like flexibility requires additional mechanisms not currently present in such models.

Angelika Kunkel

19 - From Words to Pictures: Understanding Conflict Detection Across Cognitive Domains

Angelika Kunkel, University of Tübingen, Department of Psychology

Hartmut Leuthold, University of Tübingen, Department of Psychology

Markus Janczyk, University of Bremen, Department of Psychology

Carolin Dudschig, University of Tübingen, Department of Psychology

Abstract:

In cognitive research, a central question is how we deal with conflict, and what cognitive adjustments occur during information processing. According to the conflict monitoring theory (Botvinick et al., 2001), conflict serves as a key signal to the cognitive system, indicating the need for increased cognitive control. Traditionally, this phenomenon has been studied using simple conflict tasks, such as the Stroop, Simon, or Eriksen flanker task.

More recently, however, it has been proposed that conflict processing may operate as a domain-general mechanism. Specifically, some authors argued that conflict arising in the language domain (e.g., syntactic conflict) can influence subsequent conflict processing in unrelated domains, such as sensorimotor tasks (e.g., Kan et al, 2013; but see Simi et al., 2023, for an alternative view). Supporting this idea, recent studies have shown that conflict in language can lead to adjustments in processing at both local and global levels (Dudschig, 2022). Local adjustments are observed through trial-by-trial manipulations of conflict sequences, whereas global adjustments emerge when the overall probability of conflict is varied across blocks.

For instance, reading sentences with a semantic conflict, such as “Bananas are depressive”, alters the processing of subsequent, similarly conflicting sentences such as “Hippos are drunk.” These effects are reflected in electrophysiological markers of semantic integration, specifically the N400 component, and manifest both locally and globally. The present study investigates whether pictorially displayed conflict resembles conflict processing observed in the sensorimotor and language domains. In a first set of rating studies, we tested whether images depicting implausible or anomalous scenarios (e.g., a panda drinking beer) evoke similar conflict ratings as corresponding sentences. Across two studies, we found that participants rated pictorial and sentential conflicts similarly. In a follow-up study currently underway, we are examining whether pictorial conflict also leads to response slowing, a well-documented effect in the sensorimotor domain. Finally, in an ongoing series of experiments, we aim to determine whether conflict in the pictorial domain can induce cross-domain adjustments that affect language processing.

To our knowledge, this is the first study to investigate how individuals detect and resolve conflicts between incoming information and their world knowledge across different modalities.

These findings will advance our understanding of the cognitive architecture underlying conflict processing across domains and will inform the interpretation of future EEG studies investigating the effect of conflict probability manipulations using the same stimulus sets.

Hsiang-Chung Lin

20 - How can pain be shaped? A conceptual framework for understanding pain shaping

Hsiang-Chung Lin, National Yang Ming Chiao Tung University

Xiang-Yu Lu, National Yang Ming Chiao Tung University

Ying-Tung Lin, National Yang Ming Chiao Tung University

Abstract:
Pain is increasingly recognized as a heterogeneous phenomenon in both science and philosophy. It is not monolithic or uniform but varies across individuals, cultures, and contexts. This heterogeneity may be shaped by a range of biological, psychological, social factors, and evolutionary processes. What are the different ways pain can be shaped? Are there any aspects or parts of pain that cannot be possibly shaped? What could they be? What does it tell us about the nature of pain? This paper proposes a conceptual framework to map and clarify the different ways in which pain can be shaped.

A starting point for understanding how pain can potentially be shaped is the biopsychosocial model.From the biological perspective, pain is closely linked to the nervous system; many interventions aim at this level. For example, changes in neural pathways through neuroplasticity can alter pain sensitivity, and pharmacological treatments (e.g., opioids, anti-inflammatories) directly modulate nociceptive processes.
Psychologically, pain can be shaped by cognitive and affective factors, such as expectation, attention, and meaning attribution; phenomena like the placebo and nocebo effects demonstrate how beliefs and anticipations can intensify or alleviate pain experiences. At the social level, for example, seeing others express pain can heighten one's own sensitivity, and cultural practices and language can also shape how individuals interpret and report pain. However, the model is far from comprehensive because it is not tailored to understand pain and its shaping.

Our framework aims to address this limitation by proposing three dimensions. Each dimension represents a different aspect of pain shaping: First, the dimension of what is being shaped refers to the specific facet or component of pain as well as the pain-related component that undergoes transformation. This could include sensory-discriminative aspects (e.g., intensity or quality), affective-motivational aspects (e.g., unpleasantness), or cognitive-evaluative aspects (e.g., beliefs or judgements about pain). Second, the dimension of how it is being shaped concerns the mode of change—whether the facet is being reinforced, modified, suppressed, or eliminated. Finally, "by what it is being shaped" refers to the influencing factors or mechanisms, including immediate physiological states (e.g., inflammation), to broader socio-cultural and temporal contexts (e.g., the cultural understanding of pain), and even to

evolutionary history. These three dimensions provide a structured way to analyze the diversity and complexity of pain-shaping processes.

This conceptual framework servestimultiple purposes. First, it can be used to systematically map existing studies on pain-shaping factors in different fields and to examine unexplored intersections for insights into new lines of research. Second, it can help us understand how pain varies and how its heterogeneity arises. Most importantly, by outlining the possible ways pain can be shaped, this theoretical project provides a way to think about the nature of pain. If certain aspects of pain are highly malleable while others remain relatively stable across contexts, this may reveal an underlying core structure of pain that is resistant to external shaping. Identifying such invariances could inform debates on the nature of pain. This theoretical project not only helps systematize empirical research but also contributes to conceptual issues concerning the ontology of pain.

Judith Schmidt

21 - How does the context of fault-relevant information influence fault diagnosis?

Judith Schmidt, TUD Dresden University of Technology, Chair of Engineering Psychology and Applied Cognitive Research

Fidélio Wiesend, TUD Dresden University of Technology, Chair of Engineering Psychology and Applied Cognitive Research

Romy Müller, TUD Dresden University of Technology, Chair of Engineering Psychology and Applied Cognitive Research

Abstract:
In complex production processes, different process steps are carried out to achieve a desired end product. Complex interactions between process parameters, product characteristics, and environmental factors may lead to faults, but the underlying causal information is typically not made available for fault diagnosis. Consequently, people may sample inadequate information, ignore alternative causes, and struggle to identify indirect effects. One way of helping people overcome these difficulties is to provide the underlying causal relations to them, for example as a causal diagram. These diagrams help people identify relations between variables, and some studies find that people are able to use causal knowledge for system control and decision-making. However, people can also misread, misinterpret ordistrust the information presented in causal diagrams. Accordingly, causal diagrams can have no or even detrimental effects. Regarding fault diagnosis, no previous studies have examined how causal diagrams affect the diagnostic process and diagnostic performance. To address this question, we conducted an experiment in which participants identified fault causes in a complex production process (i.e., chocolate production), with potential causes being presented in a causal, topological, or typological context.

In each trial, participants were asked to identify all parameters causing a provided fault (e.g., too few air bubbles have been removed from the chocolate). They saw all potential causes (i.e., 50 process parameters), could check their current values and compare them with a list of set point ranges. Between participants, we varied whether potential causes were presented as a causal diagram (causal context), according to the temporal and spatial layout of the process (topological context), or according to their parameter type (typological context). Within participants, we varied how the fault was caused and whether an assistance system suggested one parameter as the fault cause. More specifically, faults could be caused by one parameter outside its setpoint range, and the assistance system could correctly suggest this parameter (hit) or it could suggest another, incorrect parameter (false alarm + miss). Faults could also be caused by two parameters outside their ranges, with the assistance system correctly identifying one of them (hit + miss). Finally, faults could be caused by an interaction of two parameters that were each close to one end of their setpoint range, jointly causing the fault because they were exerting their effects via the same causal mechanism. For these types of faults, the assistance system suggested an incorrect parameter outside its ranges (false alarm + two misses). Regarding the diagnostic process, we expected participants to check

causally relevant parameters more and causally irrelevant parameters less if the causal context was provided. Consequently, we expected participants receiving the causal context to identify fault causes most accurately. Participants with the topological context were expected to have trouble differentiating between causally relevant and irrelevant parameters, thereby identifying additional, but incorrect causes (i.e., false alarms). For participants with the typological context, this was expected to an even larger extent.

Our results indicate that participants with the causal context checked fewer parameters overall, but more causally relevant parameters compared to participants with the topological and typological context. Consequently, participants with the causal context identified most causes correctly, and they included only few false alarms. However, their performance declined for the most difficult fault type in which two parameters within their ranges caused the fault. In some cases, participants even identified causally irrelevant parameters as fault causes, even if this was not supported by the causal diagram. Participants with the topological and typological context identified fewer causes correctly, especially when faults had two causes. They also produced more false alarms across all fault types. In sum, presenting potential fault causes within their causal context helped participants focus their search on relevant parameters and correctly identify causes, even if an assistance system provided incorrect suggestions. However, we argue that fault diagnosis might only require low-level causal information (i.e., which parameters are causally related to a given fault) instead of higher-level causal information (i.e., mechanisms explaining how parameters relate to faults). Future studies should disentangle the specific effects of different types of causal information on different cognitive tasks.

ABSTRACTS
Poster Sessions II
Tuesday
(Order: Numbered)

Sebastian Wallot

22 - Language, Meaning, and the Foundations of Scientific Practice: Limitations of the Computer Metaphor in Cognitive Science

Sebastian Wallot, Leuphana University Lüneburg

Moritz Bammel, Leuphana University Lüneburg

Abstract:

The present paper investigates the adequacy of the computer metaphor of mind and brain in accounting for cognition, particularly in relation to language and its role in scientific practice. We argue that language is not merely one domain of cognition among others, but foundational to the very possibility of science as a human practice.

A theory of cognition must therefore also be able to account for how scientific practice itself is possible (Sanches De Oliveira, 2023). We critically examine whether algorithmic accounts of cognition, which form the backbone of the computational theory of mind, can meet this requirement.

Drawing on Gödel's (1931) incompleteness theorem and Tarski's (1936) undefinability theorem, we demonstrate that algorithmic accounts of language necessarily fall short of providing a coherent theory of meaning, which is necessary for scientific practice. This structural limitation in turn undermines the capacity of the computer metaphor to account for how scientific communication and understanding are possible at all. Rather than proposing a singular replacement for the computer metaphor, we offer metatheoretical suggestions for alternative frameworks to avoid the same pitfalls, primarily that any viable framework must systematically limit its own explanatory scope.

Monika Tschense

23 - MEASURING TEXT COMPREHENSION THROUGH EYE MOVEMENTS AND READING TIMES

Monika Tschense, Leuphana University Lüneburg

Sebastian Wallot, Leuphana University Lüneburg

Abstract:

Reading a text is a complex and dynamic task that involves a precise interplay of motoric, perceptual, and higher-order cognitive processes. Moreover, the reading process adapts to text properties (e.g, di=iculty; Kaan & Swaab, 2003), task demands (e.g., proofreading vs. skimming; Schotter et al., 2014), and reader characteristics (e.g., prior knowledge; Kendeou & Van den Broek, 2007). It is well-established that eye movements and reading times reflect the coupling between a text and a reader (Engbert et al., 2005; Rayner et al., 2016). In a previous study, Tschense and Wallot (2022) demonstrated that this relationship can be quantified by the degree of regularity in time series of the reading process. The authors further proposed that regularity might also be informative about outcome measures such as text comprehension.

To test this assumption, participants read three fictional texts (~3,000 words, ~15 minutes) in three conditions: at a comfortable pace, as fast as possible, and as accurately as possible. After each text, comprehension was assessed using open-ended wh-questions and yes/no statements. In Study 1, participants' eye movements were recorded (EyeLink 1000, binocular recording, 500 Hz). Two additional studies measured self-paced reading times: in Study 2, words were presented in isolation, while Study 3 employed a word-by-word text build-up. Time series from all studies were analyzed using Recurrence Quantification Analysis (RQA), and the resulting regularity measures (RR, DET, MDL, ADL, LAM, and TT) were passed on to mixed-e=ects models.

In both studies, regularity measures significantly predicted participants' text comprehension scores. However, di=erences emerged between the two types of comprehension items. Moreover, eye movements and word reading times yielded distinct patterns of results. This highlights the need for a more systematic investigation of di=erent types of both comprehension measures and process measures, as well as their suitability for RQA. Additionally, it underscores potential advantages of RQA over traditional measures of the reading process, such as average reading times, the number of fixations, and average fixation durations (Mézière et al., 2023; Southwell et al., 2020).

Asaf Einav

24 - MECHANISTIC EXPLANATIONS AND "WHY QUESTIONS"

Asaf Einav, Ben-Gurion University of the Negev

Abstract:
In this paper, I argue that mechanistic explanations in cognitive neuroscience cannot answer "why questions", unless representation is incorporated within the mechanism. This is done by (a) Introducing the mechanistic framework and Kohar's (2023) claim that representations do not play an explanatory role in mechanisms; (b) introducing the notion of mechanistic explanatory texts (MET) and its claimed capability for answering "why questions"; (c) showing that Mayr's (1961) and Tinbergen's (1963) notions of biological explanations demand evolutionary aspects to answer "why questions"; and (d) using the locust escape behavior as a case study, for arguing that MET is not sufficient for answering "why questions", unless a representation is a part of it.

Cognitive neuroscience uses mechanistic explanations that incorporate computation and representation (Boone & Piccinini, 2015). A mechanistic explanation explains the behavior of a system (i.e., a phenomenon) in terms of the causal interactions of the system's parts and their spatial, temporal, and hierarchical organization (Machamer et al., 2000; Craver, 2007; Krickel, 2018). Generally, to be explanatorily relevant, the system's parts – acting entities – need to fulfill two conditions (Craver, 2007; Krickel, 2018): (i) being part of the system whose phenomenon is to be explained – the parthood condition (PC), and (ii) causally intervening on acting-entities should manipulate the phenomenon and vice-versa – the mutual manipulability condition (MMC). In comparison, representations are used in cognitive neuroscience to explain cognitive capacities and behavior, by emphasizing the relationship of the system's activity (i.e., neural activation) and environmental factors (Bechtel, 2007, Ch. 5; Shea, 2018, Ch. 1). However, the individuation of representational content by environmental factors and teleological functions (Schulte, 2023, 20; Ch. 4.4), has led Kohar (2023) to argue that representations do not fulfill PC or MMC, and thereby are not explanatorily relevant in mechanistic explanations.

Another important characteristic of mechanistic explanations is mechanistic explanatory texts (MET), (Kohar and Krickel, 2021). Drawing on Craver and Kaplan's (2020) contrastive mechanisms, MET are construed as descriptions of the relevant acting entities that explain the difference between the mechanism for a phenomenon P, and a set of mechanisms responsible for phenomena P', which are contrasted with P. Kohar (2023, ch. 3) has argued that MET can answer "why questions" by asking why does P and not P', and identifying the relevant acting entities that explain this contrast. For example, to answer "why does a car move straight rather than turn", wheel alignment will be included in the MET, while engine operation will not.

However, it seems that in biological systems, answering "why questions" can only be done by considering evolutionary factors. This can be shown by Mayr's (1961) and Tinbergen's (1963) notions of biological and ethological explanations. Mayr divided causes in biology into two

types: proximate and ultimate. Proximate causes are used to answer "how questions" – "how does something operate, how does it function" (Mayr, 1961, 3) – by studying structural elements from the level of molecules to organs, and their operations and interactions. Ultimate causes are used to answer "why questions", or "how come". To answer "why", the evolutionary factors that shaped, by natural selection, the organism's functional structures, are studied.

Tinbergen divided the types of questions in ethology into four: What is it for; how did it develop; how did it evolve; and how does it work (Tinbergen, 1963; Bateson and Laland, 2013). Both Sherman (1988) and Ness (2013; 2019) have argued that Tinbergen's questions correspond to Mayr's "proximate" and "ultimate" division, while Sherman specifically framed these as corresponding to "how" and "why" questions. While reframing the word "ultimate" as "evolutionary", Ness presented another sub-division, into "developmental/historical" and "single-forms" explanations, resulting in four types of explanation: (a) proximate-developmental/historical concerns the ontogeny of the organism; (b) proximate-single-form concerns the mechanism; (c) evolutionary-developmental/historical concerns phylogeny; and (d) evolutionary-single-form concerns adaptive significance. Overall, it seems that mechanistic explanations correspond to Mayr's proximate causes and Tinbergen's proximate-single-form explanations. If we adhere to Mayr's (1961) and Sherman's (1988) formulations of "why" and "how" questions, then it seems that mechanistic explanations can only answer "how", while "why" needs to be answered by evolutionary factors.

Let us examine whether MET can answer "why questions", by using the locust escape behavior as a case study. This behavior is mechanistically explained as follows: the LGMD neuron innervates the DCMD neuron, which affects motor neurons. The LGMD receives an excitatory input that correlates with an approaching object's angular velocity, and inhibitory input that correlates with the object's angular size. The LGMD's activity increases as the angular size of the object increases, reaching a peak firing rate and then quickly decreases, leading to the locust's jump (Gabbiani et al., 1999; 2002; 2012). This mechanism can be used to answer the question "how does the locust escape looming objects".

However, consider a hypothetical experiment where the looming object is paired with pheromones, simulating an approaching potential mate. Here, the locust would presumably not jump, prioritizing reproduction over escape. Mechanistically explaining this non-jump response is feasible – for instance, a neuron (N) that is activated by pheromones could inhibit motor neurons activated by the DCMD, thereby preventing muscle contraction and jump responses. A MET that contrasts the mechanism for the locust's jump behavior with that of the non-jump behavior, can identify N's activity. However, this identification does not address the relevant evolutionary factors that explain the adaptive significance of supporting species survival versus enhancing individual survival. Therefore, the "why question" remains unanswered by the suggested MET.

As a result, mechanists can do the following: (a) concede that mechanistic explanations can only answer "how questions"; (b) argue that contrasts in the form of MET are essentially contrasts between functional mechanisms (Krickel, 2018, ch. 3), thereby involving functional

differences in the explanation that do address the “why question”; and (c) allow representation to play explanatory part as acting entities in mechanisms. I claim that claim (b) is beneficial for addressing the “why question”, but that its explanatory power lies in contrasting functions and not in identifying the relevant parts of the MET, thereby resulting in a non-mechanistic explanation.

Nevertheless, it seems that incorporating representation in MET can bridge the gap between the functional, explained by evolution, and mechanistic, explained by the organization of acting entities, rendering MET as compatible with addressing “why questions”. This may be done by explaining representation using teleosemantic accounts. This means that the existence of a representation is already explained by evolutionary factors. Now, consider that in the MET for locust jump versus non-jump, N’s neural activity represents an approaching mate. Holding that this representation is already explained by evolutionary factors, an answer to the “why question” may be given by MET, i.e., by identifying that the representation of an approaching mate, rather than a dangerous object, is the relevant acting entity that makes the difference. Therefore, representation may be explanatorily relevant in mechanistic explanations, and thus the PC or MMC need to be amended.

A mechanist could argue that the inhibitory neural activity caused by an approaching mate is individuated by evolutionary processes without any representational content, and thus can play an explanatory role in answering the “why question”. However, such an individuation (a) does not fulfill PC or MMC, and (b) could very well be equivalent to a teleosemantic representation.

Johan Largo

25 - MENTAL REPRESENTATIONS IN LLMS?

Johan Largo, University of Luxembourg

Abstract:
One important issue behind large language models (LLMs) is whether we should see them as cognitive agents in their own right or just as mere tools which approximate to real cognition. To answer this question, it is useful to try to apply a scientific or philosophical theory that can tell us what cognition is and when does a system counts as a genuine cognitive system. Currently we don't have such a theory. Yet, there is still a relatively wide agreement about certain criteria a theory of mental representation should include.1 Some popular views characterize mental representations as internal components which carry information or have a structural resemblance with their targets, allowing to explain a system's robust and stable behavior (Shea, 2018). Others apply similar conditions to natural language processing, algorithms that are behind systems like LLMs, to show these systems appear to fulfill conditions such as information carrying, exploitability of vehicles and capacity to misrepresent (Harding, 2023). Views of this sort try to explain scientific practice and attempt to give a scientific status to the concept of representation, sometimes assuming these are real properties of a model. However, I will argue, theories and explanations that attribute representations to current AI systems miss an important part of the explanation: how cognitive contents are actually instantiated and manipulated by the internal workings of a system in order to explain its behavior.

My argument mainly focuses on mechanistic interpretability (the cognitive neuroscience of LLMs, one could say) as a practice that attributes semantic or cognitive contents to internal mechanisms of language models. My main argument can be decomposed into one positive and one negative part. Regarding the first one, I take it to have the following form:

1) Mechanistic interpretability is the attempt to uncover the cognitive representations and the reasoning process of LLMs by looking to their internal structure.
2) LLMs' cognitive representations and reasoning process as intrinsic and objective facts about the models may be misleading or simply false. Then,
3) Mechanistic interpretability is wrongheaded if it conceives cognitive representations and reasoning processes in LLMs as intrinsic and objective facts about the models.

I take 1) to be uncontroversial here, and 2) doing the whole argumentative work. For this I will argue we still deal with the problem of indeterminacy of content and an especial sort of "opaqueness" when it comes to explaining models' reasoning process in terms of such contents. This problem arises from trying to ground representational contents in more basic features like mathematical or structural facts of the model, e.g. potentially transparent computational facts about vector operations and hidden layers activations.

The more positive argument has the following structure:

1) Mechanistic interpretability conceived as the practice of enhancing control, prediction and trust in LLMs is an equally necessary and important endeavor.

2) Controlling, predicting and trusting LLMs can, and perhaps should, be pursued by using cognitive representational talk, although in a more deflated and pragmatic sense. Then,
3) Mechanistic interpretability can, and perhaps should, use cognitive representational talk in a deflationary and pragmatic sense.

In a similar way, I take 1) to be uncontroversial and actually endorsed by practitioners (Bereska & Gavves, 2024; Sharkey et al., 2025) and 2) doing most of the argumentative work. For this, I try to show, mostly using Egan's (2020; 2025) deflationary framework, that cognitive explanations are relative to experimental conditions and pragmatic considerations of the researchers rather than objective properties that may potentially generalize certain algorithmic and mechanistic features across models. In essence, the argument tries to arrive to the conclusion that models are explained by a framework that we project as theorists and is useful in predicting, controlling and trusting these systems but it doesn't instantiate any intrinsic mental property about them (at least, until we come up with a widely accepted and more robust theory of mental representation).

In order to achieve these two conclusions, I divide the paper in the following parts: in the second section, I try to dive in some evidence that supports the argument behind cognitive explanations in LLMs not only being opaque but also having indeterminate contents. In the next section, I show how this problem is reminiscent of the now classical problem of indeterminacy of content for biological systems. In the fourth section, I suggest that deflationary interpretations of cognitive processes of these models, a la Egan, may provide a satisfactory answer to the problem of cognitive indeterminacy for LLMs. In the last section, I show the advantages of such a view and argue that it still fits with some of the most important goals of mechanistic interpretability, namely, promoting control, prediction, trust, etc. towards these systems.

Emil Eva Rosina

26 - MNEMIC PERSPECTIVE DOESN'T MATTER

Emil Eva Rosina, Ruhr-University Bochum

Kristina Liefke, Ruhr-University Bochum

Abstract:

We discuss the results of two studies that cast doubt on the idea that perspectival centers in remembering are marked linguistically in memory reports, e.g. via 'remember myself' for observer memories and PRO-forms for field memories. Given that phonologically null PRO-forms are obligatorily interpreted de se (Chierchia, 1989), our experiments also support a dissociation of de se reference and perspectival center (Liefke, 2024; contra Stephenson, 2010).

Barbara Mühlbauer

27 - MODELING CATEGORY DIFFERENTIATION IN A CHANGING STIMULUS CONTEXT

Barbara Mühlbauer, University of Tübingen

Felix Wichmann, University of Tübingen

Abstract:

Levari et al. (2018) found that when ”blue” stimuli are presented less frequently, the color range participants assign to the ”blue” color category will broaden. However, they neither took individual differences in color categories into account, nor did they relate their findings to existing theories of perceptual category shifting. Two such theories, the Range-Frequency Theory (Parducci, 1965) and the Criterion Setting Theory (Treisman & Williams, 1984) do provide explanations and models for the effect. The Range-Frequency Theory (RFT) Model predicts the category border as the weighted sum of a quantile of the recently seen stimuli (Frequency Criterion) and a stable Range Criterion. The Criterion Setting Theory (CST) Model assumes an effect of recent stimuli on a stable initial criterion that lessens with every new stimulus. Two less complex models were constructed for comparison, one assuming a stable category border and one using only the Frequency Criterion.

After simulating participant behavior according to the models, several experiments were set up to answer whether the category boundary changes depending on the stimulus context; whether the catgeories are stable when more extreme stimuli are shown in the decreased category; and whether a task that does not rely on category judgments shows a similar effect. Stimuli were uniformly colored disks, and participants were asked to judge whether they were ”blue” or not. Careful calibration ensured that the stimuli were both equiluminant and equidistant in CIELUV color space. The result was a stimuli scale, on which the category border can be placed according to an individual’s unique perception, while still ensuring comparability between subjects.

At the beginning of each of the three sessions the participant’s category border was determined in two experiments, which was used to choose stimuli from both categories for the last experiment. In the last experiment of the first two sessions the frequency of “blue” stimuli was slowly decreased from 50% to 10%. The broadening of the category could be replicated, and both models were found to predict time-course and effect size of the experiments with high accuracy, outperforming the two less complex models. Additionally, in the second session, once the frequency of the ”blue” category was at 10%, some of the stimuli in the ”blue” category were ”extremely blue”. If model parameters stay the same the CST Model predicts that these extreme stimuli should keep the boundary more stable. This is because while the ”blue” stimuli appear less frequently, and therefore affect the criterion less often, the more extreme stimuli have a greater effect on the criterion. For the RFT Model on the other hand, the Frequency Criterion depends only on a quantile of the data, which will only be affected by the frequency at which the categories are shown. The acquired participant data did show a similar shift in the first and second session, which can be interpreted as evidence

supporting the RFT over the CST Model. However, since prediction accuracy is high for both models, it could also be the case that the condition changed the CST Model parameters.

In the third session a similarity rating task revealed that the observed shift does not only affect category judgments. Participants were asked to rate either the left or right stimulus of a presented triplet as more similar to the center stimulus in two different conditions; one showing 50% “blue” stimuli, the other only 10%. According to the previous findings and the models this change in frequency should shift the category border, which could also affect the similarity between stimuli. By aligning the triplet embeddings of individual participants in the two conditions, systematic differences in the distances of stimuli pairs between the two conditions could be shown. This implies a change in the perceived similarity of stimuli, caused by the stimulus context.

Mohamad Hadi Azraq

28 - MODELING CATEGORY DIFFERENTIATION IN A CHANGING STIMULUS CONTEXT

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Sebastian Wallot, Leuphana Universität Lüneburg

Abstract:

Introduction

Dyslexia is considered as a developmental learning disorder with impairment in reading, characterized by persistent difficulties in learning academic skills related to reading—such as word reading accuracy, reading fluency, and reading comprehension—that are not consistent with the person's chronological age, intellectual abilities, or educational exposure (WHO, 2022). Diagnosing dyslexia in adulthood is challenging, as individuals with dyslexia may develop compensatory strategies—such as enhanced use of text structure—to support academic success, potentially masking their difficulties (Moojen et al., 2020). While reading comprehension is often compensated, reading dysfluencies typically persist (Breznitz & Meyler, 2003; Swanson & Hsieh, 2009). Based on research in developing readers (Karageorgos et al., 2023), the current study uses speech pattern analysis during three reading tasks (non-word reading, word reading, and text reading) to distinguish between adult dyslexic and non-dyslexic readers.

Methods

The sample consisted of 40 adult participants, half of whom were diagnosed with dyslexia. All participants completed three reading-aloud tasks: reading a list of non- words, reading a list of words, and reading a short text. During the reading tasks, participants' voice was recorded.

From the voice recordings, standard measures of reading fluency were computed (mean pronunciation time (MP) and standard deviation of pronunciation times (SDP)), as well as measures of speech complexity using Recurrence Quantification Analysis (RQA; Marwan et al., 2007). The complexity measures included the determinism rate of the voice amplitude (%DET) reflecting the predictability of the voice signal, and the diagonal line entropy of voice amplitude (DENTR) quantifying the randomness or irregularity of the voice signal.

Logistic regression was used to relate these speech features separately to the binary dyslexia diagnosis for each task, as well as pooling these features across tasks. We mainly present values of the models' Akaike Information Criterion (AIC), where lower values indicate better fit; differences in the AIC of 4 to 7 can be considered substantial (Burnham & Anderson, 2004).

Results

Overall, the conventional measures, MP and SDP, suggest that dyslexic reading is marked by longer pronunciation times and, occasionally, greater variability in pronunciation times. When the reading tasks were analyzed separately, SDP significantly predicted dyslexia in the Non-word and Word conditions, whereas MP was a significant predictor only in the Text condition.

In contrast, the complexity measures (%DET and DENTR): consistently predicted dyslexia across all three reading tasks, with both measures reaching statistical significance at $\alpha = 0.05$ in each condition. This suggests that dyslexic reading is characterized by increased rigidity and reduced adaptive flexibility in the speech stream during reading.

On average, both sets of predictors performed equally well across tasks (average MP + SDP: AIC = 35.34; average %DET + DENTR: AIC = 36.99). Prediction accuracy was highest for non-word reading (average AIC = 26.52), followed by text reading (average AIC = 37.63), and lowest for word reading (average AIC = 44.35). Overall, these models suggest that dyslexic reading is characterized by longer pronunciation times, greater variability, higher predictability, and lower complexity in speech dynamics.

Finally, we pooled all predictors from all tasks and applied a cross-validated Least Absolute Shrinkage and Selection Operator (LASSO; Kuhn, 2020) to identify the most informative and stable predictors. The selected model included predictors from both sets and all three tasks. This model achieved reasonably good classification performance using a cut-off probability of 0.5.

Discussion

Speech pattern analysis may offer a valuable contribution to distinguishing between typical and compensated dyslexic readers in adulthood. Our findings suggest that speech patterns could potentially be used in an automatized way to differentiate between dyslexic and control readers. Notably, dyslexic speech appears to be characterized by increased higher rigidity and reduced temporal complexity, as indicated by RQA measures (%DET and DENTR). Additionally, our results highlight that complementary information across different reading tasks enhances the ability to differentiate between dyslexic and non-dyslexic readers.

However, this study serves as a proof-of-concept with a limited sample size. Future research should apply these methods to larger and more diverse populations to better clarify the relationship between speech patterns and reading impairments and to develop more robust diagnostic tools. Nonetheless, the results demonstrate the promising potential of voice feature extraction for advancing understanding and diagnostics of adult dyslexia.

Yannik Neukirch

29 - Reward History on Contextual Reacquisition

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Abstract:
Understanding how organisms adapt their behavior in changing environments is a fundamental question in the study of learning and memory, with broad implications for understanding behavior in everyday life. Extinction learning, the process by which a previously learned association between a stimulus and an outcome is weakened when reinforcement no longer occurs (Bouton, 2016; Pearce et al., 2008), is not merely the loss of information but is strongly modulated by contextual factors (Bouton, 1994; Khoo et al., 2020; Nieto & Bernal-Gamboa, 2015). Recent studies suggest that prior reward experiences influence how new contexts are perceived and processed during extinction learning, thereby shaping behavioral flexibility and the retrieval of learned associations (Bouton et al., 2011; Harris et al., 2000). This study investigates how reward history modulates contextual representations during extinction learning, with a particular focus on how previously rewarded contexts affect behavioral responses in novel or ambiguous situations.

We developed a novel experimental approach to investigate within-session reward history manipulations in free moving pigeons. Expanding upon classical ABC renewal paradigms (Khoo et al., 2020; Nieto et al., 2023), we introduced sequences of test phases reflecting positive, negative, and ambiguous reward history. To further explore reward expectation in the renewal context, we designed an ABC-reacquisition paradigm in which the renewal context was explicitly reinforced. Simultaneous in vivo extracellular neuronal recordings were conducted to examine underlying neural mechanisms. Our arena design allowed the presentation of multiple contexts within a single session without altering their physical features.

Pigeons consistently showed high response rates to familiar stimuli, largely independent of contextual changes. However, context-dependent reward manipulations involving session-unique novel stimuli resulted in modulated behavioral responses. Closer examination revealed individual differences in contextual performance and reward history sensitivity, an effect influenced by temporal dynamics. Some pigeons appeared to prioritize recent experiences, while others gave greater weight to previously acquired information.

The findings provide evidence for different distinct learning strategies in pigeons shaped by reward history. Some individuals quickly adapt to new conditions, while others rely on a more experience-based strategy, favoring past information over recent learning. This difference in behavioral flexibility likely reflects adaptive trade-offs between rapid situational adjustment and efficient, memory-driven decision-making. In ecological terms, such strategies may

support resource-saving behavior but require enhanced memory capacity and long-term consolidation processes.

Patrick Anselme

30 - SHORT EXPOSURE TO ADVANCED INFORMATION IS DISCRIMINATED AND PREFERRED TO SIGNALED NON-INFORMATION IN PIGEONS

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Abstract:
In the paradoxical choice task, pigeons prefer an initial-link stimulus leading to one of two terminal-link stimuli consistently predictive of food or no food (informative option), respectively, over an initial-link stimulus leading to a terminal-link stimulus inconsistently predictive of food or no food (non-informative option). This preference occurs even when the informative option is suboptimal in terms of reward rate, compared to the non-informative option (e.g., 20% vs 50%) (Anselme & Blaisdell, 2024; McDevi2 et al., 2016; Zentall, 2016). In this task, the terminal-link stimuli last for 10 s (or more) and the pigeons cannot change their duration by pecking.

We developed an instrumental version of this task, in which the terminal-link stimuli were a succession of five 12-s stimuli that had to be pecked once each to reach the trial outcome. Pecking switched a stimulus to the next one, so that the sequence duration could be drastically shortened (see also Wittek et al., 2024). Two conditions were tested. Condition EarlyInfo: The informative stimulus was the first stimulus in the sequence. Condition LateInfo: The informative stimulus was the last stimulus in the sequence. In this experiment, the informative and non-informative options provided the same probability of food (50%), so that the options only differed by their informational value.

The results related to the number of completed trials showed that the EarlyInfo and LateInfo conditions were chosen at a higher rate than chance level (p's ≤ 0.024) and that they did not significantly differ from each other ($p = 0.662$). The speed of trial completion differed significantly depending on the trial type, with a longer trial duration in the informative option than in the non-informative option (p's ≤ 0.002). Also, within the informative option, there was a longer trial duration in response to the stimuli sequence predictive of food than in response to the stimuli sequence predictive of no food (p's < 0.001).

Conclusion: Pigeons are sensitive to the presence of information, even when the informative stimulus is presented briefly. In this experiment, the timing of information (early or late) did not matter. Also, pigeons respond faster when the probability of food is lower than 100%. This allows them to terminate the trial faster and start a potentially more successful one. Thus, contrary to the traditional version of the task in which a non-rewarded trial is disregarded, the pigeons were motivated to complete this type of trial as quickly as possible. This behavior makes sense in a naturalistic perspective, because less me should be spent exploring and

exploiting a poor environment if a potentially richer one is available. But given that environments are changing, poor locations should not be disregarded totally.

Guste Staseviciute

31 - SOCIAL TOUCH IN INTENSIVE DAIRY FARMING

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Abstract:

Introduction.

Close interpersonal relationships are a crucial component of our human wellbeing (Ditzen et al., 2008; Myers & Diener, 1995), often acting as a source of strength, purpose and belonging. The feeling of closeness—which can be characterized in terms of physical proximity and/or psychological intimacy—is often achieved through communicating using one's body. While the study of embodied, emotional communication has long been of interest within psychological research, it has also recently been extending into other cognitive sciences. In particular, the use of various embodied communication modalities (such as physical gesture) in interaction with other people and the environment has recently gained increasing attention in the discipline of cognitive linguistics (Cienki, 2017, 2022). This growing interest is particularly relevant to physical touch, as it begins to establish this embodied modality not just as a crucial building block in forming and sustaining relationships, but also as entailing forms of expression comprising their own semiotic system (Jakubiak & Feeney, 2017; Parks & Floyd, 1996).

While the notion of being close to someone by using physical touch has been documented in human relationships, research about closeness within non-human animal communication is still critically understudied (Mondémé, 2020). The discipline of linguistics begun to broaden its primary scope by introducing non-human animals into its analysis, but to a limited extent. This work, however, does help decenter the human, both theoretically and methodologically (Cornips, 2022; Cornips & van Koppen, 2024; Pennycook, 2017; Rasenberg et al., 2023; Schlenker et al., 2023). This potential interplay between the field of linguistics and human-animal interaction subsequently raises the following questions:

1. How do different embodied activities—i.e., any use of the body that conveys meaning, including facial expressions, gestures, gaze and more—relate to and inform each other?
2. Which embodied activities are a part of fixed or conventionalized form-meaning relationships when employed by animals (Suzuki, 2024)?

To answer these questions, further understanding of human-animal and animal-animal interaction based on empirical research is crucial. In turn, this can contribute to new theoretical developments concerning the nature of sign systems (form-meaning pairings) in non-human animal communication. The aim of the paper is to begin filling this gap in

knowledge by delving into inter- and intraspecies notions of closeness from a multimodal perspective.

Study.
In the present study, closeness is studied through conducting multispecies ethnography, zooming into the embodied interactions between humans and dairy cows, as well as among the dairy cows themselves. In particular, it analyses two interactions based on a 20-hour set of video recordings collected on 11 dairy farming locations. The two cases selected highlight differing approaches that humans take when interacting with the cows using physical touch. The study employs interaction analysis in order to reveal sequential patterns of movement and touch in relation to the interactions.

Case 1.
With the use of interaction analysis, it first discusses a touching interaction between dairy cows and a cow caretaker in a meadow and delves into how the particular interaction unravels sequentially, beginning with (i) increased interest in the caretaker by the cows (characterized by the combination of directed gaze and open ear position (Cornips & van Koppen, 2024)), followed by (ii) minimising the physical distance and the potential co-creation of closeness among the caretaker and the cows (characterized by the combination of stretched out neck, upward head position and open nostrils by the cows and slow, repetitive, caress like petting by the caretaker (Cascio et al., 2019)). This particular cow-caretaker interaction is examined in light of the cow-cow interactions within the same dairy farm, pointing out the similarities in combinations of embodied modalities in cow-cow affectionate communication. This interaction is contextualised by opposing it to case 2.

Case 2.
The second interaction displays a differing approach to physical touch in a cow-farmer interaction, in which the farmer uses a pointing gesture combined with scratching and receives repeated responses of avoidance from the cow, followed by an attempt to display aggression (as characterized by the head position (Fiems et al., 2016)). This interaction is additionally investigated using the literature on unwanted touch among humans, both on cognitive and somatic levels (Saarinen et al., 2021; Suvilehto et al., 2015; van Raalte et al., 2021; Wilhelm et al., 2001).

Discussion.
Based on the two illustrative, differing approaches to physical touch employed by the animal caretaker and the farmer, the project discusses how touch relates to other embodied modalities (such as gaze and positioning of the body) and how they come together to form conventionalized form-meaning relationships. The study additionally highlights touch as a way to (dis)respect one's agency and discusses potential tools that could minimize the unintentional harm caused when interacting with non-human animals (e.g., employing informed consent by proxy (Janssens, 2024)). The subsequent findings of the present study contribute towards understanding the animal experience in communication and the role of physical touch in multimodal interaction.

Verena Seibold

32 - The Bear or the Lion – Who Did It? The Role of Verbs and Adjectives in Pronoun Resolution

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Bettina Rolke, University of Tübingen, Department of Psychology, Evolutionary Cognition

Abstract:

Introduction.

Language comprehension is based on the dynamic integration of lexical-semantic expectations and discourse-related cues such as contextual, semantic, and causal relations (Dietrich et al. 2024). Causal relations linking events and agents are crucial for the coherence of a discourse. Implicit Verb Causality (IVC) (e.g., Garvey & Caramazza, 1974) helps to assign an active role as the cause of an event to a discourse protagonist, thereby focusing attention on that protagonist and influencing subsequent pronoun resolution. For example, in “Ted amazes Paul because he…” versus “Ted admires Paul because he…”, the verb bias leads to different referent interpretations of “he”, in assigning the active role to Ted in the former and to Paul in the latter. Previous research has shown that verbs differ in their causal biases (e.g., Ferstl et al., 2011) and that expectations driven by IVC can be reinforced or counteracted by other sentence elements (e.g., Garnham et al., 1996). One such element is the semantic meaning of adjectives which is reflected, for example, in the Winograd schema. Here, changes in lexical semantics shift the causal interpretation of the referent as in “The trophy doesn't fit in the brown suitcase because it is too small/large”, where the final adjective`s meaning determines which noun is referenced because only one of the references is consistent with the causal conclusion (Levesque et al., 2012; Winograd, 1972).

In particular, ‘because’ triggers a brief counterfactual reasoning process, which identifies which referent assignment of the property (small/large) indeed leads to a consistent argument (Butz, 2017).

In two experiments, we investigated how IVC interacts with the semantic meaning of an adjective to influence global discourse coherence. Participants read a context sentence consisting of a main clause with an implicit causal verb favoring one of the two protagonists or neither of them as the cause of an event, and a subordinate clause with an ambiguous pronoun followed by a concluding adjective (e.g., “The bear annoyed the lion because he was aggressive.” – in which case the IVC focusses on the subject and the adjective is congruent with this bias, that is: was the bear not aggressive, it would probably not annoy the lion.). The

adjective was either semantically (here causally) congruent or incongruent with the predictions of IVC or provided no preference for pronoun resolution. To investigate the influence of IVC and adjective semantics, we asked participants to rate the coherence of a test sentence (e.g., “The lion was aggressive.”) with respect to the context sentence. The test sentence provided a possible pronoun reference to one of the two protagonists of the context sentence. In Experiment 1 (N = 32) we presented sentences in which IVC and adjective semantics were mixed, while in Experiment 2 (N = 32) adjective semantics provided no bias towards pronoun resolution in one block of trials and no bias in another block. The results of the two experiments were very similar: coherence judgments were influenced by both IVC and adjective semantics. Test-context-sentence pairs were judged as most coherent when the meaning of the adjective matched the protagonist preferred by the IVC but decreased when the expectations evoked by the verb were contradicted by the adjective. Most importantly, the results show that although adjective semantics appeared to be dominant, evidence for an integration of both cues suggests that discourse interpretation is a dynamic process relying on the convergence of multiple informational streams. These results support coherence-driven models of language comprehension, in which interpretation is guided by expectations about discourse structure and meaning (Kehler et al., 2008).

Annika Oldach

33 - The 'I' in Narrative: How Reader Characteristics Influence the Effect of Narratives on Comprehension

Annika Oldach, University of Freiburg

Stefanie Golke, University of Kaiserslautern-Landau

Abstract:

Humans have long used storytelling to communicate knowledge and experience, and narratives continue to shape both entertainment and education today. Understanding narratives typically relies on intuitive comprehension of their chronological, agent-centred structure and on drawing inferences based on world knowledge (McNamara et al., 2011). In contrast, expository texts – common in educational contexts – present information in domain-specific language, often requiring the reader to integrate definitions and conceptual explanations. These texts are usually more challenging for novice readers. Successful learning from texts requires the construction of an integrated, cohesive mental model (Kintsch, 1988), which depends on both text features (e.g., complexity, structure) and reader characteristics (e.g., cognitive processing depth, reading skill). To combine the intuitive accessibility of narratives with the educational depth of expository texts, a hybrid genre known as the informative narrative has emerged, particularly in popular science writing (e.g., Sacks, 1985). This new genre is assumed to effectively embed educational content in an engaging and comprehension-facilitating storyline (cf. Marsh et al., 2012). The growing use of informative narratives in educational contexts has led to an increasing body of research on the following important questions: How effective is this type of text in facilitating comprehension? What cognitive processes are involved when readers engage with informative narratives compared with traditional expository texts? Do individual differences affect how well an individual learns from informative narratives compared with expository texts? Contrary to expectation, informative narratives have repeatedly been outperformed by the traditional expository text, regarding reader comprehension (cf. Golke et al., 2019), though the underlying mechanisms remain unclear. One explanation is that narratives are perceived as less credible (Dai & Wang, 2007), potentially reducing deep processing. Others suggest that their apparent simplicity leads readers to process them superficially (O'Brien & Myers, 1985), impairing the construction of a coherent mental model. Furthermore, individual differences are likely to shape these effects: for instance, Need for Cognition (NFC) – a trait reflecting one's willingness to engage in complex cognitive tasks – and text-level reading skill, which predicts comprehension, may influence how effectively readers extract
information from different genres of texts.

As part of a project funded by the German Research Foundation (DFG project: GO1980/2-1, principal investigator: Stefanie Golke), we conducted a study employing a between-subjects experimental design with a two-level independent variable (text genre: expository vs. informative narrative), to examine moderated mediation effects on text comprehension. As potential mediators, we assessed participants' perceived text credibility and perceived text difficulty, both of which have been shown to affect depth of processing. Standardised

measures of NFC and text-level reading skill were included as potential moderators. A total of 89 participants were recruited from a student population, with the vast majority being native German speakers. Results replicated previous findings, indicating that informative narratives were significantly more difficult to comprehend than expository texts. Individual differences also played a role: conditional effects showed both higher NFC and lower reading skill to be associated with significantly impaired comprehension of informative narratives compared with expository texts. This suggests that the narrative elements may distract from the scientific content. Contrary to prior assumptions (cf. O'Brien & Myers, 1985) and rather than acting as a mediator, perceived text difficulty was a direct predictor of comprehension, with greater perceived difficulty associated with reduced comprehension – particularly for expository texts. The study highlights the need to tailor educational texts to individual reader characteristics and suggests that while expository texts generally support comprehension, informative narratives may complicate understanding. Due to limited statistical power, mediation and moderation effects require further investigation. Future research should examine the role of prior knowledge, interest (cf. Golke & Wittwer, 2024), and motivation to explore if and in which cases informative narratives may be beneficial to comprehension.

Eva Nuhn

34 - 'TURN LEFT WHERE YOU HEAR THE ELEVATOR' – WHAT SOUNDS COULD GUIDE US INDOORS?

Eva Nuhn, University of Augsburg

Kai Hamburger, Justus Liebig University

Sabine Timpf, University of Augsburg

Juliane-Christine Burkhardt, University of Augsburg

Abstract:
Landmarks are essential for human navigation, but research has mainly focused on visual cues. This study explores auditory information as navigational landmarks in indoor environments. Indoor sounds were systematically mapped in three university buildings, resulting in the identification of 248 unique sounds. These were categorised into a taxonomy of 11 classes and several subclasses, such as physical structures, electronic devices, human noise, and inventory. Most of the sounds were found to be time-dependent, with varying loudness. The most frequently recorded subclass was ’door’ from the physical structure class. Future work should refine the taxonomy, capture temporal variations, and explore the integration of auditory landmarks into pedestrian navigation systems.

Jane Francescon

35 - Turn-Taking in Vocal Exchanges of Jackdaws (Corvus monedula)

Jane Francescon, Ruhr-Universität Bochum

Lutz Wehrland, Ruhr-Universität Bochum

Jonas Rose, Ruhr-Universität Bochum

Abstract:

To ensure mutual understanding and avoid interference while transmitting or receiving acoustic signals, communicative systems must adhere to temporal rules shared among all interacting individuals. Turn-taking - the rapid but precisely timed exchange of communicative turns - provides such a temporal framework for social interactions and is considered a fundamental feature of communication, even proposed to be an important stepping stone in the evolution of complex communicative systems such as the human language. While well-documented in humans and other primates, the role of turn-taking in the vocalcommunication of corvids - a family of songbirds known for their remarkable cognitive abilities - remains largely unexplored. Given their gregarious nature, complex social structures, and high levels of vocal activity, jackdaws (Corvus monedula) present a valuable model for investigating this phenomenon. The current work analyses temporal patterns of jackdaw call exchanges to assess whether their vocal interactions exhibit a temporal structure consistent with turn-taking. We compared the timing of calls exchanged between individuals (between-individual intervals) to the timing of calls produced when individual birds repeatedly vocalised on their own (within-individual intervals). Our results reveal distinct temporal patterns for both conditions. Between-individual intervals were clustered around 200-300 milliseconds, reflecting a precise and consistent response pattern shared by all individuals. In contrast, within-individual intervals exhibited greater variability, with a bimodal distribution featuring prominent peaks at 200-300 milliseconds as well as 2-4 seconds, suggesting a higher degree of flexibility. This temporal flexibility was observed both within individuals, who exhibited a broader distribution of interval durations, and between individuals, who differed in their preferred timing patterns. These findings are consistent with our hypotheses, as we expected the intervals used by repeatedly vocalising individuals to exhibit less temporal regularity, in contrast to the more rule-governed timing anticipated in coordinated social interactions. Overall, the short response latencies and high temporal consistency observed in the between-individual intervals indicate that jackdaws engage in temporally structured vocal exchanges characteristic of turn-taking. The current study provides the first evidence of turn-taking in this species.

Joshua Welbers

36 - WHO ARE YOU? - IS AN AI ABLE TO IDENTIFY INDIVIDUAL SIGNATURES IN CORVUS MONEDULA CALLS?

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Abstract:
The capability for language, enabling nuanced and targeted communication, distinguishes humans from other organisms. However, sending acoustic signals is the foundation of communication for many species (Briefer et al., 2024). One particularly interesting aspect of vocal communication in animals is the use of signature calls. These individually distinctive vocalisations allow for individual recognition and support social dynamics (Linhart et al., 2022). Some species can deliberately address specific information to a particular individual by sending distinctive acoustic signals. For example, rhesus macaques can identify individuals solely by their “coo”-calls. Each macaque has a distinctive vocal signature or feature in its sound, making individual identification possible even without visual contact (Fukushima et al., 2015).

Similarly, corvids, although classified as songbirds, do not “sing” in the conventional sense. They show advanced cognitive abilities (Taylor, 2014), a flexible vocal repertoire (Enggist-Dueblin & Pfister, 2002) and complex social behaviours (Kondo & Hiraiwa-Hasegawa, 2015). A study by Kondo et al. (2010) provides evidence suggesting that corvids, specifically jungle crows, can recognise each other based solely on their vocalisations. Additionally, studies on rooks demonstrated the presence of individual vocal signatures (Benti et al., 2019) and confirmed that individuals can be reliably identified acoustically using multi-task neural networks (Martin et al., 2022). Thus, corvids demonstrate strong communication skills and should be further explored as a model for studying “language-like” communication in non-human animals. While individual vocal differences have been documented, it remains unclear whether corvids possess stable signature calls that serve as consistent acoustic identifiers across contexts.

This study investigates whether jackdaws (Corvus monedula) display individual vocal signatures or distinct call characteristics that enable recognition among individuals. Reliable individual identification is essential for analysing vocal communication in non-human animals. While traditional methods are labour-intensive, deep learning has the potential to offer a more efficient alternative with comparable accuracy. By applying transfer learning, pre-trained 2 models can be adapted to new datasets with relatively little labelled data, enhancing practicality in naturalistic settings. More broadly, AI-based approaches promise to improve efficiency and automate workflows in bioacoustics research.

To address this, a transfer-trained deep learning neural network (DLNN) is used to analyse sound recordings and classify individuals based on their calls. The model is trained on a labelled dataset consisting of pre-segmented and manually pre-labelled audio recordings. The pre-trained model has already undergone transfer learning in previous studies conducted by our group. Its performance is currently being evaluated in terms of classification accuracy and potential contributions to data collection. Overall, this study focuses on two main questions: (1) How can a DLNN be trained to reliably identify individual jackdaws, including determining the optimal number of samples per individual? (2) Which feature, either frequency range or call duration, serves as the primary determinant for recognition by the DLNN?

The network is trained using Mel-spectrograms extracted from the recordings as input. Before each training session, recordings are randomly split 80:20 into training and validation sets. Once the optimal dataset size is established, the second question is explored by systematically altering frequency and duration. A significant decline in performance is interpreted as an indication of the most relevant feature.

A key metric to evaluate the model's performance is the strength of the correlation between predicted and true identities, which reflects the model's generalisation ability and its capacity to reliably recognise potential individual vocal signatures. Assessing the model's accuracy across different test sets and under varying conditions can provide further insights into its robustness and the significance of the identified vocal patterns. Test runs have shown the capability of the model to discriminate jackdaw individuals with high accuracy, further supporting its potential for individual recognition. It is important to note, however, that the features utilised by the DLNN may not necessarily be the same as those used by jackdaws to recognize individuals. Nevertheless, the results could offer valuable clues about features and may be further explored in future animal-based studies to confirm their relevance.

Dhanaraaj Raghuveer

37 - WHY THE BRAIN IS NOT A COMPUTER – TWO ARGUMENTS.

Dhanaraaj Raghuveer, Philipps University of Marburg

Abstract:
In this short contribution, we will present two arguments for why the brain is not a computer: one simple and one complex. Before we get into both arguments, some preliminary questions have to be answered. We will cover those preliminaries before laying out our simple and complex arguments. Both arguments start with the premise that by a computer, we mean a mathematical (Turing) Machine (Rosen, 1991). Turing Machines are rigorous mathematical objects. The question now comes down to what mathematical objects are.

We answer this question based on Alfred North Whitehead's philosophy of mathematics - i.e. mathematical objects are abstract entities, also called pure potential patterns (Desmet, 2010). In Whitehead's philosophy, they are specifically called Eternal Objects (EOs) of the objective species. Also, any and every mathematical object is an abstract relational pattern. The mathematical object called `circle' is given by the abstract relational pattern: $\sqrt{((x-a)^2 + (y-b)^2)} = r$. In this case, it is a triadic relation between three terms $R_{cir}(X, C, r)$ where $X = (x,y)$, $C = (a,b)$ & $X,R \; e \; E^2$ & R are the 2-D Euclidean space and Real numbers respectively. Another famous mathematical object, relevant to science, is the Minkowski metric given by the relational pattern: $\sqrt{((t_1-t_2)^2 - (x_1-x_2)^2 - (y_1-y_2)^2 - (z_1-z_2)^2)} = r$.

This is also a triadic relation holding between three terms. The point is that any and every mathematical object is a relational pattern. That is why contemporary philosophers of math and Whitehead call mathematics the study of pure relational patterns (Shapiro, 2000; Desmet, 2010). Now once we have understood what mathematical objects are (i.e. pure potential patterns), the question then becomes what their relation to actualities like the chair, the ball, the sun, etc is. As is well known, abstract entities like mathematical objects are called universals while concrete entities like the chair, ball, and sun are called particulars. In Whitehead's philosophy, any and every concrete particular (the brain, the amoeba, the electron) will exhibit/ingress universals like abstract relational patterns. For example, the ball exhibits a pure potential pattern called 'spherical' (given by the triadic relational pattern: $\sqrt{((x-a)^2 + (y-b)^2 + (z-c)^2)} = r.$) Thus, the relation between mathematical objects and actualities is one of exhibition/ingression.

We need to cover one last question before getting into the two arguments - what is the role of pure mathematicians and applied mathematicians (natural/cognitive scientists)? Pure mathematicians study the realm of pure potential patterns. Now in the realm of pure potentials/EOs, there are infinite relational patterns, relations between relational patterns, relations between relations between relational patterns, and so on. The pure mathematician studies these pure potentials irrespective of whether or not they ingress into actuality. The role of applied mathematicians is to survey the pure mathematician's work and see if any concrete particular actually exhibits those relational patterns. If one were both a pure mathematician and a physicist/biologist (like Whitehead/Rosen) then closely studying the

subject matter (like a cellular organism), one might abstract a pattern that was never discovered by a pure mathematician until then. This is what Whitehead calls an act of pure abstraction. Thus, pure mathematicians study pure potential patterns without any regard for actuality, while applied mathematicians' interest lies in relational patterns that have a definite existential import.

With this in place, we'll get back to our two arguments starting with the simple argument. The Turing Machine formalism laid out by Turing is a pure mathematical object – an abstract relational pattern. This relational pattern may or may not be exhibited by any actuality. Even if an actuality exhibits a mathematical object, that actuality is never identical to that mathematical object. So even if in some cases, some aspects of the brain activity approximately exhibit the Turing Machine mathematical pattern it is never identical to it. If one identifies a particular with a universal, then one commits what Whitehead calls the `fallacy of misplaced concreteness.' This concludes our simple argument for why the brain is not a computer based on the ontological status of mathematical objects and actualities. The complex argument starts by considering the work of mathematical biologist Robert Rosen. The crux of Rosen's argument comes down to the fact that there are broadly two classes of pure potential patterns – predicative and impredicative relational patterns. The Turing machine mathematical pattern falls within the predicative class. However, according to him the adequate pure potential pattern to characterize life and mind belongs to the class of impredicative relational patterns. Even in this case, one should not claim that living organisms just are impredicative relational patterns for then one would be committing Whitehead's fallacy. If one avoids this reductionist temptation, we have a complex argument for why living systems and the brain are not computers. In this case, the argument gets its content from the fact that there are two classes of pure potential patterns, with computational and brain systems falling disjunctively into those two classes.

Vania De La Garza Espinosa

38 - LITERACY PREDICTS SEMANTIC FLUENCY IN TURKISH ILLITERATE AND LITERATE SPEAKERS

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Abstract:
Semantic fluency tasks—eliciting as many words as possible from a semantic category within a time constraint—are widely used to assess lexical access and cognitive-linguistic functioning (Strauss et al., 2006). While numerous studies have documented the effects of neurocognitive disorders, aging, and bilingualism on fluency (Yasa Kostas et al., 2024), the role of literacy, particularly in adults with no formal schooling, remains underexplored. This study investigates how literacy acquisition impacts semantic fluency performance in Turkish- speaking adults, with a focus on categories of varying ecological validity: animals, fruits, and household objects.

Building on research showing that literacy acquisition affects brain structure and cognitive functions (Dehaene et al., 2010), we tested two hypotheses: (1) that illiterate participants would perform significantly lower than literate ones on the animal category due to its association with formal education, and (2) that this gap would narrow for more ecologically valid categories like fruits and household objects.

We tested 44 native Turkish speakers (24 illiterate, 20 literate), matched approximately for age. Illiterate participants were enrolled in adult literacy classes; literate participants averaged 16 years of formal education. A custom 1-minute word reading task (Deeney, 2010; Simos et al., 2013) was used to measure literacy fluency (i.e., how many words one could read in one minute). This was followed by a semantic fluency task using three categories. Literacy was treated as a continuous variable via a composite score.

Literate participants significantly outperformed illiterate participants in all categories, including fruits and household objects. This contradicts earlier findings that suggested ecologically valid categories reduce group differences (da Silva et al., 2004; Nielsen & Waldemar, 2016). Regression analysis revealed that reading fluency (ReadComp) was the only significant predictor of fluency performance, explaining 58% of the variance. Age and education did not significantly contribute once literacy was considered.

The strong effect of literacy aligns with prior findings that reading alters cognitive and neural processes (Dehaene et al., 2010), enhances executive functions like working memory (Dąbrowska et al., 2022), and improves lexical access (Kosmidis et al., 2006; Kolinsky et al., 2014). These benefits are especially important for tasks that involve timed, strategic retrieval (Strauss et al., 2006). Written language also provides richer lexical input than speech (Roland et al., 2007) and can arguably expand semantic networks (Mol & Bus, 2011; Stanovich & Cunningham, 1998). Children with bigger vocabulary size learn to read and write faster (Foy & Mann, 2003; Lee, 2011), and we may be seeing a similar effect in our findings (i.e.,

illiterate speakers who have bigger vocabulary produce more items per category and learn to read faster).

Sociocultural factors may also contribute. Illiterate individuals, particularly women, may face social restrictions that reduce their opportunities for language use (Fingeret, 1983; Gökçe, 2016; Gökçe & Yıldız, 2018). Despite encountering fruits or household items in daily life, illiterate speakers may not develop the same semantic access mechanisms as literate individuals who practice retrieval through schooling and literacy-based activities.

Critics may argue that socioeconomic status (SES) accounts for these results. However, our analysis found that literate participants did not produce SES-exclusive vocabulary (e.g., komidin [dresser], mumluk [candle holder]), and years of education did not significantly correlate with fluency in either group. Moreover, prior studies have shown that illiterate speakers can perform comparably on certain semantic tasks (Nielsen & Jørgensen, 2013), yet our findings show persistent gaps even in familiar categories.

Taken together, our findings support a feedback-loop model (Dąbrowska et al., 2022) in which literacy improves language and cognition, which in turn improve literacy and so on. ReadComp, our proxy for reading fluency, proved a strong predictor of semantic fluency, even in illiterate learners early in their literacy journey.

This study emphasizes that literacy influences language processing far beyond decoding. Future work should explore subcategory analysis or recognition-based fluency tasks, as well as detailed descriptors of fluency patterns (da Silva et al., 2004). The cognitive and linguistic impact of literacy—especially among marginalized populations—makes it a critical variable in understanding adult language use and communicative capacity.

Catalina Iricinschi

39 - GOING BEYOND THE EVENT BOUNDARY IN NARRATIVE PROCESSING: RECONSTRUCTING THE STORY AFTER SEGMENTATION

Catalina Iricinschi, independent researcher

Abstract:
Studies on cognitive processes underlying discourse (visual/textual narrative, media) segmentation, have provided overwhelming evidence that the human mind divides perceptual continua into meaningful units of information, referred to as events (Chase and Simon 1973[1]; Newtson 1973; Zacks & Swallow 2007; Kurby & Zacks 2008; Schwan and Garsoffky 2008; Swallow et al. 2022, etc.). The environment presents itself as an uninterrupted visual and auditory stimulus: there are no inherent logical blanks in what we see, there are no inherent logical pauses in what we hear. To make sense of these perceptual continua, we impose – albeit automatically - 'edges' onto the environment and thus create cognitively manageable and meaningful segments of reality. "How we break up all of these streams [of action] into events influences how we think about things and what we remember later" (Radvansky, 2012, p. 269).

Based on empirical evidence on event segmentation and its cognitive correlates (event boundary prediction, event comprehension), researchers proposed models - mental, situational, representational - that attempt at accounting for discourse comprehension as a whole (e.g., Bailey & Zacks, 2011; Bower & Morrow, 1990; Kurby & Zacks, 2008; Morrow et al., 1989; Schwan & Garsoffky, 2008; Zacks et al., 2009).

This paper is motivated by a two-fold goal: 1. An outline of existing research will indicate that methodological approaches to event segmentation in (narrative) discourse focus exclusively on participants' identification of event boundaries thus omitting (sometimes overtly) any explanatory consideration regarding post-segmentation encoding and comprehension of entire discourses (entire narratives, speeches, etc.). 2. This paper will propose a new experimental method in which participants incorporate the already segmented events in a network architecture that may reveal discourse comprehension and memory encoding processes. In addition, the process of constructing event networks has the potential of indicating the perceived complexity of the experimental discourse stimuli.

In what follows, I will elaborate upon the two sections of the paper summarized above.

1. Event segmentation as a prerequisite for narrative discourse comprehension

Information naturally presents itself in 'raw' unorganized formats. The human mind, however, finds and encodes patterns in the incoming information. In other words, human cognition (attention, memory) operates only on organized information and, therefore, it imposes order on raw input. It is the statistical regularity of these organized patterns that enables the human mind to direct attention to and memorize relevant bits of information, and construct mental

representations of information. We automatically discretize continuous information into meaningful and cognitively manageable chunks (Chase and Simon 1973; Newtson 1973) or events (Kurby & Zacks 2008; Zacks & Swallow 2007) in an automatic cognitive process referred to (for the purposes of this paper) as event segmentation. Discretizing the environment is a necessary and automatic effort because "the continuous input is so rich and complex that much of it must be, and is, ignored; the input must be categorized to be effectively processed and understood" (Tversky, Zacks, & Hard 2008). As memory and attention increase in the vicinity of event boundaries (e.g., Kurby & Zacks 2008), the Event Segmentation Theory (Zacks et al. 2007, Zacks et al. 2010) construes segmentation as "a side effect of prediction during ongoing perception" (Zacks et al. 2010, p.11). The Event Segmentation Theory (EST) thus contends that information consolidation processes occur at each event boundary and engage attention and memory mechanisms (Zwaan 2016)[2]. With event model updates and increased attention occurring at event boundaries , it follows that memory is more reliable when retrieving the content of clearly segmented events (Swallow et al. 2022). These processes of attention and memory are not confined to the moving image: readers are perceptive of shifts between meaningful 'chunks' in text similar to viewers of visual media[3]. Discourse comprehension requires an internal representation, a "working model" for the information one processes "in much the same way as, say, a clock functions as a model of the earth's rotation" (Johnson-Laird, 1983, p. 2). These mental or situational working models, were established (in the 1970s) as theoretical accounts primarily of textual discourse comprehension, and were (arguably) based on top-down semantic or inference-making processes in conjunction with the bottom-up sentence-level syntactic analyses (Kintsch and Van Dijk's (1978) for mental model in text representations; Glenberg et al.'s (1987) for text content models). Kintsch and Van Dijk (1978) measured comprehension and recall at three time delays with text reproductions decreasing, text reconstructions increasing slightly, and metastatements increasing significantly (see also Glenberg et al. (1987). Mental models thus suggest semantic (not just structural) representations of discourse.

2. Segmentation versus Parsing: From sequences of events to discourse representation

Event segmentation serves as a prerequisite for (narrative) discourse representation. The event segmentation method approximates a bottom-up approach in that it deals with the unit of information at the expense of the relational architecture these units form to construct the discourse. In order for representation to take place at a macro level, the segmented events must be processed as interconnected elements in a relational network. Narratives are not linear series of adjacent events ('beads on a string'), but complex networks of interrelated events.

Parsing algorithms in computational implementations of grammars (e.g., Earley, 1970) or parsing strategies in human sentence processing (Chomsky, 1965; Fodor, 1998, etc.) afford deep-level connections among units. Drawing from earlier studies on text showing that "the importance of a statement depends directly on its relational role to other statements in the text", Trabasso and Sperry (1985) tested participants' judgments of statements/ events as correlated to the event's direct causal connections and its presence on a causal chain throughout the text narrative (Trabasso & Sperry, 1985, pp. 595–596). The findings show that

"judgments of importance are predetermined, in part, by the connections - causal or logical - of one event to another. The result of these individual links is a network of events and event relations" (p. 610; see also Graesser, 1980; 1981). In film narrative, the Scene Perception and Event Comprehension Theory (SPECT) (Loschky et al., 2020) seems to allow for feedback loops which place the front-end and back-end processes in a dynamic informational exchange, and not in a feed-forward linear structure.

To afford prescriptive mechanisms and generalization, event connections must be flexible and vulnerable to additions, edits, redactions. Only a complex network structure of connections affords efficient comprehension processes applicable to all forms of discourse, from the simple sequence of chronological events to semantically complex forms of discourse. Measuring participants' ability to reconstruct (narrative) discourse based on event connections - even non-adjacent - and connection density (as a measure of semantic weight) would inform discourse representation beyond the individual event.

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[1] In Chase and Simon's (1973) research, 'chunking' is the terminology used for segmentation, with chunks being the resulting unit of processing and memory encoding.

[2] Radvansky and Copeland (2006) provide similar results for a virtual reality environment in which participants explore different rooms. Walking through a door appears to elicit a representational model update and consolidation of the space-event left behind.

[3] Baggett (1979) constructed a text structurally equivalent to The Red Balloon (Lamorisse, 1956) with each narrative containing fourteen content-identical episodes. In a subsequent cued-recall test, readers & viewers agreed on the location of structural boundaries, identical in both narrative formats, even when the test was administered with a seven-day delay.

Callum White

40 - CORTEX-WIDE PHASE COHERENCE OF ONGOING ACTIVITY INDUCED BY PSYCHEDELICS AND ANESTHESIA IN MICE

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Abstract:
Although the consciousness-altering effects of drugs such as anesthetics and psychedelics are well-established, their effects on cortex-wide activity at high spatiotemporal resolution is less understood.

Utilizing wide-field optical imaging, we recorded fluorescent signals reflecting membrane potentials across both cortical hemispheres in mice that genetically encode voltage indicators in upper layer pyramidal neurons[1,2]. Experiments were conducted under three conditions: anesthetized, resting waking state, and post injection of a hallucinogenic 5-HT2A agonist.

As many hypotheses of consciousness rely on brain-wide coherence dynamics, we investigated the holistic nature of ongoing activity. During the resting waking state, we observe a stable fragmented distribution of phases.

In contrast, both conditions of an altered state of consciousness revealed strong modulation of coherence. After injection of a 5-HT2A agonist, we revealed cortex-wide patterns of activity which oscillated between strong phase coherence and decoherence, independent of frequency. While, anesthesia showed an increased decoherent state.

These findings are consistent with prominent hypotheses, which describe metastability or entropy to play a crucial role in understanding consciousness[3,4]. Furthermore, the observed psychedelic-induced effects on brain state supports emerging evidence that 5-HT2A modulation attenuates visual processing, potentially inducing a bottom-up state[5–7].

To further analyze the underlying changes in brain states, we calculated neural manifolds from the time-resolved activity dynamics. We found relatively compact manifolds with sharp curvature during the wake state, suggesting attractor dynamics with metastable brain-wide neural activity. In contrast, application of a psychedelic induced long sweeping manifolds

suggesting a diverse range neural states with high degrees of freedom, indicating a less constrained state of neuronal processing. Anesthesia, on the other hand, generated constrained manifolds, which could infer a less flexible and stable brain state. Overall, the observed changes in cortex-wide dynamics during states of altered consciousness point towards neural mechanisms that involve massive changes in brain-wide coherence.

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Vadim Weinstein

41 - RELIANCE AS A FORMAL ENACTIVIST CONCEPT

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Abstract:
An undeniable strength of the cognitivist and computational approaches to cognition is that they speak the same language as computer science, the majority of neuroscience, engineering, artificial intelligence and robotics making concepts, theories, and results from cognitive science readily available these fields. Concepts from cognitive science are guiding research in those fields, often even when the researchers are unaware of it (Favela & Machery, 2025). Searching for *representations*, algorithms that build *internal models*, and robot's internal state spaces that are treated as if they are semantically charged are all examples of this phenomenon. Arguably this approach has worked well as modern advances in those disciplines show. This success of course feeds back, reinforces, and supports the computational cognitivist theories. It is very hard to break out of this loop (and might not be necessary for the success) which is probably one reason for the popularity of the computational paradigm.
Enactive theories, on the other hand, are deficient in concepts which are easily reinterpretable in the computational realm. On one hand, this is due to enactivism's roots in phenomenology and its strong connections to social sciences. These paradigms are not interested in formulating formal accounts that are "translatable" to mathematical and computational concepts, but rather are interested in explaining the phenomena in humanistic terms. In this paper we ask what kind of concepts should enactivists introduce which would both capture essential enactivist principles and provide formal tools for the computer scientists, roboticists, engineers, and neuroscientists to understand te cognitive landscape in a new way so as to benefit from the enactive approaches. We also give an answer by describing the concept of *reliance* and argue that it has not only the potential of bringing enactivism with engineering, robotics and the like, but also to *benefit* those disciplines. Through capturing enactivist principles in formal way and creating a feedback loop with the formal disciplines we also aim to strengthen enactivist philosophy.
Our focus is in robotics. According to a classical understanding, the robot ought to generate and execute plans based on its *internal model* of the environment which in turn is *stored* in the memory and has been *constructed* based on collected and pre-loaded data. Even the modern deep learning techniques, even though they are apparently less symbolic and more adaptive, are currently conceptualised in computational[2] terms.

Reliance When we step out from our bed in the morning, we do not think about the importance of the floor greeting our legs. Without it, we would fall off a cliff. We *rely* on it. We rely on the shape of our body when we instictively stop a door from closing in front of a parent with a baby in a subway station. We rely on the position of the center of gravity of our

[2] Computational here is used in its philosophical meaning. The same term when used by computer scientists and mathematicians does not have the same connotations.

body when run, jump, and walk. We rely on the fact that the ink on paper is stable when performing calculations by hand (Wittgenstein, 1953). A lot of the theory of affordances is a special case of reliance. One *relies* on the fact that a chair affords sitting etc. The list goes on and on. Reliance is evidently a central phenomenon in embodied and enactive cognitive science, yet it has not been systematically studied as an independent idea. While enactivism, especially its radical versions (Hutto & Myin, 2013), rejects contentful states in basic minds. This rejection is often taken as roadblock for algorithm design which operates with the notions of "right" and "wrong" assumptions or "true" or "false" statements "about" the environment, the past events, and predicted future events. The roadblock analogy becomes even more pronounced when no implementation-friendly alternative is provided. Enactivist approaches, even radical ones, do accept failure, however. When a mouse picks up a cheese from a mouse trap and is killed, it has failed. The concept of reliance has this failure built-in. When a skiier encounters a patch of ice while relying on it being snow and having snow-like properties, and due to this reliance slips, she fails. Just like affordances, reliance is a property of the coupled agent-environment system and has counterparts (projections) in both the agent and the environment. The counterpart within the agent are whatever changes in the brain, nervous system, and body that shape agent's behaviour in a way that is consistent with environmental invariants. The environmental counterpart are those invariants which, in turn, enable cognitive off-loading.

Reliance and the frame problem *Reliance* penetrates in all four of the 4E-aspects of cognition: embodied, embedded, extended, and enactive. What enables the relatively low cognitive performance in complex environments? Representational approach has notably failed to account for this, as manifested by the age-old frame problem (Shanahan, 2016). This problem states that if an agent tries to account for all the relevant possibilities, a combinatorial explosion ensues, and computational limits are reached. Reliance overcomes this problem by narrowing the decision tree[3] to a narrow subtree to a limited number of sensorimotor patterns which emerge from sensory probing (?, ?).

Reliance and the extended mind The extended mind hypothesis put forward by Clark and Chalmers (1998) states that the mind off-loads computation to the environment. Whether representational or not, this hypothesis is well-defined. Understood in representational terms, it states, that an agent may e.g. remember things by making marks in the environment. Reliance has this property built-in in a non-representational way. By adapting sensorimotor responces in a way that relies on relevant properties of the environment, the agent off-loads cognitive capacity because it does not need to recognize things which rarely happen (like the absense of the floor in the morning).

Reliance and affordances When I pick up a coffee cup, I rely on a vast collection of physical properties such as, for example, that the coffee will not spill, if the cup is upright. While reliance and affordances are closely related concepts, they are not the same, as reliance

[3] A decision tree is a concept which originates in the computational approach to cognition, but can also be applied in non-semantic forms to describe sensorimotor patterns.

extends to many other aspects of perception and memory. But the theory of affordances are a concrete case where reliance has a fundamental importance.

Attunement A central concept in 4E-cognition which has eluded formalisation is that of *attunement*. When the sensory system is sensitive to the "right" features of the sensory landscape? While this notion is fundamental to enactivism, it is difficult to explicate it in terms of more fundamental properties. Reliance and attunement go hand-in-hand. Relying on visual and auditive

features in our day-to-day activities is more effective when the features are carefully selected through a history of sensorimotor interactions.

Importance for robotics It is almost invariably overlooked that "forgetting" is an important part of an effective algorithm (?, ?). When we begin to learn to drive a car, we are overtly aware of things that are irrelevant in the moment. Over time, we learn to ignore irrelevant features. In the computational paradigm this would correspond to removing things from the database, or from memory. This, at first, sounds counterintuitive. How can forgetting be beneficial? But at a closer look it becomes clear that in this way an algorithm can quickly become more effective. Forgetting such features is the beginnings of *reliance*.

Summary We introduce reliance as a fundamental concept underlying all of 4E-cognition and formalisable in a way to be used by formal sciences. The formal treatement itself, however, goes beyonf the present paper.

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Sibel Kocaaslan Atli

42 - Exploring Brain Asymmetry with Face and Word Priors: An EEG Study

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Abstract:

The human brain is functionally specialized between the left and right hemispheres. For example, face recognition predominantly engages the right hemisphere, whereas word recognition primarily involves the left hemisphere (Reinke et al., 2024). Although hemispheric asymmetries have been observed at multiple stages of information processing (Güntürkün et al., 2020) —from early sensory input to motor responses— they do not fully explain how visual information is selectively routed to the appropriate hemisphere.

Recent evidence indicates innate predispositions toward face-like stimuli, observed even in third-trimester human fetuses, newborn infants, and non-human species such as newly-hatched chicks and infant monkeys reared without facial exposure (Reid et al., 2017; Vallortigara et al., 2005; Simion et al., 2008). These findings suggest the existence of innate prototypical templates—or priors—within the brain's feature detection systems, potentially guiding the selective processing of visual stimuli (Versace et al., 2018).

In this EEG study, our primary aim is to investigate the early neural mechanisms supporting selective visual processing and hemispheric specialization. To this end, we developed a specialized stimulus paradigm in which face and word prior stimuli were presented in three visual fields (left, central, and right) immediately before the target items. Participants initially learned two neutral faces and two words in a learning session. In the testing phase, they were presented with these familiar items intermixed with novel ones. Each stimulus was preceded by a face prior, a word prior, or no prior stimulus (control). Participants indicated whether each stimulus was familiar or novel by pressing a button.

EEG data have been successfully collected from 62 participants, nearing our planned sample size of 70. Behavioral results showed significant differences in accuracy and response time based on stimulus type (face vs. word) and familiarity (familiar vs. novel), but not for prior conditions. Electrophysiological analyses—particularly those focusing on early event-related potentials such as the N170—will be presented in detail in this poster. These analyses aim to further clarify the neural dynamics underlying hemispheric specialization and context-dependent modulation of visual processing.

This methodological approach, combining subliminal face and word stimuli with contextual priming across visual fields, allows us to examine early cortical structures thought to function as feature detection systems. The findings from this study are expected to contribute meaningfully to our understanding of visual processing, innate cognitive templates, and hemispheric specialization in the human brain.