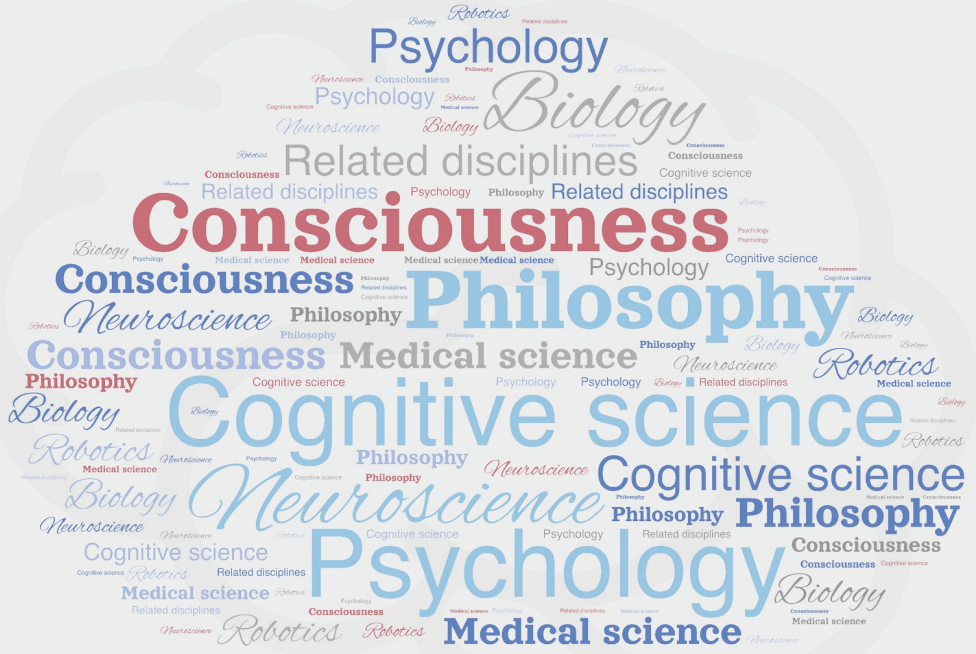
Abstract Book - CoRN 2023

Consciousness Research Network 2023

Hybrid Meeting, Taipei, Taiwan

Connecting Consciousness-Related Researchers from East Asia to Oceania



Keynote Speakers

Ann-Shyn Chiang
Institute of Systems Neuroscience
National Tsing Hua University
Taiwan

Noam Slonim
IBM Research Center, Haifa
Israel

Hakwan Lau
RIKEN Center for Brain Science
Japan

Ophelia Deroy
Faculty of Philosophy &
Munich Center for Neuroscience
Cognition Values Behaviour Research Group (CVBE)
Ludwig Maximilian University Munich
Germany

CoRN 2023

National Taiwan University
Boya Lecture Building

26th – 28th August , 2023

9:00 A.M. – 5:30 P.M.
*Differ by sessions

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Table of Contents

Program

	Session	Time	Activity
Day 1 – 26/8	*Morning Session*		
		10:00 – 10:30	Welcoming address + Bureaucratic Arrangements
		10:30 – 11:30	Keynote lecture – Hakwan Lau – The Ubiquity of Perceptual Metacognition Moderator: Shao-Min (Sean) Hung
		11:30 – 12:50	Lunch Break + Poster Session
	Noon Session		
		12:50 – 14:10	Talk Session #1A – Imagination, Virtual Reality, and Memory Moderator: Tzu-Yu Hsu
		14:10 – 14:20	Short Break
		14:35 – 16:00	Talk Session #1B – Imagination, Virtual Reality, and Memory Moderator: Tzu-Yu Hsu
		16:00 – 16:15	Coffee break
		16:15 – 17:15	Keynote Lecture – Ann-Shyn Chiang – Cracking the Brain Code Moderator: Po-Jang (Brown) Hsieh
		17:15 – 17:30	Break
	Evening Session		
		17:30 – 18:30	Workshop – How to facilitate CoRN collaboration + Selection of CoRN 2025 organizers Moderator: Yaron Caspi
		19:00 – 21:00	Reception/Gala dinner in a Restaurant
Day 2 – 27/8	*Morning Session*		
		9:30 – 12:00	Talk Session #2 – Consciousness and its Alterations Moderator: Yaron Caspi
		12:00 – 13:30	Lunch Break + Poster Session
	Noon Session		
		13:30 – 14:30	Keynote Lecture – Ophelia Deroy – Getting real : How the sense of reality is constructed in perception Moderator: Tony Cheng
		14:30 – 14:45	Coffee break

		14:45 – 16:45	Talk Session #3 – Unconscious processes Moderator: Po-Jang (Brown) Hsieh
		16:45 – 17:15	Coffee break
	Evening Session		
		17:15 – 18:30	In Consciousness We Trust – Book symposium Moderator: Shao-Min (Sean) Hung
		19:00 – 21:30	Night Social Activity – Pub Evening
Day 3 – 28/8	*Morning Session*		
		10:30 – 12:00	Talk Session #4 – Consciousness: Animal models Moderator: Shao-Min (Sean) Hung
	Noon Session		
		12:00 – 13:30	Lunch break and Career Workshop
		13:00 – 14:50	Talk Session #5 – Consciousness: Body and Action Moderator: Tony Cheng
		14:50 – 15:20	Coffee break
		15:20 – 16:20	Keynote Lecture – Noam Slonim – Project Debater – Past, Present, and Future (**Talk Online**) Moderator: Tzu-Yu Hsu
		16:20 – 16:35	Coffee break
	Evening Session		
		16:35 – 18:15	Talk Session #6 – Consciousness: Techniques and Constraints Moderator: Phil Tseng
		18:15 – 18:40	Wrapping up + Award Ceremony

Sessions

Session 1		**Time**	**Speaker**	**Speaker**	**Title**
Date:	26/8/2023				
Time:	12:50 – 16:00				
Session Title:	**Imagination, Virtual Reality, and Memory**				
		12:50 – 13:20	Lu Teng (**Talk Online**)	Does Aphantasia Support Unconscious Imagination?	
		13:20 – 13:50	Ying-Tung Lin	Dimensions of immersion and episodic simulation	
		13:50 – 14:10	YenTung Lee	Virtual Veridicalism, Cognitive Orientation, and Fregean Representationalism	
		14:10 – 14:20	Short Break		
		14:20 – 14:40	Yuwei Sun (**Talk Online**)	Sparse Associative Memory-Enabled Artificial Neural Networks Through the Lens of Global Workspace Theory	
		14:40 – 15:00	Andrew Budson	Consciousness as a Memory System	
		15:00 – 15:20	Shao-Chi Chiu	Boundary Extension in Observer Perspective Memory and its Comparison with Field Perspective Memory	
		15:20 – 15:50	Christopher Jude McCarroll (**Talk Online**)	Experience, Episodic Memory, and the Epistemic Limits of Imagination	

Session 2		**Time**	**Speaker**	**Speaker**	**Title**
Date:	27/8/2023				
Time:	9:30 – 11:45				
Session Title:	**Consciousness and its Alterations**				
		9:30 – 10:00	Chun Siong Soon	Brain Signatures around Transitions between States of Consciousness	
		10:00 – 10:30	Yoshida Masatoshi	Aberrant processing of visual salience in schizophrenia	
		10:30 – 11:00	Niall Duncan	Thinking about the role of GABA in disorders of consciousness	
		11:00 – 11:20	Hyugrae Noh	Minimal Consciousness as a Clinical Explanatory Posit	

11:20 – 11:40	Qiantong Wu (**Talk Online**)	Dreaming experience as an immersive imagination: Response to the problem of dream reports by Schwitzgebel

Session 3		**Time Speaker**	**Speaker**	**Title**
Date:	27/8/2023			
Time:	14:45 – 16:45			
Session Title:	**Unconscious processes**			
		14:45 – 15:15	Yee Joon Kim	The influence of subjective visibility on conscious perception: An EEG study
		15:15 – 15:45	Takashi Obana (Replacing Christopher L. Asplund)	Surprise-induced deafness: awareness failures caused by unexpected auditory stimuli
		15:45 – 16:15	Shao-Min (Sean) Hung	Attention gates uncosncious processes: psychophysics, fMRI, and more evidence from aging science
		16:15 – 16:35	Yenju Feng	Decoding facial information without consciousness under dis-continuous flash suppression

Session 4		**Time Speaker**	**Speaker**	**Title**
Date:	28/8/2023			
Time:	10:30 – 12:00			
Session Title:	**Consciousness: Animal models**			
		10:30 – 11:00	Chuan-Chin Chiao	Predatory behavior and decision making in cuttlefish
		11:00 – 11:30	Vishal Kapoor	Conscious perception and the primate prefrontal cortex
		11:30 – 11:50	Rong Mao (**Talk Online**)	Investigating the Role of Cerebral Cortex in Consciousness

Session 5		**Time Speaker**	**Speaker**	**Title**
Date:	28/8/2023			
Time:	13:00 – 14:50			
Session Title:	**Consciousness Body and Action**			
		13:00 – 13:30	Acer Chang	The sense of agency as active causal inference: How We Comprehend Our Control Over the Environment

			using Abstract Action Plans
13:30 – 14:00	Hyeong Dong Park (**Talk Online**)		Brain-body interactions in perception and action
14:00 – 14:20	Patrick Grüneberg		A heterarchical approach to conscious motor control – evidence from phenomenology and behavioral neuroscience
14:20 – 14:40	Anna Ciaunica		Why Consciousness is not a Thing – Implications for Artificial Minds

Session 6		**Time**	**Speaker**	**Title**
Date:	28/8/2023			
Time:	16:35 – 18:15			
Session Title:	**Consciousness: Techniques and Constraints**			
		16:35 – 17:05	Shui'Er Han	About the use of interocular suppression techniques
		17:05 – 17:25	Shao-Pu Kang	A Puzzle about Self-Knowledge of Consciousness
		17:25 – 17:45	Tzu-Ling Liu	The quality of phosphene percept is dominated by amplitude-modulated frequency of transcranial electric stimulation
		17:45 – 18:05	Kanit M. Sirichan	Why is a Weak Representationalist Theory of Consciousness too Weak?

Talks

Keynotes Speakers

1) Hakwan Lau (RIKEN Center for Brain Science, Japan) – The Ubiquity of Perceptual Metacognition

The sophistication of human perception far exceeds feedforward 'deep' neural networks in current AI, in large part because our perceptual processes are both monitored and controlled by the higher-order processes of perceptual metacognition. These include not only the generation of explicit confidence, but also implicit (i.e. automatic) judgments of reality versus imagination, of subjective similarity between stimuli, the deployment of attention, and dynamic adjustments of readout mechanisms that are sensitive to changes in noise level and representational drifts of early sensory content. It is difficult to imagine what subjective perception would be like without these processes. Perhaps there would be 'nothing it is like' to perceive, i.e. perception without perceptual metacognition, broadly defined as we did above, is probably best conceptualized as nonconscious. Because these processes likely depend on the lateral prefrontal cortex, for which there is no homologue in rodents, it raises the intriguing possibility of the uniqueness of human/primate sentience.

2) Ann-Shyn Chiang (National Tsing Hua University, Taiwan) – Cracking the Brain Code (破解大腦密碼)

The brain is responsible for controlling all aspects of a person's behavior, from movement and eating to sleeping, emotions, memory, consciousness, and even lifespan. Since the launch of the "Brain Initiative" by the United States in 2013, various countries, including the European Union, Japan, Canada, South Korea, and China, have also introduced their own national brain projects. These massive scientific undertakings aim to decipher the brain's code by deconstructing and reconstructing connectomes, which are the synaptic connections between all neurons in the brain, across various animals such as nematodes, fruit flies, zebrafish, mice, and monkeys. Recent advances in connectomics have led to the development of disruptive technologies and revealed many new principles of information processing in the brain network. In the coming decade, knowledge gained from structural and functional connectomics may provide us with the ability to manipulate specific brain cells, understand the mysteries of emergent properties in neural networks, treat various mental diseases, and even develop Artificial General Intelligence that mimics the brain.

During this lecture, I will share my personal journey in connectomics, including creating the transparent brain, reconstructing the *Drosophila* connectome, localizing genes and proteins in the entire brain, mapping memory engrams, and manipulating behavior. I will also discuss the potential for new industries that brain technology may bring and how we can apply new knowledge in brain science to improve learning efficiency and healthy living.

Key reference

1) Lin HH, Lai JSY, Chin AL, Chen YC, Chiang AS* (2007) A map of olfactory representation in the Drosophila mushroom body. *Cell* 128, 1205-1218.
2) Chiang AS*, Lin CY, Chuang CC, Chang HM, Hsieh CH, etc. (2011) Three-dimensional reconstruction of brainwide wiring networks in Drosophila at single cell resolution. *Current Biology* 21, 1-11.
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6) Lin HW, Chen CC, de Belle JS, Tully T*, Chiang AS* (2021) CREBA and CREBB in two identified neurons gate long-term memory formation in *Drosophila. Proc Natl Acad Sci USA*118, e2100624118.
7) Lin HW, Chen CC*, Jhang RY, Chen L, de Belle JS, Tully T, Chiang AS* (2022) CREBB repression of protein synthesis in mushroom body gates long-term memory formation in *Drosophila. Proc Natl Acad Sci USA* 119, e2211308119.

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Short Biography

Ann-Shyn Chiang Received Ph.D. (1990) and trained as a postdoctoral fellow (1992) in Rutgers University, Ann-Shyn Chiang joined Department of Life Science, National Tsing Hua University as an associate professor (1992), promoted as professor (1997), took sabbatical to study *Drosophila* memory at Cold Spring Harbor Laboratory (2001) and became the adjunct International Faculty of Kavli Institute for Brain and Mind (KIBM) at the University of California, San Diego (since 2011). For his contribution to our understanding of memory formation using a connectomics approach, Chiang was elected as an Academician of Academia Sinica (2014) and a fellow of The World Academy of Science (2016).

Chiang invented the world-first hydrophilic tissue clearing technology, reconstructed a brain-wide wiring diagram in *Drosophila* (the New York Times reported this discovery as the first step toward mapping human brain) and published the first *Cell* (2007) paper from Taiwanese scientists. Guiding by this connectomics map, he and his colleagues discovered that long-term memory formation requires new protein synthesis only in few brain neurons and published the first full article in *Science* (2012) from Taiwanese scientists. At his Presidential Special Lecture in the Society for Neuroscience 2016 Annual Meeting, Chiang announced the era toward whole-body connectomics. He received many awards, including: Outstanding Research Award, National Science Council (2004, 2009, 2012); Outstanding Scholar Award, Foundation for the Advancement of Outstanding Scholarship (2007); Academic Award of Ministry of Education (2007); Outstanding Contributions in Science and Technology of Executive Yuan (2008); TWAS Prize in Biology (2012); and National Chair Award of Ministry of Education (2015, 2021).

Chiang is currently the Director of Brain Research Center, the Distinguished Chair Professor of National Tsing Hua University, and the International Fellow of Kavli Institute for Brain and Mind (KIBM) at the University of California, San Diego.

3) Ophelia Deroy (Ludwig Maximilian University, Munich, Germany) – Getting real : How the sense of reality is constructed in perception

The sense of reality plays an important role in deciding whether we are seeing or imagining a rabbit in front of us. But how can we account for cases which are decidedly perceptual, and yet don't feel real enough, for instance in derealisation? What about cases which feel too real, as may happen when we are tired or in awe? This talk addresses the challenge of explaining the sense of reality within perception, which differs from explaining the distinction between imagination and perception. It also explains why multisensory metacognition plays a central role in the conscious feeling of reality in perception, but also why it cannot be sufficient to account for it.

4) Noam Slonim (IBM Research Center, Haifa, Israel) – Project Debater – Past, Present, and Future

Project Debater is the first AI system that was able to meaningfully debate a human opponent. The system, an IBM Grand Challenge, was designed to build coherent, convincing speeches on its own, as well as provide rebuttals to the opponent's main arguments. In 2019, Project Debater competed against Harish Natarajan, who holds the world record for most debate victories, in an event held in San Francisco that was broadcasted live world-wide. In this talk I will tell the story of Project Debater, present the results of systematic evaluation of the system performance (https://www.nature.com/articles/s41586-021-03215-w), and discuss the relation between this IBM Grand Challenge and recent developments of tools that demonstrate language creativity, such as Chat-GPT.

Short Bio: Noam Slonim is a Distinguished Engineer at IBM Research AI. He received his doctorate from the Interdisciplinary Center for Neural Computation at the Hebrew University and held a post-doc position at the Genomics Institute at Princeton University. Noam joined the IBM Israel Research Lab in 2007, and in 2011 he proposed to develop Project Debater. He has been serving as the Principal Investigator of the project since then, and more recently has been working on utilizing language models in practice, to address large scale text classification problems.

Sessions

Session 1 - Imagination, Virtual Reality, and Memory

Invited Speakers

1) Lu Teng (NYU, Shanghai, China) – Does Aphantasia Support Unconscious Imagination?

Aphantasia is a condition where subjects are unable to voluntarily create mental imagery in their mind. Recent research employs both subjective and objective measures to verify the lack of such an ability in aphantasics. Intriguingly, compared to non-aphantasics, these subjects can perform mental rotation tasks with similar accuracy and response time. Does this mean that they rely on unconscious imagination? In this talk, I first examine and raise objections to some arguments for unconscious imagination. Then I draw on research on consciousness and metacognition to argue that a negative answer is actually more plausible at this point.

2) Christopher Jude McCarroll (IPMC, National Yang Ming Chiao Tung University, Taiwan) – Experience, Episodic Memory, and the Epistemic Limits of Imagination

There is a debate about transformative experiences and the epistemic limits of imagination. This is a debate about the ways in which our imaginations might provide, or fail to provide, us with knowledge of what it would be like to have a certain experience before undergoing it. Many claim that some experiences are epistemically transformative: only by consciously experiencing them can we obtain knowledge of what they would be like. We can only gain knowledge of the phenomenal character of the experience by actually having it, and no amount of imagining will enable us to grasp it beforehand. Others think that, for many experiences, imagination might enable us to arrive at knowledge of what the experience would be like before we have had it. This debate crucially hinges on an assumption about episodic memory, however. Both sides of the

debate assume that episodic memory retains knowledge of our previous experiences. Yet, this view about episodic memory has recently been challenged. In this talk, I push back against this challenge about the nature of episodic memory. I suggest that episodic memory does indeed retain knowledge of our previous experiences. I use the debate about the role of experience in gaining new knowledge and the epistemic limits of imagination to shed light on the nature of episodic memory. I suggest that if episodic memory did not provide us experiential knowledge, then the epistemic limits of imagination would be much narrower, and the range of epistemically transformative experiences would be much broader than they in fact are.

Keywords: Episodic Memory; Imagination; Experience; Transformative Experience; Experiential knowledge

3) Ying-Tung Lin - (National Yang Ming Chiao Tung University, Taiwan) – Dimensions of immersion and episodic simulation

The concept of immersion has been used to describe experiences associated with virtual reality, gaming, dreaming, memory, imagination, mind-wandering, etc. (e.g., Gorisse et al., 2017; Liao, manuscript; Schad et al., 2012; Schellenberg, 2013; Windt, 2010). For instance, episodic memory is characterized by mental time travel (Suddendorf & Corballis, 1997; Tulving, 1985) or the ability to “re-experience” past events. During remembering, an episodic simulation of the past world is constructed, and the subject is partially detached from the current environment and becomes immersed in the episodic simulation. Each episode of memory differs in terms of the depth of immersion. Individuals with post-traumatic stress disorder (PTSD) suffer from vivid involuntary intrusive memories of past traumatic events. In the flashbacks, they may lose awareness of the current environment, and the sensory impressions are experienced as if they were features of present surroundings or of what is happening right now (Hackmann et al., 2004).

Despite the widespread use of the concept, what it means remains elusive. This talk aims to examine how the concept is applied and utilized in these contexts and to propose a multi-dimensional framework for immersion. The framework includes the dimensions of reality opacity, self-presence, cognitive integration, absorption, which jointly constitute a multi-dimensional space in which different forms of immersive experiences are located. These dimensions offer a new perspective on the conditions of immersion: They show how experiences can differ qualitatively respective to immersion. In addition, by analyzing the case of episodic simulation, I argue that there could be tradeoffs between conditions of immersion. The framework not only can be used to understand how phenomenology of memory differs from that of other kinds of experiences such as perception, but also provides us with a way to explore remembering experience as part of the whole experience of the remembering individual.

Keywords: Immersion, Virtual Reality, Episodic Simulation, Mental Time Travel

Selected Speakers

4) YenTung Lee (Rotman Institute of Philosophy, Western University, Canada) – Virtual Veridicalism, Cognitive Orientation, and Fregean Representationalism

This paper assesses Chalmers's (2017) defense of virtual veridicalism, the view that many perceptual experiences in virtual reality (VR experiences) are veridical. Chalmers argues that, whereas naïve VR users illusorily perceive virtual things as non-virtual, sophisticated users veridically perceive virtual things as having virtual colors, locations, and shapes because of cognitive orientation: Their knowledge of being in VR orients their perceptual content to represent things as virtual.

First, I argue that cognitive orientation is ambiguous. It can be interpreted as either cognitive penetration (Macpherson, 2012; Siegel, 2012) or perceptual learning (cf. Connolly, 2017, 2019). I argue that both interpretations fail to defend virtual veridicalism: If cognitive orientation is cognitive penetration,

users' VR experience cannot be penetrated as Chalmers suggests. If cognitive orientation is perceptual learning, it fails to ground the veridicality of VR experiences, since it at best explains the content's etiology. An independent theory of content that underpins perceptual veridicality is needed.
Second, I argue that Fregean representationalism is the best extant candidate for the underpinning theory of content. Fregean representationalism claims that phenomenal content picks out as extension whatever external property normally causes that content under certain perceptual conditions (Chalmers, 2004, 2006; Thompson, 2009). This allows VR experiences to pick out virtual colors, locations, and shapes as extension. Hence, a VR experience is veridical iff the subject perceives these virtual properties as virtual.
Finally, I argue that Fregean representationalism is insufficient to support virtual veridicalism. While experiences can be systematically veridical in the isolated VR (e.g., the Matrix) under Fregean framework, the veridicality does not hold in the mixed reality, where a particular content may simultaneously pick out both virtual and non-virtual properties as extension. I conclude that the limitation of Fregean solution is fatal to Chalmers's defense of virtual veridicalism.

Keywords: Virtual Reality, Virtual Veridicalism, Cognitive Penetration, Fregean Representationalism

5) Yuwei Sun (The University of Tokyo/RIKEN AIP/Araya, Japan) – Sparse Associative Memory-Enabled Artificial Neural Networks Through the Lens of Global Workspace Theory

Common sense is not just facts but a collection of world models. The global workspace theory demonstrated that in the human brain, multiple neural network models cooperate and compete in solving problems via a shared feature space for common knowledge sharing. Within such a learning framework, using different kinds of metadata about individual modules, as in meta-learning of AI research, shows the potential to learn, select, or combine different learn-

ing algorithms to solve a new task efficiently. The problem of uncertainty in the predictions of SOTA artificial neural networks shows that the world is only partially predictable, and a learned model cannot generalize to its ever-changing surrounding environments. We aim to provide a fundamental understanding of learning to learn in the contents of Decentralized and Modular artificial neural networks, and we believe this is one of the most critical questions and prerequisites to building an autonomous intelligence machine. To this end, we shall demonstrate several pieces of evidence for tackling the problems above by incorporating several critical elements, i.e., sparsity, discretization, and attention. We borrow inspiration from neuroscience studies and aim to develop intelligent systems with great generality to uncertainty in real-world tasks based on 1) the implementation of Global Workspaces (GWs) with diverse dimensionalities to balance storage capacity efficiency and obtain rich feature space construction for patterns, 2) Mixture of Experts in the GWs leverage the sparse selection of expert modules and the reuse of their learned patterns, and 3) feature discretization with associative memory using continuous Hopfield networks to associate perturbed memories with attractor states of learned patterns. Our hypothesis is that these constraints would serve as critical inductive biases to build general intelligence systems in the future. Notably, the sparse architecture would be differentiable, enabling end-to-end training using SOTA deep learning practices such as backpropagation.

Keywords: Global Workspace Theory, Meta-Learning, Artificial Neural Networks, Multi-Modal

6) Andrew E Budson, (Boston University, Boston, Massachusetts, USA) – Consciousness as a Memory System

Co-Authors: Kenneth A Richman[1]
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We suggest there is confusion between why consciousness developed and what additional functions, through evolution, it has co-opted. Consider episodic

memory. If we believe episodic memory evolved solely to accurately represent past events, it seems like a terrible system—prone to forgetting and false memories. However, if episodic memory developed to flexibly and creatively combine and rearrange memories of prior events to plan for the future, then it is quite a good system. We argue that consciousness originally developed as part of the episodic memory system—quite likely the part needed to accomplish that flexible recombining of information. We posit further that consciousness was subsequently co-opted to produce other functions that are not directly relevant to memory per se, such as problem-solving, abstract thinking, and language. We suggest that this theory is compatible with many phenomena, such as the slow speed and the after-the-fact order of consciousness, that cannot be explained well by other theories. We believe that our theory may have profound implications for understanding intentional action and consciousness in general. Moreover, we suggest that episodic memory and its associated memory systems of sensory, working and semantic memory as a whole ought to be considered together as the conscious memory system in that they, together, give rise to the phenomenon of consciousness. We also suggest that the cerebral cortex is the part of the brain that makes consciousness possible, that every cortical region contributes to consciousness, and that consciousness is modular, such that different aspects of consciousness are present in different cortical regions, with subcortical regions (such as the thalamus) likely acting as the hub. Lastly, our memory theory of consciousness is compatible with many others, including global workspace theories, multiple drafts model, beast machine theory, and the mnemonic basis of subjective experience.

Keywords: Episodic Memory, Explicit Memory, Cerebral Cortex, Neural Correlates of Consciousness

7) Shao-Chi Chiu (National Yang Ming Chiao Tung University Institute of Philosophy of Mind and Cognition, Taipei, Taiwan) – Boundary Extension in Observer Perspective Memory and its Comparison with Field Perspective Memory

This talk focuses on Boundary Extension (BE) in Observer Perspective Memory (OPM). BE is commonly regarded as a form of false memory, characterized by the tendency of individuals to recall having seen beyond the physical boundaries of a previously presented scene (Spanò et al., 2017). OPM pertains to a type of memory where individuals see themselves within the recalled scene from an external perspective (McCarroll, 2018). In this talk, we investigate the presence of BE in OPM and compare the extent of BE in OPM to that of Field Perspective Memory (FPM), which involves perceiving the remembered scene from the original point of view of the subject (McCarroll, 2018). Our findings demonstrate the presence of BE in OPM, with a lesser degree of extension observed compared to FPM. These findings suggest a discernible distinction in the representations of spatial boundaries between OPM and FPM.

Reference:
McCarroll, C. (2018). Remembering From the Outside. Oxford University Press.
Spanò, G., Intraub, H., & Edgin, J. O. (2017). Testing the “Boundaries” of boundary extension: Anticipatory scene representation across development and disorder. Hippocampus, 27(6), 726–739. https://doi.org/10.1002/hipo.22728

Keywords: Observer Perspective, Memory, Boundary Extension

Session 2 - Consciousness and its Alterations

Invited Speakers

8) Soon Chun Siong (National University of Singapore, Singapore) – Brain Signatures around Transitions between States of Consciousness

Human consciousness typically gets turned on and off at least once a day. While EEG has yielded tremendous insights into the electrophysiological structures of sleep, few studies have tried to zoom in on the exact moments when the brain transits between conscious states. In a series of microsleep studies, we combined eyetracking and self-reports to pinpoint the seconds during which the brain loses / regains consciousness, and the concomitant EEG, BOLD and physiological changes around these transitions.

9) Yoshida Masatoshi (Center for Human Nature, Artificial Intelligence, and Neuroscience (CHAIN), Hokkaido University, Sapporo, Japan) – Aberrant processing of visual salience in schizophrenia

Patients with schizophrenia show a variety of eye movement abnormalities, such as shortened scan paths during free-viewing of natural images. To understand the pathology of schizophrenia, it is necessary to find a link between these behavioral markers and theories about how the symptoms develop. Here, we investigated the relevance of exploratory eye movements as a behavioral marker and the aberrant salience hypothesis of psychosis. Specifically, we examined whether abnormalities in eye movements during free-viewing reflect aberrant processing of visual salience. Analysis of eye movements in 82 participants with schizophrenia and 252 healthy controls showed that the gaze of the participants with schizophrenia was attracted to positions of high visual salience in the image. These results suggest aberrant processing of visual salience in schizophrenia, thereby connecting the dots between abnormalities in early visual processing and the aberrant salience hypothesis of psychosis.

To understand the brain mechanisms of aberrant salience, animal models of schizophrenia need to be established. To this end, subanesthetic doses of ketamine were injected intramuscularly to the common marmosets, New World monkeys, and their eye movements were recorded during free-viewing. Ketamine injection significantly reduced scan paths, reproducing the symptoms seen in schizophrenic subjects. We concluded that ketamine administration is a promising pharmacological model of schizophrenia in the common marmosets. Ongoing studies have shown that ketamine also affects brain activity in the posterior parietal cortex as measured by Ca imaging. This work was funded by AMED (JP19dm0207069) and KAKENHI JP22H02936.

References:

Yoshida et al. (2022) Aberrant visual salience in participants with schizophrenia during free-viewing of natural images. medRxiv 2022.11.21.22282553

Polyakova et al (2022) The effect of ketamine on eye movement characteristics during free-viewing of natural images in common marmosets. Front Neurosci. 16:1012300.

Keyword: Salience, Schizophrenia, Saccades, Vision, Ketamine

10) Niall Duncan (Taipei Medical University, Taiwan) – Thinking about the role of GABA in disorders of consciousness

GABA is the primary inhibitory neurotransmitter in humans and is found across the whole brain. Different lines of evidence suggest that this transmitter system plays a role in the production of consciousness. We might therefore expect to see alterations to GABAergic transmission in patients with disorders of consciousness. In my talk, I will introduce empirical evidence that this is indeed the case. I will also discuss what mechanisms may lie behind an association between GABAergic activity and disruption to consciousness.

Selected Speakers

11) Hyungrae Noh (Philosophy Department Sunchon National University, South Korea) – Minimal Consciousness as a Clinical Explanatory Posit

Patients emerging from a coma are classified as being in a minimally conscious state when they exhibit signs of executive functions. Traditional behavioral assessments may not always capture these signs in post-comatose patients, prompting clinicians to seek alternative methods, such as observing localized brain activities in response to specific task instructions, like imagining wiggling toes, to diagnose minimal consciousness. This paper critically evaluates the underlying assumption of such methods: that brain activities can be taken as neural signals conveying information about minimal consciousness. Drawing inspiration from Shannon's idea of information, I distinguish between the informational and engineering aspects of clinical tasks. Take the toe-imagery task as an example. The informational aspect pertains to the conditional probability that, given the activity in the motor areas of the brain in response to task instructions, a patient is indeed imagining wiggling toes. On the other hand, the engineering aspect involves the efficient activation of relevant brain areas in a patient under specific task conditions, such as understanding the instruction, "Imagine wiggling all of your toes on both your feet and then relaxing them." This distinction reveals that while the current alternative methods are not informationally problematic, they are structurally "ill-formed." For example, the toe-imagery task relies on the capacity to comprehend syntactically complex sentences, a skill which can be dissociated from minimal consciousness. I propose a misrepresentation task, which tests the capacity to misconceptualize lukewarm water as melting wax, as an addition to the current alternative methods. This task, while as informationally reliable as these methods, is structurally "well-formed," as it does not rely methodologically on prerequisites such as language comprehension.

Keywords: Post-Comatose Disorders of Consciousness, Shannon's Theory of Information, Minimal Consciousness, Mental Action

12) Qiantong Wu (Department of Philosophy, National University of Singapore, Singapore) – Dreaming experience as an immersive imagination: Response to the problem of dream reports by Schwitzgebel

Schwitzgebel uses the example of dream coloring to cast doubt on people's dream reports based on subjective introspection. In this paper, I argue that Schwitzgebel's interpretations of dream reports about dream coloring are based on a problematic assumption about the characteristic of dreaming experiences, which assumes there is a distinction between our "experience" in dreams and the "dream world." I will propose a new theory, the immersive imagination theory, to recharacterize dreaming experiences based on the lack of situatedness of the dreaming subject. With this theory, I will explain why Schwitzgebel's assumption is problematic and propose a possible explanation of his empirical findings.

In particular, I first analyze the characteristics of dreaming experiences, pointing out that the loss of situatedness of the dreaming subject distinguishes dreaming experiences from hallucination and imagination during waking states, which also casts doubt on Schwitzgebel’s assumption in his interpretation of dreams. Then I propose the immersive imagination theory. This theory explains dreaming experiences as a special version of imagination, which, fundamentally speaking, are pieces of thoughts, but experienced as vividly as perceptual experiences during waking states. I explain why the immersive imagination theory is explanatorily more powerful than other theories by its specific emphasis on the influence of the lack of environmental interactions for the dreaming subjects and how we should understand the problem with the reports about dream coloring under the framework of this theory.

At the end of the paper, I respond to potential objections to the immersive imagination theory from lucid dreams and REM behavioral disorders.

Keywords: Dream Colouring, Introspection, Dream Reports, Immersive Imagination Theory

Session 3 – Unconscious processes

Invited Speakers

13) Yee Joon Kim (Center for Cognition and Sociality, Institute for Basic Science (IBS), Daejeon, South Korea) – The influence of subjective visibility on conscious perception: An EEG study

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Previous attentional blink study demonstrated perceptual integration without conscious access. However, it is unclear how systematically illusory contour perception can occur independently of subjective visibility. We investigated this by generating five types of stimuli consisting of an image with four pac-man-shaped inducers: four illusory conditions with inducers configuring isosceles right triangles and a control condition with random inducer orientation, but neither forming triangles nor a square. To influence consciousness, we only manipulated the ISI between target and backward mask with their contrast level fixed. At the end of each trial, participants were instructed to report one of five possible target shapes and then rate its subjective visibility. We recorded participants' 128-channel EEG and divided EEG trials into high-visibility(HV) and low-visibility(LV) groups according to visibility ratings and behavioral performance accuracy. Preliminary Kanizsa vs. control EEG classification analysis showed that perceptual integration emerged transiently around 150ms post-target onset, subsided quickly, and reappeared during a late period from 300 to 800ms post-target onset for HV trials whereas perceptual integration occurred very briefly around 450ms post-target onset for LV trials. The subjective visibility-dependent differential perceptual integration dynamics of the same physical target suggest that brief perceptual integration can still occur through long-range integration during a late period even though masking interferes with local recurrence-based perceptual integration during an early period.

14) Takashi Obana – (Yale-NUS College, National University of Singapore, Singapore) – Surprise-induced deafness: awareness failures caused by unexpected auditory stimuli

Attention is often captured by unexpected or unusual sounds. Such stimulus-driven control of attention can be adaptive, as potentially relevant events need to be quickly evaluated and acted upon. Attentional capture, however, comes with a cost: Ongoing tasks may be disrupted, and otherwise obvious events may fail to reach awareness. Here I describe three experiments in which we investigated the effects of task-irrelevant, rare, and relatively unexpected sounds ("surprise stimuli") on probe detection in rapid auditory presentation (RAP) streams. Surprise stimuli caused "surprise-induced deafness" (SiD), a substantial detection deficit that lasted for less than a second within each trial and gradually habituated across several trials. SiD was sensitive to informational surprise, with larger deficits following stimuli that were infrequent or varied across trials. We compared SiD to the auditory attentional blink (AAB), a similar paradigm in which goal-directed target processing disrupts probe detection. We found that the two deficits were weakly correlated. We conclude that SiD is a novel outcome from stimulus-driven attentional capture. It may involve other forms of attentional control as well, thereby reflecting multiple attentional influences on awareness.

15) Shao-Min (Sean) Hung 洪紹閔 (Waseda Institute for Advanced Study, Waseda University 早稲田大学) – Attention gates uncosncious processes: psychophysics, fMRI, and more evidence from aging science

The existence of high-level, in-depth unconscious processing has been heatedly debated. Both positive and negative data are constantly provided, making an impasse. Here I propose that a revisit of the Load Theory may break the deadlock. In several studies, I will first show that attention, specifically the task load, modulates unconscious semantic processing. This modulation can be observed as early as the primary visual cortex. Next, I will explain why the tight

link between attention and unconscious/implicit processes constitutes a powerful tool to study cognitive aging. The empirical support will come from my recent studies on older individuals who have different levels of risk of developing Alzheimer's. Overall, these findings provide both theoretical advances and clinical relevance.

Selected Speakers

16) Yen-Ju Feng (Department of Psychology, National Taiwan University, Taiwan) – Decoding facial information without consciousness under dis-continuous flash suppression

Co-authors: Po-Jang (Brown) Hsieh[1]
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The accessibility of facial information without awareness remains a contentious topic in neurophysiological research. Previous studies may have suffered from suboptimal parameters, contributing to the lack of consensus. To address this, we implemented three key improvements in this study to investigate optimal measurements for unconscious processing of facial information. Firstly, we employed dis-continuous flashing suppression (dCFS), allowing for extended suppression durations. Secondly, we utilized both univariate analysis and multivoxel pattern analysis (linear SVM) to probe face-driven activations across lower and higher visual areas. Lastly, to enhance ecological validity and improve signal-to-noise ratio, dynamic video clips were incorporated alongside static images. Using functional magnetic resonance imaging (fMRI), two experiments were conducted. The first experiment (Exp. 1, N=16) examined the decodability between faces and objects, while the second experiment (Exp.2, N=43) explored the decodability between faces and scenes.

In Exp. 1, conscious faces elicited broader univariate activations compared to conscious objects, while no differential activation was observed when stimuli were suppressed as invisible. Employing multivariate classification with re-

gion-of-interest (ROI) analysis, we successfully distinguished dynamic invisible faces from dynamic invisible objects in occipital-temporal regions (left CAL, right MOG, and bilateral FFA), indicating that interocularly suppressed faces/objects are processed and decodable without conscious awareness.

Likewise, in Exp. 2, conscious faces evoked wider univariate activations compared to conscious scenes. Utilizing multivariate classification coupled with the searchlight algorithm, we found that static faces could be differentiated from static scenes in the conscious condition, specifically in the l-PoCG, l-CB, r-CAL, r-STG, r-SMA and r-SFGdor. Moreover, dynamic faces could be differentiated from dynamic scenes in the l l-SOG, l-IOG, l-SMA and r-IFGtriangle. Notably, even in the unconscious condition, several regions such as the l-ACC, l-SMA, r-CAL, r-SFGdor and r-MTG exhibited discriminative ability between suppressed static faces and suppressed static scenes. Additionally, numeral regions, including the l l-PCL, l-STG, l-CB, r-LING, r-SFGdor, r-STG, r-TPsup, and r-SPG demonstrated differentiation between suppressed dynamic faces and suppressed dynamic scenes.

Overall, our experiments consistently demonstrated that conscious faces elicited more widespread univariate activations compared to conscious objects or scenes, while no differential activation was found when stimuli were rendered invisible. However, employing a finer-grained analysis through multivariate classification techniques enabled the decoding of visual cortex and face-related areas even in the absence of conscious awareness, suggesting that facial information can undergo processing without conscious perception.

Keywords: Unconscious Processing, Facial Information, Dis-continuous Flashing suppression, fMRI, Multivariate Pattern Analysis, Univariate Analysis, Dynamic Stimuli, Visual Cortex, Face Recognition.

Session 4 – Consciousness: Animal models

Invited Speakers

17) Chuan-Chin Chiao (Department of Life Science, National Tsing Hua University, Taiwan) – Predatory behavior and decision-making in cuttlefish?

Cephalopods including cuttlefish, squids, and octopuses evolved with teleost fishes some 200 million years ago, and they have the most complex brain in invertebrates. Cuttlefish are predatory animals. They constantly search for food or ambush for prey. Cognitive ability is essential for their preying behavior. In this talk, I will present evidence showing that cuttlefish can count number and their choice of prey depends not only on the quantity but also on the quality. Similar to human economic behavior, cuttlefish's decision-making also involves risk assessment and is dependent on their metabolic states. When they choose between two options, cuttlefish are not always based on the absolute values of the options, but can also depend on their relative values. Furthermore, cuttlefish's foraging strategies are influenced by the previously surprised event and their internal states. They also exhibit a speed-accuracy tradeoff in difficult and ambiguous situations when foraging for prey. All these findings demonstrate that cuttlefish are highly cognitive animals, and there are more to be learned in the future.

18) Vishal Kapoor (International Center for Primate Brain Research, Center for Excellence in Brain Science and Intelligence Technology, Chinese Academy of Sciences, Shanghai, China) – Conscious perception and the primate prefrontal cortex

The functional role of the prefrontal cortex has been a central debate in the field of consciousness. The focus of this discussion has been, if this region is involved in conscious perception or if prefrontal activity associated with paradigms investigating conscious perception is instead conflated by task-related or

post-perceptual cognitive processes associated with reporting perceptual content, e.g. decision-making, motor action. This talk shall present results obtained from experiments, wherein we probed the neurophysiological underpinnings of conscious perception in the prefrontal cortex of non-human primates, while they were engaged in paradigms of conscious perception. We found prefrontal neuronal activity correlated with both exogenously induced and endogenously generated transitions in conscious perception. Moreover, conscious content could be reliably decoded from the activity of prefrontal ensembles in the absence of volitional reports. Interestingly, the neurons displaying activity correlated with conscious content were functionally segregated from a simultaneously recorded population which displayed trial phase-related activity. Further, the fluctuations in prefrontal state as indicated by the local field potential, are associated with spontaneous changes in conscious perception. Taken together, these results suggest that the dynamics of prefrontal activity reflect perceptual content and transitions of conscious perception.

Keywords: Conscious Perception, Prefrontal Cortex, Binocular Rivalry, Electrophysiology, Decoding

Selected Speakers

19) Rong Mao (Department of Psychiatry, University of Wisconsin-Madison, Madison, Wisconsin USA) – Investigating the Role of Cerebral Cortex in Consciousness

In humans, the level of consciousness is reliably assessed by quantifying the spatiotemporal complexity of cortical responses using Perturbational Complexity Index (PCI) and related PCI^{st} (st, state transitions), but its responsible mechanisms are poorly understood. Here, we investigated PCI^{st} responses in freely moving rats and mice using electrical and optogenetic stimulation accompanied by unit recording probes with multiple contacts. First, we validated PCI^{st} in rats and mice by showing that it is lower in NREM sleep and slow wave anesthesia

than in wake or REM sleep, as in humans. Specifically, we found that in rats (8 males) PCI^{st} values in NREM sleep decreased on average by 50 ± 20% relative to wake and by 51 ± 27% compared to REM sleep. Similarly, in mice (8 CaMKIIα::ChR2 mice, 4 females), PCI^{st} recorded from posterior parietal cortex are higher in wake and REM sleep than in NREM sleep. We then showed that low PCI^{st} is associated with the occurrence of a cortical OFF period of neuronal silence. Moreover, we found that stimulation of deep, but not superficial, cortical layers lead to reliable PCI^{st} changes across sleep/wake and anesthesia. Overall, we found that consistent PCI^{st} changes are independent of which single cortical area is being stimulated or recorded, except for recordings in mouse prefrontal cortex.

These experiments show that PCI^{st} can reliably measure vigilance states in unresponsive animals and support the hypothesis that it is low when an OFF period disrupts causal interactions in cortical networks. In ongoing experiments in mice, we also find that the selective optogenetic activation of pyramidal neurons in different cortical areas is sufficient for the recovery of the righting reflex after the induction of a coma-like state. Thus, the direct activation of cortical pyramidal neurons is likely sufficient for the recovery of consciousness.

Keywords: Neural Correlates of Consciousness, Cerebral Cortex, Quantifying Consciousness, Animal Consciousness

Session 5 – Consciousness: Body and Action

Invited Speakers

20) Acer Chang (Department of Psychology Rikkyo University, Japan) – The sense of agency as active causal inference: How We Comprehend Our Control Over the Environment using Abstract Action Plans

Several aspects of conscious experience can be understood as the results of internal inference processes. As the conscious experience of controlling one's own actions, we asked whether computation of the sense of agency could also be viewed as causal inference. In this study, participants were asked to move a computer mouse freely and determine whether a visual object is controlled by them (control judgment task) or which of three moving objects they are controlling (control detection task). The degree of control and rotation of the motion directions of the objects were manipulated. We showed that the participants formed high-level action policies (plans) to effectively infer their degree of control in the noisy environment. We utilized deep neural networks (transformer-LSTM-based autoencoders) to capture action plans which were idiosyncratic across but stable within individuals. Specifically, we trained the autoencoder with motor sequence data from the control judgment task and tested the generalization of the trained action plan spaces to the control detection task. We found that the individual behavioral profiles in the two tasks can be well predicted by the geometrical relationship between the intentional and the presented action plans in the action plan space. Crucially, not only the similarity but also the dynamical similarity of action plans contribute to predictability suggesting that participants assess the effects of interventions on the environment, an essential aspect of causal inference. Our findings demonstrate that the computation of the sense of agency is not simply determined by passive observational inference but involves actively inferring the causal influence of one's own actions on the environment.

21) Hyeong Dong Park (Taipei Medical University, Taiwan) – Brain-body interactions in perception and action

Do interactions between the brain and body (e.g., heart and lung) play a functional role in human cognition, in particular conscious experiences? This is the central question of my research career. In this talk I will introduce my previous research suggesting that 1) neural responses to heartbeats (i.e., heartbeat-evoked brain potentials) could predict conscious visual perception, using MEG (Park et al. Nature Neuroscience. 2014); 2) experimentally induced changes in self-consciousness are associated with heartbeat evoked brain potentials, using virtual reality technology combined with scalp EEG (Park et al. Journal of Neuroscience. 2016); 3) voluntary action and cortical readiness potentials are coupled with the breathing system (Park et al. Nature Communications. 2020). Then, general implications and potential future projects will be discussed.

Keywords: Brain-Body Interaction, Heartbeat Evoked Potential, Perceptual Awareness, Bodily Self-Consciousness, Voluntary Action

Selected Speakers

22) Patrick Grüneberg (Institute of Liberal Arts and Sciences, Kanazawa University, Japan) – A heterarchical approach to conscious motor control – evidence from phenomenology and behavioral neuroscience

Conscious motor control, one of the hallmarks of human behavior, demonstrates the integration of cognitive and motor processes. While many movements are conducted habitually or automatically, human agents can also initiate bodily movements in a self-controlled manner and determine their start, direction, and speed, such as during motor learning or rehabilitation. However, common representational accounts of consciousness do not address the conscious performance of motor control as the origin of behavior, as they consider conscious agency to emerge from subpersonal motor control processes. Beyond

this hierarchical view of primary subpersonal (unconscious) and secondary personal (conscious) processes, I propose a heterarchical control architecture to explain the conscious performance of motor control and its neuromuscular implementation. This model relies on self-determined variables (the choice of and the efforts to implement the intended movement) and constrained variables (physiological conditions of the movement). Depending on the needs of the agent and the environment, the neuromuscular implementation of a movement occurs in different configurations of these variables, allowing for (the combination of) specific modes of action (conscious/unconscious, automatic/self-controlled, spontaneous/habitual). In my talk, I will refer to experimental evidence from the phenomenology of gait initiation and behavioral neuroscience and argue that motor control performs consciously when the self-determination of the agent directs the neuromuscular implementation toward the intended movement. By contrast, configurations dominated by automatic or habitual behavior lead to unconscious motor control. Secondly, I will consider some implications of this heterarchical approach. Assuming that the neuromuscular implementation of the movement builds on referent configuration and parametric control, the computational task of pre-programming motor behavior, which is highly problematic due to redundancy problems, is no longer required. Instead, self-controlled (conscious) initiation determines the neuromuscular implementation of the intended movement by relying on the physiological constraints of the agent and situational constraints.

Keywords: Conscious Agency, Motor Control, Heterarchy, Referent Control

23) Anna Ciaunica (Centre for Philosophy of Science, University of Lisbon, Campo Grande, Lisbon, Portugal and Institute of Cognitive Neuroscience, University College London, London, UK) – Why Consciousness is not a Thing – Implications for Artificial Minds

Significant theoretical and empirical efforts have been employed recently to unravel the psychological and neurobiological nature of human consciousness. In this paper I suggest that talking about ‘consciousness’ may be misleading as

it implies one single unitary ‘thing’. Instead, I draw attention to the intrinsic link between consciousness, experiences and experiencing subjects, which are first and foremost embodied and situated organisms essentially concerned with self-preservation within a precarious environment. I argue that most theoretical and empirical discussions about the nature of conscious experiences are typically couched in a way that endorses a tacit adult-centric and vision-based perspective. I suggest that in order to understand what consciousness is, one should first tackle the fundamental question: how do embodied experiences arise from square one? I highlight one key yet overlooked aspect of human consciousness studies, namely that the earliest and closest environment of an embodied experiencing subject is the body of another human experiencing subject. I present evidence speaking in favour of fairly sophisticated forms of early sensorimotor integration of bodily signals and self-generated actions already being established in utero. These primitive and fundamentally relational and co-embodied roots of our early experiences may have crucial impact on the way human beings consciously experience the self, body and the world across their lifespan. I conclude by discussing the implications of this shift in perspective for current theories on artificially conscious agents and artificial embodied intelligence.

Keywords: Self-Consciousness, Embodiment, Predictive Processing, In Utero Perception, Artificial Minds

Session 6 – Consciousness: Techniques and Constraints

Invited Speakers

24) Shui'Er Han (Institute for Infocomm Research, Agency for Science, Technology and Research (A*STAR), Singapore) – About the use of interocular suppression techniques

When each eye is presented with a different, irreconcilable image from the other eye, one of these images would become temporarily suppressed from visibility. Known as interocular suppression, the phenomenon allows easy manipulation of visual awareness, contributing to its widespread use in cognitive neuroscience, particularly with studies of unconscious visual processing. However, despite its popularity, findings of unconscious high-level processing with the technique has been under debate, presumably due to the fractionated nature of interocular suppression. In addition, the unusual visual presentation during typical interocular suppression paradigms raises questions about whether the findings obtained with the technique are externally valid. In this talk, I will evaluate these two points and discuss how the technique can remain useful, providing as well an open-source resource for evaluating high-level and low-level explanations of results.

Selected Speakers

25) Shao-Pu Kang (Sage School of Philosophy, Cornell University, Current Affiliation: Institute of European and American Studies at Academic Sinica, Taiwan) – A Puzzle about Self-Knowledge of Consciousness

It is widely thought that there is an asymmetry between one’s access to one’s conscious states and one’s access to others’ conscious states. One seems to have a special way of knowing that one sees the sunrise, that one is feeling cold, that one is excited, and so on, which others cannot use to know that one is

in those conscious states. Why is there such an asymmetry? A natural thought is that there is a parallel asymmetry:

> **Special Relation**: One can know one's conscious states in a way unavailable to others because one bears a special relation to one's conscious states such that others cannot bear that relation to one's conscious states.

While a major challenge is to say what the special relation is, recent work on shared consciousness suggests that the issue is even more complicated.

Krista and Tatiana Hogan are craniopagus conjoined twins—that is, they are joined at the head. They are unique because they are also joined at the thalamus, where information in each's brain can be transmitted to the other's brain. As a result, stimulation of each's body can cause the other to have experiences. On one interpretation (Cochrane 2021), they share conscious states:

> **Sharing**: The Hogan twins can be in numerically the same conscious states while being distinct subjects.

In previous work (Kang 2022), I argued that even if they share conscious states, their case does not threaten asymmetry:

> **Asymmetry despite Sharing:** When the Hogan twins share a conscious state, each can know that she is in that state in a way unavailable to the other.

The three claims seem jointly inconsistent, thereby generating a puzzle. In this talk, I will explain what the puzzle is in more detail and consider some solutions to it.

Keywords: Self-Knowledge, Introspection, Asymmetry, Consciousness

26) Tzu-Ling Liu (Institute of Cognitive Neuroscience, National Central University, Taiwan) – The quality of phosphene percept is dominated by amplitude-modulated frequency of transcranial electric stimulation

Brain oscillations are known not only to correlate to but causally affect visual awareness. While most of the oscillatory studies are based on linear frequency methods, how nonlinear oscillatory property plays a part in visual awareness is rarely discussed. The current study includes two transcranial electric stimulation experiments to examine the functional role of amplitude-modulated (AM) oscillation in phosphene perception. In experiment 1, we elicited phosphene, which indicates illusory flashing without photons stimulating the retina, in healthy human subjects with transcranial alternating current stimulation (tACS) to examine how AM tACS affects visual percept. Our results (N=12, 4 females, 20-44 years old) showed that AM tACS can induce phosphene percept with a higher threshold intensity. AM frequency did not interact with the carrier frequency function that participants tend to be more sensitive at the frequency around the beta band. Moreover, AM frequency seemed to override carrier frequency by abolishing the frequency effect in flashing speed rating. Compare to sinusoidal stimulation, participants tended to rate the AM stimulation slower regardless of its carrier frequency. Experiment 2 further examined whether the AM effect interacted with the polarity by making the oscillating current positively or negatively charged with oscillatory transcranial direct current stimulation (otDCS). The results (N=25, 12 females, 20-45 years old) confirmed our prediction that AM effect on the threshold and flashing speed rating was robust in either positive, negative, or polarity-switching stimulations, indicating the relative change, rather than the absolute magnitude, of the electric field causes phosphene percept. Our study suggests that neural phase-locking to the AM envelope may be one of the underlying mechanisms of how the brain binds temporal information into perceptual events. We, therefore, propose the pivotal role of amplitude modulation in visual perception formation.

Keywords: Phosphene Percept, Amplitude Modulation, Transcranial Electric Stimulation (tES)

27) Kanit M. Sirichan (Department of Philosophy, Chulalongkorn University, Thailand) – Why is a Weak Representationalist Theory of Consciousness too Weak?

According to Brentano (1874), only mental states have intentionality. Intentionality is characterized as that which can be beyond itself, to be about or directed at its object of thought as its content. The Brentano thesis on the mark of the mind provides a background debate on the relation between the phenomenology of the mind and its content. After Block's analysis (1995) on phenomenal and access consciousness, the debate turns to the relation between phenomenal consciousness and its content. Phenomenal consciousness is the qualitative or subjective features of experience or the experience of 'what it's like' (Nagel 1974)). The quest for consciousness then turns out to be a hard problem. (Chalmers 1995) It is hard as it would beg an explanatory gap if physicalism were true. The problem concerns the difficulties of explaining consciousness in terms of physical states. But suppose we try to escape the hard problem by looking for the objectivity within the subjective realm of consciousness, like what Brentano did (see, e.g. Crane 1998, Montague 2016, Roy 2015) or what Nagel called 'objective phenomenology'. In that case, we will succumb to the myth of the stream of consciousness, the content of which is lost. The problem hence concerns the question of how content is possible within the realm of phenomenality or consciousness. Another way to look at the problem is, as Horgan &Tienson (2002) puts it, the problem between separatism and inseparatism. For those who are separatists or representationalists, consciousness and intentionality are two mutually independent or separable aspects of our mental lives, and the content of consciousness can be explained by its intentional or representational structure. (e.g. Dretske 1995, Millikan 1984, Tye 1995, Kriegel 2003) For the inseparatists, consciousness and intentionality are interdependent or inseparable; and the phenomenal realm of consciousness can determine intentionality. (e.g. Brentano 1874, Horgan&Tienson 2002). One

main objection to representationalism is the possibility of experience without intentional structure or aboutness, e.g., mood. However, this merely shows that strong representationalism is false. (Kind 2003, 2010, 2014; Mendelovici 2014) My presentation will examine Kind's and Mendelovici's arguments and raise a concern about whether their weak representationalism is too weak for understanding the original problem of how content is possible in the realm of consciousness. The primary assumption behind my criticism is an application of Wittgenstein's rule-following argument.

Keywords: Consciousness, Intentionality, Weak Representationalism, Mood

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Posters

Physical Posters

1) Nguyen Thi Nhung (International Ph.D. Program in Medicine, College of Medicine, Taipei Medical University, Taipei 110, Taiwan) – Transcranial random noise stimulation over right parietal cortex modulates EEG complexity but does not improve visuospatial working memory

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Transcranial random noise stimulation (tRNS) is a form of noninvasive brain stimulation that uses alternating current over a random spectrum of frequencies. Its effect in the motor cortex has been shown to be comparable to anodal transcranial direct current stimulation (tDCS), and researchers have mostly relied on stochastic resonance to explain the positive effects of tRNS on EEG complexity and enhanced behavioral performance. Here we tested the possible effect of tRNS on visuospatial working memory (VWM), using a color-location change detection task that has been shown to be sensitive to low-performers' improvement when applied with anodal tDCS. However, unlike anodal tDCS, we observed no effect of tRNS (or tRNS+DC) in modulating people's VWM performance. This was true for both high- and low-performers. Multiscale entropy analysis of EEG data revealed that low-performers in the active stimulation session—which is usually the group that shows improvement with anodal tDCS—showed increased signal complexity in frontoparietal electrodes and between scales 11 to 20. This, however, was also not associated with any kind of behavioral modulation. These results suggest that, using the same task where anodal tDCS has been shown to improve low-performers' VWM performance, tRNS can modulate signal complexity in low-performers but does not necessarily lead to cognitive or behavioral changes.

Keywords: Visuospatial Working Memory, Transcranial Random Noise Stimulation, Multiscale Entropy.

2) Paul Cheng (Graduate Institute of Mind, Brain and Consciousness (GIMBC), Taipei Medical University, Taipei, Taiwan and Brain and Consciousness Research Centre (BCRC), TMU-Shuang Ho Hospital, New Taipei City, Taiwan) – Replicating a subjective color choice fMRI task to prob self-related network

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Previous fMRI research has utilized various self-oriented paradigms to map self-related brain networks in the cortical midline structures. One such paradigm, introduced by Johnson and colleagues in 2005, employed subjective choices based on simple color stimuli to probe self-related networks. Although the original study revealed increased activity in the anterior cingulate cortex (ACC) and posterior cingulate cortex (PCC) during subjective decisions compared to objective ones, the small sample size limited the statistical power and reliability of the findings. The present study aimed to replicate and expand upon the initial investigation using an adapted version of the paradigm with a larger sample size to address these limitations. Sixty healthy participants were recruited to perform the fMRI color preference judgment task, similar to Johnson et al.'s design, which required participants to choose the combination of presented colors that they found most subjectively pleasing (i.e., self-related), contrasting them with objectively similar (i.e., non-self-related) options as a control condition. Our finding is consistent with the original study, which revealed self-related responses in the ACC and PCC regions. In addition, our study found the left inferior and orbital frontal cortex related to the self-ori-

ented task. Our finding supports the validity of the subjective color choice task as a tool for investigating self-related networks in the brain.

Keywords: Self-Related Network, Self-Oriented Task, fMRI

3) Masaki Mori (Faculty of Environment and Information Studies, Keio University, Japan) – Relationship between obsessive-compulsive traits and the consciousness of face with different gaze direction

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Gaze consciousness is known to be influenced by social anxiety traits and autistic traits. A recent study has found that attention to gaze differs between patients with obsessive-compulsive spectrum disorders and those with typical development. However, it is not clear whether obsessive-compulsive spectrum disorder traits affect gaze consciousness. The present study examined the relationship between obsessive-compulsive traits and gaze consciousness in general college students. In a psychometrical survey, the Japanese version of the Obsessive-Compulsive Inventory was used to evaluate for obsessive-compulsive traits. In a psychological experiment, participants observed a woman's face picture for a non-dominant eye and a dynamic Mondrian pattern for a dominant eye in a breaking continuous flash suppression task. The face picture has five different gaze directions and could be observed with gradually increasing contrast over a 10-second period. The dynamic Mondrian pattern was 5.0 degrees x 5.0 degrees that switched at the rate of 10 Hz. Stimuli were observed for a maximum of 10 seconds per trial. The Miles test was used to determine the dominant eye. Participants responded by face position (left or right) within the stimulus area as soon as they became aware of a face while observing the stimuli. The 60 trials consisted of 5 different gaze directions x 2 different face positions x 6 repetitions. Outliers were excluded based on reaction time data outside the mean ± 2 SD range for each stimulus within an individual. Forty-

eight participants' data were analyzed, indicating a positive relationship between face detection time and obsessive-compulsive traits. The results suggest that the higher the obsessive-compulsive traits, the less likely the face is to be detected. These results support the existence of a spectrum of obsessive-compulsive traits in the general college student population in face consciousness.

Keywords: Obsessive-Compulsive Traits, Face Consciousness, Gaze Direction, Breaking Continuous Flash Suppression

4) Pin-Hao Chen (Department of Psychology, National Taiwan University) – Exploring the impact of self-monitoring on neural representations of food cues: an intersubject representational similarity analysis approach

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Self-monitoring of one’s current state can help individuals resist temptation and improve their self-control abilities. Although prior studies have provided supportive evidence, individual variability in the enhancing effect of self-monitoring has been noted. In this study, we recruited 41 participants who have a history of chronic dieting to investigate how self-monitoring affects individuals' perception of tempting cues in the brain and what kinds of individual differences may contribute to variations in this enhancing effect. Participants were randomly assigned to one of two groups: a group that received manipulation of their dieting-related information and a group that received no such manipulation before fMRI scanning. All participants then completed a food-cue reactivity task while in the scanner. We used intersubject representation similarity analysis (IS-RSA) to test whether similarities in participants' self-reported sensitivity to external appetitive food cues were associated with similarities in brain spatial representations of food cues and whether self-monitoring manipulation enhanced this association. Our findings indicate that in the monitoring group, similarities in sensitivity to external appetitive cues were associated

with similarities in brain representations in the fronto-parietal control network, whereas no such association was found in the non-monitoring group. Finally, we used meta-analytic decoding to explore which psychological processes were most likely engaged in this self-monitoring enhancing effect. Our results revealed stronger associations with executive control, conflict, and error monitoring than non-monitoring effects. Our results demonstrated that by using IS-RSA, researchers can have a new understanding of how self-monitoring impacts the representation of temptation in the brain

Keywords: Awareness, Self-Monitoring, fMRI, ISRSA

5) Alvin Wong (The N.1 Institute for Health, National University of Singapore, Singapore) – Exploring multitasking training-related changes in brain function under varying cognitive loads

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Training improves performance on numerous cognitive tasks, but the neural changes that underlie such improvements remain unknown. We investigated the effects of training on brain function under varying degrees of cognitive load. Healthy young adults (n=21) learned the Multi-Atribute Task Batery (MATB), a multitasking paradigm that challenges attention and executive control by demanding conscious perception and sustained vigilance. During fMRI

scanning, participants practiced the MATB under three levels of difficulty for 20 minutes per day across 10 weekdays. Participants returned after two weeks, six weeks, and six months for tests of performance retention. Participants showed gains in speed, accuracy, and number of responses by the end of training, demonstrating increased multitasking ability. As training progressed, changes in brain function occurred at two scales. Focally, task-evoked activation changes were moderated by cognitive load in the middle and superior frontal gyri and anterior cingulate. Activity decreased across successive low-difficulty blocks, indicating increased efficiency (less processing time per response), but increased across high-difficulty blocks, suggesting increased efficiency (more responses per unit time). Globally,task-related network reconfiguration (change from resting FC during task performance) decreased across sessions in most edges within and between the default, attention, and salience networks, implying that task-relevant information transfer pattern were reinstated with increasing efficiency. Conversely, most connections involving the control network showed increases in reconfiguration, perhaps reflecting its role in coordination. These training effects largely persisted at follow-up. Performance retention occurred at all but the highest difficulty setting. We suggest that multitasking training facilitates performance by optimizing distinct but complementary neural and cognitive processes spanning the cortical hierarchy. Whilst processes such as task-set reinstatement likely benefit from increased processing efficiency, more effective response selection and prioritization (whether conscious or automatic) may relate to strengthened control network connectivity and greater recruitment of lateral prefrontal areas, especially under high load.

Keywords: Attention, Multitasking, Neuroimaging, Training

6) Yun Da Chua (Division of Social Sciences, Yale-NUS College, National University of Singapore) – Effective coordination across major brain network regions, not intra-network function, underlies successful performance of two executive function tasks.

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Executive control is a crucial component of cognition and consciousness, allowing individuals to modify their ongoing thoughts to achieve behavioral goals. Executive control has been studied with the n-back and visual attentional blink (VAB) paradigms. A working memory control limitation is a hypothesized cause of the awareness failures in both tasks. Here we used Connectome-based Predictive Models (CPMs), which associate individual differences in task performance with fMRI-based functional connectivity (FC) patterns, to better understand the processes involved in the VAB and n-back tasks. For our comparisons, we used Wu et al. (2020)'s vabCPM (n=73), which could successfully account for VAB performance from FC data (r_s =0.31, p=.011). We also constructed a CPM from Chen, Tam, et al. (2022)'s analysis of the Adolescent Brain Cognitive Development Study's 2back task (n=2252). This 2backCPM was also successful (r_s =0.48, p<.001). To test for prediction generalizability, we first applied the vabCPM to the 2-back FC and behavioral data, which yielded a small but significant positive correlation (r_s =0.05, p=.014). Applying the 2backCPM to the VAB data produced a non-significant correlation (r_s =0.13, p=.29), perhaps due to insufficient power. To account for cross-task generalization, edges across each predictive network were compared. The most positively predictive 10% of all edges overlapped significantly above chance across each task's CPM (17.7%), as did the most negatively predictive 10% of all edges (12.4%). Surprisingly, the edges that predicted both better VAB and

2-back performance were inter-network connections between the default and either somatomotor or salience attention regions. Conversely, worse performance was predicted by greater FC within dorsal attention, and between dorsal attention and either somatomotor or salience attention regions. Contrary to what we hypothesized, successful performance in each paradigm was due to broad coordination or induced brain states involving the default mode network, not due to executive control network function per se.

Keywords: Attentional Blink, N-back, Executive Function, fMRI

7) En-Lin Leong (Division of Social Sciences, Yale-NUS College, National University of Singapore) – Leveraging EEG and pupillometry to understand the surprise-induced failures of auditory awareness

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Relatively infrequent or unexpected stimuli can grab attention to the detriment of ongoing tasks. In the surprise-induced deafness (SiD) paradigm, such stimuli render participants unaware of an auditory probe presented 300-400 ms thereafter. These detection deficits, however, quickly habituate across successive surprise trials.

We sought to identify physiological markers of SiD to better understand its causes. EEG was recorded from 33 participants (18 males, 15 females; age range 18-53,) while they completed 24 surprise trials interspersed amongst 136 standard trials. Participants evidenced SiD: Probe detection was severely impaired for the first few surprise trials, improving rapidly thereafter. In contrast, detection was consistently high during standard trials. The initial behavioral

deficits were accompanied by a parietally-maximal late (400-600 ms) positive component in the EEG time-locked to the surprise stimulus presentations. Furthermore, this component attenuated alongside the behavioral habituation of the probe detection deficits. These qualities are characteristic of a P300 late positive complex and consistent with the behavioral effects, indicating that the SiD perceptual deficits are the consequence of expectation violation and subsequent attentional reorientation as indexed by the P300.
However, the observed signal-to-noise ratios precluded correlation analyses (e.g., between P300 amplitude and behaviour across individual subjects), which would have allowed for stronger inferences. We are therefore evaluating whether pupillometry would support such correlations, and have begun SiD experiments with this alternative physiological measure. Preliminary results (n=6) show surprise-evoked pupil dilations. Their features and utility will be discussed.

Keywords: Surprise, Auditory Awareness, EEG, Pupillometry.

8) Jingwen Chai (Department of Psychology & N.1 Institute for Health, National University of Singapore) – Value influences on feature gain control in temporal attetional capture

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Explicit goals and implicit learning bias attention. These influences form a control state that drives saliency computations on spatial and feature gain control (Luck et al., 2021). Although studies of value-driven (or value-modulated) attentional capture have characterized how reward learning influences spatial

gain control, less is known about non-spatial feature gain control. Here we explore this issue through four experiments of temporal attention, in which value feedback was paired with specific target or distractor colour features. Importantly, the target and distractors were embedded in a rapid serial visual presentation (RSVP) stream at fixation (117 ms per item). In each experiment, participants pressed “J” or “K” immediately after detection of these targets. Experiment 1 (N = 43, in-lab) and Experiment 2 (N = 121, online) demonstrated that value produced distinctive and gradual learning (and unlearning) profiles across trials. Experiment 3 (N = 108, online) addressed whether task-irrelevant learned values could impair performance. Reward feedback was paired with a critical distractor, appearing just before or after the target. Contrary to expectations, distractors either did not affect or instead facilitated performance, likely through unanticipated cueing effects. Experiment 4 (N = 108, online) controlled for such cueing by varying the time between distractors and targets; it also employed non-spatial contingent capture (Folk, Leber & Egeth, 2008) to more reliably induce distraction effects that learned value could then modulate. Contingent capture was observed, but it was statistically independent of value modulation. Taken together, the experiments show that value modulates temporal attention, especially when rewarded features are target-relevant. Distraction from learned value signals may be relevant under more specific contexts. We conclude that learned value can influence attention through non-spatial gain control. Differences in learning profiles and distraction effects, however, suggest that the mechanism is at least partially distinct from spatial gain control.

Keywords: Temporal attention, RSVP, Reward, Saliency

9) Takashi Obana (N.1 Institute for Health, National University of Singapore Neuroscience) – The temporal dynamics of contingent capture and surprise capture, two attentional limits to conscious perception

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Stimuli that engage attention often enter awareness. Attentional engagement also has a dark side: Unattended stimuli are frequently missed. Non-spatial contingent capture (Folk et al., 2007) and surprise-induced blindness (Asplund et al., 2010) illustrate detection failures following attentional capture. In contingent capture, a distractor with a target-defining feature disrupts detection of a target that follows several hundred milliseconds later. In surprise-induced blindness, a relatively unexpected, task-irrelevant distractor disrupts target detection for a similar duration. Both effects habituate across trials, though the latter's habituation is faster and more complete (Liaw et al., 2020). Given the similarities in their evoking conditions (abrupt distractor onsets) and effects, we tested whether contingent and surprise capture may jointly contribute to observed deficits in contingent capture paradigms; we also sought to better dissociate their effects. In four online experiments, participants searched for a color target in a rapid serial visual presentation of letters surrounded by a white box. On a minority of trials (15%), the box transiently became a critical distractor whose color was the same, similar, or opposite the target color. When critical distractors and targets were separated by two intervening stimuli (Lag 3; Expts. 1, n=108, and 2, n=121), the critical distractors induced a deficit proportional to their target similarity, demonstrating contingent capture. The deficits habituated across trials, suggesting a surprise capture contribution aswell. With no intervening stimuli (Lag 1; Expt. 3, n=78), however, the deficits were larger and showed no sign of habituation. Similar effects were observed even when the critical distractors appeared during every trial (Expt. 4, n=151). Taken together, the results suggest that abrupt onsets capture attention regardless of their task relevance, but only some distractors cause prolonged attentional engagement and subsequent awareness deficits (Theeuwes, 2021). Such engagement can be due to target relevance (contingent) or contextual novelty (surprise).

Keywords: Contingent Capture, Surprise, Visual Awareness, Temporal Attention

10) De-Wei Dai (Department of Psychology, National Taiwan University, Taiwan) – The effect of perceptual causality on intentional binding and temporal judgment

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The intentional binding (IB) effect refers to the compression of subjective time between a voluntary action and its outcome. The role of intentionality versus the perceived causal relationship between an action and its outcome in the IB effect has been intensively studied in the past, but a consensus has not been reached. In this study, we shifted our focus to a related question: Does the perceived causality of the sensory outcome itself influence the IB effect? To investigate this, we designed a modified IB task with an audio-visual outcome. In the first experiment, we employed the Libet clock paradigm and displayed two 2D discs on the screen. In the agency condition, participants pressed a key to initiate the movement of the two discs towards the center. The visual perception of the two discs interacting could either appear as a collision/bounce with each other (indicating perceptual causality) or as passing through one another (no perceptual causality). The perception of these outcomes was biased by presenting one of two sound effects (either a collision sound or a whoosh sound) when the discs overlapped. In the first experiment, participants reported that the impression of collision/pass was weak and ambiguous. To induce a stronger sense of perceptual causality, in the second experiment, the two discs had different colors, and their trajectories would change if the pool sound was played. We found that the error in temporal judgment was larger when the two discs collided (perceptual causality) as compared to when they passed through each other. However, the IB effect was not detected in either the first or second ex-

periment. We speculate that the IB effect might be eliminated in multi-sensory outcomes. Further experiments should be done to test the hypothesis.

Keywords: Causality, Time Perception, Sense of Agency, Intentional Binding, Libet Clock

11) Mayuna Ishida (Laboratory in the Faculty of Environment and Information Studies, Keio University, Japan) – Downward gaze facilitates awareness of faces during breaking-continuous flash suppression

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A previous study compared direct and averted gazes in the horizontal direction under breaking-continuous flash suppression (b-CFS) and showed that a face with a direct gaze could reach consciousness faster than that with an averted gaze. However, it is unclear whether an averted gaze in the vertical direction is less likely to inhibit awareness than left and right gazes. If the downward gaze is perceived to be directed at one's body, it is expected to be perceived as different from other averted gazes. The purpose of this study was to investigate the unconscious processing of faces with up, down, left, right, and direct gaze under b-CFS. Thirty participants observed face stimuli with gradually increasing contrast in the non-dominant eye and dynamic Mondrian stimuli in the dominant eye through a binocular mirror stereoscope. When participants were aware of a face, they responded with a face position of a two-choice serial reaction time task (left and right). The face stimuli were created in computer graphics using FaceGen from a photograph of a woman's face, and the eyeballs were adjusted 8 degrees to the up, down, left, and right and in front using Blender. A one-way analysis of variance with gaze direction as a factor for reaction time showed significant differences. Multiple comparisons revealed that reaction times for faces with a downward gaze were shorter than for faces in the other averted gaze directions (up, right, and left). There were no differences in reac-

tion time for faces with downward and direct gazes. These results indicated that the face with a downward gaze is more likely to be brought to consciousness than other averted gazes. We speculate that these findings are caused by an awareness of the downward gaze directed toward the body.

Keywords: Breaking-Continuous Flash Suppression, CFS, Downward Gaze, Body

12) Katsunori Miyahara (Center for Human Nature, Artificial Intelligence, and Neuroscience (CHAIN), Hokkaido University, Hokkaido, Japan) – Exploring neural signature of the phenomenological attitude toward conscious experience

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A central methodological tenet in phenomenology is that a rigorous study of conscious experience requires a transition from the “natural attitude” (NA) to the “phenomenological attitude” (PA) in the subject. NA describes our ordinary way of being in which our attention is directed at worldly objects and their properties. PA is a distinctively reflective way of being in which our attention is directed at our conscious experience. Despite its theoretical importance both in philosophy and science of consciousness, the neural mechanisms underlying

PA remain unknown. To address this lack of knowledge, we introduced a novel behavioral task in which participants alternated between NA and PA in relation to their stimulus-induced conscious experience from trial to trial. In each trial, they were presented with two sentences describing a visual scene and required to identify the one that best captured their experience. These sentences were designed to induce either NA or PA in them (NA and PA conditions, respectively). By analyzing fMRI signals collected during the task, we aimed to uncover the neural signature of PA. Our results showed that participants had lower error rates but slower reaction times in the PA condition compared to the NA condition, suggesting differences beyond task difficulty. The task conditions were successfully classified using multivoxel activation patterns in the premotor cortex, posterior parietal cortex, supplementary motor area, and cerebellum. Moreover, activation strength in these regions was lower in the PA condition. Since these regions are involved in action planning and/or the perception of affordance, the results suggest that PA depends on neural processes that suppress action representations induced by sensory information. To our knowledge, these findings provide the first evidence for the neural signature of PA. They contribute to a better understanding of the phenomenological method and its underlying neural mechanisms.

Keywords: Phenomenological Attitude, Natural Attitude, fMRI, Neural Decoding

13) Yu-An Chen (Department of psychology, National Taiwan University, Taipei, Taiwan) – Metacognitive Bias Threatens the Constructive Validity of Thought-probing Methods in Mind-wandering Studies

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Thought-probing method is one of the most prominent tools used in mind-wandering studies. This procedure randomly probes participants to halt their ongo-

ing task and report their thoughts at the moment. Researchers can use the thought-probing method to investigate behavioral characteristics or cognitive states before or after mind-wandering episodes, as well as the relationship between mind-wandering episodes and other cognitive functions. However, participants may not accurately retrieve their thoughts every time they receive the probe. When participants' meta-awareness is low or the probe's questions are too difficult, other contextual cues may be used to answer the probe. We hypothesized that participants may respond to the probe according to the subjective evaluations of their own task performance. According to this hypothesis, what is caught by the thought probe is participants' metacognitive bias instead of their genuine mind-wandering episodes. In the current study, in order to study whether different self-evaluations of task performance are accompanied by different degrees of self-reported mind-wandering, we exploit the type 2 signal detection theory model to quantify participants' extent of metacognitive bias. In the three experiments of the current study, we manipulated the questions that were asked in the thought-probing iiimethods. The result of the experiments indicate that when asked about the intention of their mind-wandering episodes, the participants were inclined to base their reports on their self-evaluations of task performance. Moreover, the participants' lower meta-awareness strengthens this tendency. These findings suggest that metacognitive bias threatens the constructive validity of thought-probing methods, especially when demanding probe questions are presented and when participants have insufficient meta-awareness.

Keywords: Mind-Wandering, Metacognition, Thought Probe, Constructive Validity, Cognitive Model

14) Pincheng Hsiung (Department of psychology, National Taiwan University, Taipei, Taiwan) – The effect of 40 Hz Stimulation on Human Visual Thresholds and Cognitive Functions

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Previous research has established that 40 Hz auditory and visual stimulation can mitigate the pathological condition and enhance cognitive functions in Alzheimer's disease-afflicted mice. However, human-focused studies are scant, and the results have been divergent.

In our study, we divided participants into experimental and control groups to examine whether 40 Hz stimulation could enhance attention, working memory, and task performance concerning visual thresholds. In Experiment A, we utilized a lightbulb as a source of 40 Hz stimulation. Apart from noting a practice effect, we observed a positive enhancement effect on the visual threshold. Nevertheless, in Experiment B, following modification of the staircase method of measurement and controlling for the practice effect, this positive outcome could not be successfully replicated. In Experiment C, we employed a screen as the stimulation source, setting the stimulation frequency at 48 Hz. In Experiment D, we used an external screen and audio as stimulation sources, delivering 40 Hz stimulation to both visual and auditory senses. Both these experiments evidenced only a disappearance of the practice effect within the 40 Hz (and 48 Hz) groups. Lastly, in Experiment E, we shifted our focus to testing visual spatial memory, but found no between-group or within-group differences.

Collectively, these results suggest that while we observed a practice effect across a series of experiments, we did not detect a 40 Hz enhancement effect. Furthermore, simultaneous auditory and visual stimulation resulted in the disappearance of the practice effect within the 40 Hz group. These findings align with some past experiments. This research enhances our understanding of the impact of 40 Hz stimulation on human cognitive functions and supports the perspective that short-term 40 Hz stimulation may not necessarily enhance human cognitive functions.

Keywords: 40Hz Visibility Threshold, Cognitive Improvement

15) Ryota Takatsuki (Araya Inc.) – Weight structures in ANNs and their modality-specificity

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By redirecting retinal projections from the left visual field in newborn ferrets to connect to the auditory thalamus, it has been observed that they developed a retinotopic map and visual receptive field properties in the auditory cortex (von Melchner et al., 2000). Furthermore, those ferrets exhibited behaviors indicating that the visual stimuli processed in the auditory cortex were perceived as visual rather than auditory. Thisimplies that subjective sensations correspond to specific patterns of neuronal connectivity rather than relying on particular brain regions. These neuroscientific findings imply the existence of modality-specific structures within artificial neural networks (ANNs) that can correspond to sensory qualities (e.g., the circular nature of color). According to this hypothesis, ANNs with non-modality-specific architectures would learn weight parameters with distinct structures depending on the modality of training data. However, it remains unclear what modality-specific structures in ANNs are like, and even whether they truly exist. Solving these questions will contribute to improving the interpretability of ANNs, and also, would enable the study of consciousness using ANNs.

To answer the questions, we employed the encoder component of a two-layer fully connected autoencoder as a toy model with a non-modality-specific architecture. We investigated the weights trained with visual and auditory data individually. The result confirmed that the model learned weights resembling independent component analysis (ICA) filters for both modalities. This not only aligns with observed neural processing within the brain (Bell & Sejnowski, 1997; Lewicki, 2002) but also reveals certain weight structures present in ANNs. Additionally, we applied a cluster analysis method, t-SNE, to the embeddings obtained through autoencoding instances of the encoders of both modalities, each of which was trained with random initial weight parameters. The result showed that the encoder's embeddings are distributed separately ac-

cording to modality, suggesting that the weight structures within the encoder are modality-specific.

Keywords: Weight Structure, ICA, Modality-Specificity, Autoencoder

Online Posters

16) Adam Safron (Center for Psychedelic and Consciousness Research, Department of Psychiatry and Behavioral Sciences, Johns Hopkins University School of Medicine, USA) – On the degrees of freedom worth having: psychedelics as means of understanding and expanding free will

What do we mean when we talk of "free will?" What are the "varieties of free will worth having" (Dennett, 2003), and to what extent can we be said to possess such capabilities? While preferred definitions may vary across individuals and situations, we may perhaps find broad agreement that free will indicates a capacity for conscious intentions to meaningfully cause actions, which could be considered to be synonymous with agency (Safron, 2021). Free will may further be said to involve a certain open-endedness wherein agents can explore alternative possibilities and pivot based on novel information (Hills, 2019). In these ways, the meaning of free will is linguistically transparent as a capacity for both "willing" and "freedom." Others may want a freedom of will in which conscious intentions may be said to be the sole determinants of action without additional causal factors. While this may appear to entail a self-contradictory metaphysics involving "uncaused causes," one may even find support for this more "libertarian" free will as well if it is the case that action selection is influenced by forms of causation that solely exists at intermediate levels of organization at which selfhood and agency emerge (Sinnott-Armstrong, 2019; Safron, 2021), or perhaps even in terms of consciously-experienced intentionality being influenced by stochastic (in terms of limited predictability) processes. In what follows, I suggest all these forms of free will constitute real patterns that have been (and continue to be) selected over the course of evolution and development. I go on to describe how these mechanisms may overlap with serotonergic signaling pathways mediating the effects of psychedelic compounds, potentially helping to explain adaptive significances of these biophysical phenomena. Finally, I explore how this perspective on psychedelics (in terms of altering various degrees of freedom) may help to identify some of the most important sources of variation both across and within individuals.

Preprint: https://psyarxiv.com/m2p6g/

Keywords: Free Energy Principle and Active Inference Frameworks, Consciousness, Free will, Psychedelics

17) Torge Dellert (University of Muenster, Germany) – Neural correlates of consciousness in a no-report fMRI study using inattentional deafness

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Disentangling neural correlates of consciousness (NCC) from those of task-related post-perceptual processes (e.g., report) is an ongoing challenge. Moreover, NCC research has mostly focused on vision, while other sensory modalities, such as audition, have been neglected. Thus, the generalizability of sensory versus fronto-parietal NCC candidates is poorly understood. In the present study, we used functional magnetic resonance imaging (fMRI) during a no-report inattentional deafness paradigm. Sixty-three participants were asked to perform an auditory distractor task while task-irrelevant speech stimuli were presented in the background. Whereas one group was informed about these critical stimuli and later reported awareness of them, another group remained uninformed and experienced inattentional deafness. After the awareness assessment, both groups were able to detect the sounds. Comparing brain responses to the task-irrelevant speech stimuli between aware and unaware participants revealed strongly increased activity in the bilateral superior and middle temporal gyrus. Activation of fronto-parietal regions, on the other hand, was considerably weaker. These findings support a dominant role of sensory rather than

widespread fronto-parietal information processing in conscious auditory perception.

Keywords: Consciousness, Awareness, Auditory Processing, fMRI

18) Aliya Grig (Evolwe AI) – Towards a More Human AI: Designing for Empathy and Personalization

Empathy is a crucial factor for the development of intelligent AI systems. It allows humans to understand and relate to the emotions and feelings of others, and for AI systems to achieve a similar capability, it is an essential requirement. Building empathetic AI systems could lead to more personalised and emotionally aware interactions with humans. Moreover, empathy could be considered as a building block towards the creation of Artificial General Intelligence (AGI), designs of which would be equipped with emotions and ability to comprehend human emotions. This paper presents a case study of Evolwe, which is working on the creation of empathetic AI systems by combining psychometric data, sentiment analysis, neuro-symbolic AI, and embodied AI. The interdisciplinary approach that Evolwe has taken will allow the creation of AI systems that will empathetically listen, perceive and interpret human emotions. The result of such AI systems will manifest as a better personalisation experience for users, and the AI systems themselves will become emotionally aware and able to develop emotional intelligence. The interdisciplinary approach towards building empathetic AI systems is crucial to achieving the broader goal of AGI. By highlighting the potential benefits of this technology and sharing the insights gained through Evolwe's case study, this paper helps to advance our understanding of what it takes to create truly intelligent systems that can interact with humans in a more meaningful and empathetic way.

Keywords: Space, AI, Neuroscience, Emotional, Intelligence, Artificial General Intelligence, Humanization, Personalization

19) Shiling Cai (School of Philosophy, Zhejiang University, Hangzhou, Zhejiang, China) – Artificial Consciousness and Contemporary Consciousness Theories

Assuming a machine with human level intelligence, will such a machine become conscious? In fact, consciousness and intelligence are different dimensions. Consciousness is the experience of the existence of the subject, while intelligence is the ability of the subject to solve different types of problems. It means that a system with intelligence does not mean it is also conscious; Being able to simulate intelligence and establish artificial intelligence systems through computation is not equivalent to being able to simulate consciousness and establish artificial consciousness systems. People confuse artificial consciousness with machine consciousness, but the connotation of artificial consciousness is broader than that of machine consciousness. Artificial consciousness can refer to giving machines consciousness in a narrow sense, or more generally, manufacturing conscious artificial systems. Therefore, there are two directions for contemporary researches on artificial consciousness. One is to simulate consciousness on machines, that is, machine consciousness. The other is to achieve consciousness on artificial systems, that is, to create conscious artificial systems. At present, research on artificial consciousness focuses more on simulating the functions of consciousness on machines, and there is no consensus on how to create an artificial system with phenomenal consciousness. Starting from the contemporary consciousness theories, I will explore whether the current Turing machine and the machine on the future can feel, understand, take action and have consciousness. The study of artificial consciousness must have reference, guidance, and support from scientific theories of consciousness.

Keywords: Consciousness ; Intelligent; Artificial Consciousness; Autonomy

20) I-Jan Wang (Graduate Student, Department of Philosophy, University of Cincinnati, USA) – Generalizing the skillful mind through embodied mental simulation

Mental simulation is the cognitive ability of mentally projecting oneself into a situation other than the one we are currently embedded within, which, broadly construed, is involved in imagining, remembering, and dreaming. Mental simulation is widely articulated as the rehearsal of cognitive processes that allows one re-experiences past perceptual experiences in both representationalist (e.g., Grush 2004) and non-representationalist camps (e.g., Gallagher & Rucińska 2021). By conceptualizing mental simulation as being in a close relation with past intellectual encounters with the real world, these theoretical works claimed to successfully explain the phenomenal and functional similarities between mental simulation and what is simulated, viz., perception and motor control. A set of empirical findings (Taklek et al. 2004, 2008) about mentally simulating an event of motor skill learning, however, suggests a functional difference between mental simulation and the rehearsed. That is, mentally simulating performing a motor skill in a specific context, say, practicing shooting a basketball from a specific distance to the basket, can improve one's later skill performance in different contexts, say, shooting from other distances. This sort of transferrable improvement, in contrast, cannot be produced by actual motor skill practices. The functional difference, then, solicits a clarification of what distinguishes a mental rehearsal from the rehearsed cognitive process from the accounts of mental simulation. This paper offers an embodied account of mental simulation that can encompass the difference between mental simulation and actual motor skill learning. Specifically, it argues that mental simulation is the currently embodied re-activation of a mental process learned from the past. Since the embodiment couples the re-activation with the current environment, the contextual aspect of the re-activated process can be gradually washed away. That is, mental simulation generalizes motor skills through its coupling with the environment. The presented account stays neutral in the debate of whether one's mind is representational or not but offers a new view of how the mind re-

lates to the environment different from existing representational and non-representational accounts, in separate ways.

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Keywords: Mental Simulation, Decouplability, Embodiment, Motor Skill

21) Shuichiro Taya (Hiyoshi Psychology Laboratory, Keio University) – Illusion Beyond Retinotopic Propagation: Investigating the Influence of Texture Regularity on Perceptual Filling-in

This study investigates the phenomenon named Mask Induced Filling-out (Taya, 2015, 1st prize in the 7th visual illusion contest in Japan https://visiome.neuroinf.jp/database/item/7146), an optical illusion that occurs when a high-contrast circular outline (i.e. the mask circle) is briefly shown before displaying a low-contrast texture pattern within a circle. The texture appears to expand beyond the circle’s contour, giving the impression of it covering the entire visual field.

This study aimed to examine how the regularity of the texture pattern influences the occurrence of this perceptual filling-in. Participants were exposed to

two different stimuli, following the presentation of the mask circle. One stimulus involved a texture pattern that actually spanned the entire field of view (full-field stimulus), while the other was a textured circle positioned within the central visual field (circle stimulus).
The participants were tasked with identifying which of the two stimuli was displayed on the screen. The texture pattern used in the stimuli was a grid of dots with varying degrees of random displacement (denoted by δ) in the x and y axes, which was serving as the independent variable (δ = 0, 2, 4, or 6 pixels). Results indicated that the more the texture elements deviated from the regular grid pattern, the less likely the filling-in was to occur. Traditional explanations of the filling-in attribute it to the retinotopic propagation of neural representations into regions of the visual field devoid of physical stimulus. However, our findings challenge this bottom-up explanation, suggesting that the human visual system may not merely propagate the nearest neural representation into the unstimulated area. The results suggest that the spread of texture representation may not be as straightforward as previously thought and that higher-order visual processing could play a significant role in the filling-in phenomenon.

Keywords: Filling-In, Peripheral vision, Inflation, Illusion