# MIND AND MATTER 2022 CONFERENCE

## Foundations of Information, Intelligence and Consciousness

# ABSTRACTS

June 16th–18th, 2022
University of Helsinki | Porthania

# Objectives

The conference Mind and Matter 2022 (University of Helsinki, June 16–18) facilitates interdisciplinary mind studies at the University of Helsinki. It brings together researchers in artificial intelligence, cognitive neuroscience, psychology, physics and philosophy to explore topics such as intelligence, creativity, consciousness, neural processes, free will, agency, information, time and the nature of matter from different points of view. The overall aim is to explore new ways of understanding the mind in the light of the developments in both the humanities and the natural and social sciences.

# Background

In 2018 the University of Helsinki chose the research area Mind and Matter – Foundations of Information, Intelligence and Consciousness as one of its planned profiling areas, and in 2019 the Academy of Finland awarded 5,3 million Euros to this area, to fund new tenure track professorships and activities.

The Fetzer Franklin Fund of the John E. Fetzer Memorial Trust supports Mind-Matter research at the University of Helsinki by providing funds to organize a conference in June 2022.

# Programme

## WEDNESDAY, JUNE 15TH, 2022

18:30–20:00 City of Helsinki reception

## DAY 1 THURSDAY, JUNE 16TH, 2022

8:00–9:00 Registration

9:00–9:15 Welcome
**Kai Nordlund** *Vice Rector, University of Helsinki, FI*
**Paavo Pylkkänen** *University of Helsinki, FI*

### TOPIC 1 Artificial Intelligence

9:15–10:00 **Ron Chrisley** *University of Sussex, UK*
AI Alchemy?: The Limitations and Promise of Large Language Models

10:00–10:30 **Hannu Toivonen** *University of Helsinki, FI*
Why Don't Airplanes Fly South for the Winter? Ruminations on Computational vs. Human Creativity

### TOPIC 2 From Classical AI to Quantum Approaches

10:30–11:00 **Bert Kappen** *Radboud University, NL*
Why I think that classical physics cannot explain consciousness

11:00 *Break 10 minutes*

11:10–11:40 **Marilu Chiofalo** *University of Pisa, IT*
A Quantum Model for Numerosity Perception

11:40–12:10 **Paavo Pylkkänen** *University of Helsinki, FI*
Information, causation and consciousness in Bohmian quantum ontology

12:10–13:15 *Lunch Break*

## TOPIC 2 Learning in AI and Neuroscience

13:15–14:00 **Cameron Buckner** *University of Houston, USA*
Deep Learning and Moderate Empiricism--A Philosophical Framework for Transformative Artificial Intelligence

14:00–14:30 **Riikka Möttönen** *University of Helsinki, FI*
Unlocking adults' implicit statistical learning by cognitive depletion

14:30–15:00 **Minna Huotilainen** *University of Helsinki, FI*
The learning brain in a material world

15:00 *Coffee Break*

## TOPIC 3 Quantum Theory, Information and Consciousness

15:20–16:15 **Keynote** **Sabrina Maniscalco** *University of Helsinki, FI*
Quantum Walk on Complex Networks: from the Internet to Biological Systems

16:15–17:00 **Christopher A. Fuchs** *University of Massachusetts Boston, USA*
QBism and William James's world of pure experience

17:00 *Break 10 minutes*

17:10–18:00 **Larissa Albantakis** *University of Wisconsin, USA*
On the relationship between consciousness, the quantum, and integrated information theory

18:00–20:00 Poster Session with Salad and Wine

## DAY 2 FRIDAY, JUNE 17TH, 2022

### TOPIC 4 Consciousness in Philosophy, AI and Neuroscience

9:00–09:45 **Amber Ross** *University of Florida, USA*
From Spot to HAL: How the study of consciousness in animal minds can inform the philosophy of AI

9:45–10:30 **Tuomas Tahko** *University of Bristol, UK*
What Is Reductionism about Consciousness?

10:30–11:00 **Alex Carruth** *University of Helsinki, FI*
How not to define 'physical'

11:00 *Break 10 minutes*

11:10–12:10 **Keynote** **Sir Roger Penrose** *University of Oxford, UK*
On the physics of consciousness

12:10–13:15 *Lunch Break*

13:15–14:00 **Lana Kühle** *Illinois State University, USA*
Novel Features in Sensory Perception: An Embodied Account

14:00–14:30 **Anna-Mari Rusanen and Otto Lappi** (with **Jesse Kuokkanen** and **Jami Pekkanen**) *University of Helsinki, FI*
From Fly Detectors to Action Control: Representations in Reinforcement Learning

14:30–15:00 **Kristjan Loorits** *University of Helsinki, FI*
Perspective-Induced Mystery of Consciousness

15:00 *Coffee Break*

15:20–15:50 **Anu-Katriina Pesonen** *University of Helsinki, FI*
Sleeping brain in learning and emotion processing

15:50–16:20 **Kimmo Alho** *University of Helsinki, FI*
Brain activity during attention to audiovisual speech

16:20–16:50 **Martti Vainio** *University of Helsinki, FI*
Sound-Action Symbolism: Linking the Physical World with Meaning

## TOPIC 5 Free Will

17:00–18:00 **Keynote** **Jenann Ismael** *Columbia University, USA*
Nowhere Else but in the Here and Now; Temporality, incompressibility, and creativity in human action

# DAY 3 SATURDAY, JUNE 18TH, 2022

## TOPIC 6 Free Will and Neuroscience

9:00–9:45 **Liad Mudrik** *Tel Aviv University, IL*
Taking a neuroscientific-philosophical approach in studying free will and consciousness

9:45–10:30 **Hans Liljenström** *SLU and Agora for Biosystems, SE*
On the neurodynamics of intention, decision and free will

10:30–11:00 **Aku Visala** *University of Helsinki, FI*
Conscious Access and Moral Responsibility – A Skeptical Challenge

11:00 *Break 10 minutes*

## TOPIC 7 The Human Perspective on the World

11:10–12:10 **Keynote** **Huw Price** *University of Cambridge, UK*
Time for pragmatism

12:10–13:15 *Lunch Break*

13:15–13:45 **Valtteri Arstila** *University of Helsinki, FI*
Temporal experiences after the fact?

13:45–14:15 **Harald Atmanspacher** *ETH Zürich, CH*
The Role of Meaning in Dual-Aspect Monism

14:15–15:00 **Basil Hiley** *University College London, UK*
On the notion of active information: An algebraic approach to quantum theory

15:00 *Coffee Break*

15:20–15:50 **Mirja Hartimo** *University of Helsinki, FI*
From a phenomenological point of view

15:50–16:20 **Luigi Acerbi** *University of Helsinki, FI*
Probabilistic machine and human intelligence under extremeresource constraints

16:20–16:50 **Benjamin Cowley** *University of Helsinki, FI*
Performance, physiology and predictions in flow

16:50 *Break 10 minutes*

17:00–17:45 **Daniel Kolak** *William Paterson University, USA*
Alternative One: The Only Observer in the Universe is You

*Optional: Conference dinner*

# Abstracts of Plenary Talks

**Luigi Acerbi**
University of Helsinki, FI

## Probabilistic machine and human intelligence under extreme resource constraints

In this talk, I will cover research areas in my group whose common thread is the ability of intelligent systems to deal with extreme resource constraints, be the resource data, computation or memory. First, I will discuss how probabilistic -- Bayesian -- inference in brains and machines is the solution to the problem of limited data (limited in quantity and/or quality). Second, I will discuss the problem of performing probabilistic inference when computations are limited and expensive. Finally, I will present joint theoretical work on how rational but limited agents should normatively allocate expensive memory resources. The general thesis is that extreme resource constraints are at the root of intelligent behavior.

**Larissa Albantakis**
University of Wisconsin-Madison, USA

## On the relationship between consciousness, the quantum, and integrated information theory

The starting point of integrated information theory (IIT) is that consciousness (subjective experience) exists, immediately and indubitably, and that the purpose of a scientific theory of consciousness is to account for subjective experience in objective, physical terms. IIT does not presuppose that consciousness arises at the level of neurons rather than atoms, molecules, or larger brain areas, but instead predicts that consciousness emerges at the level of organization at which the intrinsic causal powers of a system are maximized. IIT thus assumes causation to be a central concept of the theory from the microphysical to the macroscopic. However, it remains to be determined whether IIT as a theory of consciousness is compatible with quantum mechanics as a theory of micro physics.

Here, I will present recent efforts to extend IIT's causal framework to quantum systems and discuss several conceptual challenges that arise around the notion of measurement, and the identification of causal entities in separate branches of the wave function. Finally, I will briefly outline how the emergent ontology implied by IIT escapes epiphenomenalism, while being agnostic about the causal closure of the physical.

**Kimmo Alho**
University of Helsinki & Aalto University, FI

## Brain activity during attention to audiovisual speech

We have recently conducted a series of functional magnetic resonance imaging (fMRI) experiments where participants attended to naturalistic but emotionally neutral dialogues between two persons seen on a screen at the presence of distracting speech in the background. The auditory quality of dialogues was manipulated by noise-vocoding and the visual quality by masking facial movements. Activity in auditory cortical areas was higher for higher auditory and visual quality. In addition, attention to the dialogues enhanced activity in these areas in relation to control conditions where the dialogues were to be ignored. Attention to the dialogues was also associated with increased activity in orbitofrontal and posterior cingulate cortices typically activated during social decision making. This suggests that attended audiovisual speech activates social brain functions even when this speech is emotionally neutral and there is no demand for social judgment. Moreover, in one of our studies higher activity was observed in the auditory cortical areas for coherent dialogues than for incoherent dialogues consisting of unrelated speech lines. Thus, also contextual coherence in speech may facilitate its processing in the auditory cortex.

**Valtteri Arstila**
University of Helsinki, FI

## Temporal experiences after the fact?

The time-consciousness theories aim to explain what our experiences must be like so that we can experience change, succession, and other temporally extended events (or at least why we believe we have such experiences). The most popular and influential explanations utilize the concept of the specious present. It is a (purported) essential temporal structure of consciousness: All episodes of experiencing (i.e., specious present) appear to us as temporally extended. Since what we experience appears to us as temporally extended, explaining the experiences of temporally extended events is seemingly straightforward. For example, by having an experience whose contents include sounds Do and Re that are experienced to have occurred at different times, we experience Re succeeding Do in the same immediacy as we experience the sounds themselves. In my talk, I argue that these explanations lead to a prediction about temporal experiences that is introspectively implausible: we experience change, succession, and other temporally extended events after experiencing the related experiential contents (e.g., Do and Re). I will end by discussing why the most obvious responses to the problem are unsuccessful. Hence, the specious present theories have not provided a satisfactory explanation of temporal experiences and, subsequently, the theories lose their central motivation.

**Harald Atmanspacher**
Collegium Helveticum Zürich, CH

## The Role of Meaning in Dual-Aspect Monism

Dual-aspect monism is a metaphysical framework addressing the mental and the physical as two aspects of an underlying reality that is neither mental nor physical, i.e. psychophysically neutral.

A key version of contemporary versions of dual-aspect monism is inspired by quantum theory (e.g.~Pauli-Jung, Eddington-Wheeler, Bohm-Hiley), where the psychophysically neutral is regarded as an undivided whole whose aspects arise by decomposition. As a consequence, this implies psychophysical correlations that are neither by chance nor causal -- rather, they are substantiated by meaning. As a relational concept connecting the triad of mind, matter, and the psychophysically neutral, meaning has a deep structure whose details will be discussed.

**Cameron Buckner**
University of Houston, USA

## Deep Learning and Moderate Empiricism--A Philosophical Framework for Transformative Artificial Intelligence

Deep learning is a research area in computer science that has over the last ten years produced a series of transformative breakthroughs in artificial intelligence—creating systems that can recognize complex objects in natural photographs as well or better than humans, defeat human grandmasters in strategy games such as chess, Go, shoji, or Starcraft II, create "deepfake" images or bodies of text that are sometimes indistinguishable from those produced by humans, and predict how proteins will fold more accurately than human microbiologists who have devoted their lives to the task. In this talk, I argue that these achievements were inspired by and in turn vindicate a moderately empiricist approach to cognition, which holds that abstract knowledge is extracted from experience rather unpacked from a stock of innate concepts or theories. In reviewing these achievements, I explain how they were accomplished by using deep neural networks to model key aspects of domain-general faculties of the human mind, like perception, memory, imagination, and attention. This empiricism echoes not the "radical" forms associated with behaviorism and logical positivism, but rather the more plausible forms defended by empiricist-leaning faculty psychologists such as Aristotle, Ibn Sina (Avicenna), John Locke, David Hume, William James, Adam Smith, and Sophie De Grouchy. I also illustrate how deep learning may gain much by more closely reconsidering its historical roots, as these philosophers had many ambitious ideas about these faculties which have not yet been realized in artificial systems.

**Alex Carruth**
University of Helsinki, FI

## How (not) to define 'physical'

What is the place of the mind in the natural world? Physicalists say that apparently mental phenomena such as conscious experiences, thoughts and volitions are nothing but physical goings-on (or at least that they are in some metaphysically significant sense fully dependent on and determined by such goings-on). Their dualist opponents believe that there is some genuine, ontological discontinuity between the mental and the physical. How should one understand the term 'physical' in such a context? Hempel's Dilemma purports to show that we cannot straightforwardly understand the term as picking out either the entities encompassed in current science (on pain of rendering physicalism likely false due to the incompleteness of current theory), nor those in some final, ideal theory (on pain of trivialising the doctrine). In response, *via negativa* and object-based accounts have become popular. However, these views face a serious objection, for they cannot distinguish physicalism from alternative monistic theories (including some non-naturalistic views that should be unacceptable to physicalists). A return to a science-based account, but one that is sophisticated enough to avoid the original dilemma, is required.

**Maria Luisa (Marilu) Chiofalo**
University of Pisa, IT (*)

## A Quantum Model for Numerosity Perception

Humans share with animals, both vertebrates and invertebrates, the capacity to sense the number of items in the environment. The pervasiveness of this skill across the animal kingdom suggest that it should emerge in very simple neural populations of neurons. Current modelling literature however has struggled to suggest a simple architecture carrying out this task, with most proposals suggesting the emergence of number sense in multi-layered neural networks [1,2].

We present a simple quantum spin model with all-to-all connectivity where numerosity arises from the dynamical spectrum of the transient signal in several system observables. We present this paradigmatic out-of-equilibrium open quantum simulation approach [3] as a new way to encode information processing in neural systems beyond using it for a microscopic description of neurons. We analyze our results whose behaviour complies with Weber's Law [4], one of the hallmarks of numerosity perception across the animal kingdom, and compare them with a classical network of units. We highlight the regimes where the classical counterpart fails to reproduce the experimental predictions without the addition of non-trivial complexity.

[1] Nasr K., Viswanathan P., and Nieder A., Sci. Adv. 5(5) (2019) DOI: 10.1126/sciadv.aav7903
[2] Kim G., Jang J., Baek S., Song M., and Paik S.B., Sci. Adv. 7, eabd6127 (2021) DOI: 10.1126/sciadv.abd6127
[3] Müller M., Diehl S., Pupillo G., and Zoller P., Adv. AMO Phys. 61, 1-80 (2012).
[4] Dehaene S., Trends Cogn. Sci. 7(4):145-147 (2003).

(*) with Jorge Yago Malo (1), Guido Marco Cicchini (2) and Concetta Morrone (3)

(1) Department of Physics “Enrico Fermi”, University of Pisa, and INFN - Pisa
(2) Institute of Neuroscience, CNR-Pisa and PisaVisionLab
(3) Department of Translational Research and of New Surgical and Medical Technologies, University of Pisa and PisaVisionLab

**Ron Chrisley**
University of Sussex, UK

## AI Alchemy?: The Limitations and Promise of Large Language Models

Large Language Models (LLMs, such as GPT-3) have been used to exhibit a wide range of impressive, seemly intelligent linguistic behaviours. A novel example, presented for the first time at this meeting, is the ability to answer questions about the Sally-Anne task from theory of mind experiments in developmental psychology. Despite these behaviours, critics point out the failures of the same models on very simple tasks, arguing that LLMs lack the intelligence that humans employ when engaging in similar behaviours: LLMs manipulate language without understanding it due to a lack of grounding in sensory-motor activity. As a counterpoint to this (largely correct) assessment, and noting the general utility of unintelligent processes in human activity, I argue that LLMs are poised to achieve even more impressive feats, especially when used in conjunction with complementary AI models, specifically text-to-image generative models (such as DALL·E 2), and conventional visual pattern recognition and classification models. The potential successes of these multi-model (and multi-modal) AI systems prompts us to re-evaluate what we might mean by "understanding" in such a context, replacing the theoretical question "does it (really) understand?" with "does it act enough like an understander to be of use?".

**Benjamin Cowley**
University of Helsinki, FI

## Performance, Physiology, and Predictions in Flow

How do people learn to perform cognitively-demanding dynamic tasks under uncertainty? The theory of Flow purports to explain the phenomenology of such high-performance cognition, but how does it arise from neural and behavioral activity? I describe a longitudinal study of skilled performance in a Flow-producing game. Participants' expectation of performance (based on trial-wise projection of their overall learning curve) was strongly related to experienced Flow, and the effect was moderated by learning (Palomäki, et al, 2021, CHB, 106891). Further, overall learning rate was predicted by sympathetic nervous response habituation rate (Tammi, et al, 2019, CCN, Berlin) and spontaneous eye blink rate. I will discuss how this evidence sheds light on the cognitive mechanisms of Flow within a predictive processing framework.

**Christopher Fuchs**
University of Massachusetts Boston, USA

## From QBism to a World of Pure Experience

In a 1904 essay the philosopher William James boldly declared that consciousness does not exist. "For twenty years past I have mistrusted 'consciousness' as an entity; for seven or eight years past I have suggested its non-existence to my students, and tried to give them its pragmatic equivalent in realities of experience. It seems to me that the hour is ripe for it to be openly and universally discarded." In doing so, James's real aim was to destroy the neo-Kantianism of his day, with its dualistic notion of 'experience'—i.e., that "object-plus-subject is the minimum that can actually be." In its place, James proffered a new *ontology*, one where the world consists of scintillating moments of novelty the he called 'pure experiences.' It would be nice to say that this ontology was part of QBism from the start, as it may well be part of its end-goal, but it was not.

QBism is a quantum interpretation that holds steadfastly to the idea that the mathematical entities of the theory (quantum states, measurement operators, Hamiltonians, etc.) are *not* representations of a third-personal reality—i.e., something that can be seen from a God's eye view. Rather the formalism should be understood as a supplement to decision theory—a supplement of paramount importance to an agent when the subject matter is how to make *their* most refined gambles on the *personal* consequences of their *personal* actions upon the world. But what are these actions and consequences? Normal people would call them quantum measurements. This is where the many no-go theorems (Bell, Kochen-Specker, Pusey-Barrett-Rudolph, Frauchiger-Renner) rear their heads. To the QBist mindset they point to one conclusion: That those first-personal actions and consequences—aka quantum measurements—are exemplars of an ontology similar to James's account of 'pure experience.' That is to say, though the formalism is not representational of reality itself, the no-go theorems derived from it are! They tell us that the stuff of the world is of the essence of quantum measurement—moments of novelty where "new being comes in local spots and patches" (James) and to which no subject-object dichotomy can be drawn.

Near the end of his life, John Bell asked rhetorically, "[A]re we not obliged to admit that more or less 'measurement-like' processes are going on more or less all the time more or less everywhere?" Given that he thought the word 'measurement' should be banished from fundamental physics, it is unlikely that he would have appreciated the QBist answer to his query. Simply put, "Yes. We are obliged." But, for the QBists' "yes" to make sense, one must first be rid of a prejudice for a dualistic subject-object / mind-matter distinction.

In this talk, I will try to explain this line of thought to the best of my ability.

**Mirja Hartimo**
University of Helsinki, FI

## From a Phenomenological Point of View

When scientists investigate the world or the mind, according to Husserl, they do it in a critical theoretical attitude, a species of so-called natural attitude. Husserl famously also held that the natural attitude can be changed into a phenomenological attitude with a phenomenological reduction. Nothing is lost in the reduction, but it changes the point of view so that the implicit "achievements of consciousness" operative in the natural attitude can be noticed and made explicit. This talk will explain the basics of the phenomenological approach, give few examples of phenomenological findings (e.g., time, epistemic values), and finally ponder how the phenomenological and the natural findings may influence each other.

**Basil J. Hiley**
University College London, UK

## On the Notion of Active Information: an Algebraic Approach to Quantum Theory.

The notion of active information emerges from the approach to quantum mechanics described by Bohm and myself in our book, "The Undivided Universe". As our approach is not universally accepted, I will show that the approach is unitarily equivalent to the standard Schrödinger representation as required by the Stone-von Neumann theorem. This freedom allowed by this theorem was recognised by Dirac and led him to the Heisenberg picture and ultimately to call for an 'algebraic' approach in which the ket vectors were to be replaced by elements of the algebraic structure, in fact by elements of a minimal left ideal. I will show how this — the Dirac-Bohm picture — links directly into the Bohm approach and leads on to the Clifford algebra (both orthogonal and symplectic) which allows us to include spin and relativity, with tantalising hints of a possible connection with the general relativity. I will show how the quantum potential energy appears in all such approaches, suggesting that 'active information' may have a very general application.

Hiley, B.J., Dennis, G. and de Gosson, A. M., The Role of Geometric and Dynamical Phases in the Dirac-Bohm Picture, Annals of Physics, **438** (2022) 168759.

**Minna Huotilainen**
University of Helsinki, FI

## The learning brain in a material world

Educational sciences study learning, and modern neuroscience can offer some insights into the neural underpinnings of learning processes. Studying how using our bodies and interacting with the material world affects learning may increase our understanding on the agency of the learners and how the active role of learners may change learning. The view of the learning brain needs to change from an information receiving, predicting, coding and systematizing system towards including active roles such as hypothesis formation and testing.

**Jenann Ismael**
Columbia University, USA

## Nowhere Else but in the Here and Now; Temporality, incompressibility, and creativity in human action

There's an image of determinism and that has had a grip on the philosophical imagination since Newton. It shows a universe unfolding with inexorable necessity from initial conditions that were in place at the beginning of time. Physics has changed a lot since Newton. The notion of an initial moment for the universe, for example, no longer makes good sense and we no longer think of the universe as unfolding in time. Even though classical physics remains deterministic, its laws are local, not global. And we have come to understand a good deal better the natural processes that produce order and the forms that creativity takes, especially in the biosphere. The result is a view of the natural world – and the place of human action in it – that is quite different from the one codified in the Newtonian image. I want to convey something of this image and what a particular events – e.g., Philip Larkin writing Aubade, a child thinking through a decision, you coming home after a long day and foraging in the fridge for dinner ideas – looks like in it. The task will be to see what things look like when we absorb agency into the physical world.

**Bert Kappen**
Radboud University Nijmegen, NL

## Why I think that classical physics cannot explain consciousness

In this presentation, I argue that consciousness cannot be understood within the framework of classical physics. It is not a proof. It is just my opinion. I will review three possible paradigms: classical physics, quantum physics, and probability or information theory. I will argue that a description of consciousness in terms of classical physics can be captured in software as a classical computer algorithm. A proposal for consciousness in terms of classical physics would then imply that the software (a number of lines of computer code) would be conscious. Or the execution of the software would make the digital computer conscious. I think this is quite absurd. The operation of the computer can be visualized as a giant mechanical clockwork of cogs and wheels. We can make the clock as complex and as big as we want, but it will never be conscious. Anderson famously wrote: More is different. Complex systems can have 'emerging' properties that are different from their constituent properties. But complexity by itself is not sufficient to explain our first person experience. The weather, turbulent flows and fractals can have infinite complexity. But they are not conscious.

Things get qualitatively different in the quantum case. The classical description is in terms of the position (and velocity) of n particles. It is called a local description, because each particle has its own variable(s). In the quantum case, the description is in terms of a field psi(x_1,..x_n,t) that depends on the position of all n particles simultaneously. This description is non-local, because the characterization of one particle is only meaningfull when all other particles are also characterized. Because of this, the quantum description is exponentially in n, while the classical description is polynomial in n and we cannot simulate quantum mechanics on a classical Turing machine. The picture of the clockwork is a picture of local operations on local variables, and that picture fails in the quantum case.

There is an intermediate case, which is the classical probabilistic system. It is described by a probability distribution p(x_1,...,x_n,t) that is also exponential in n.

It also features non-locality and a sense of entanglement (correlations). But there is an important difference between p and psi. One can often effectively approximate p using Monte Carlo sampling using a finite number of degrees of freedom. Each degree of freedom is like a particle that follows a stochastic trajectory. So the probabilistic description can be effectively approximated by a classical particle system. In the quantum case this is in general much harder, if not impossible. Instead, we need a quantum computer to simulate a quantum system. Here the have an instance where the comfortable notion of the separation of hardware and software seems to break down. Maybe it does not formally break down, but it becomes useless. In the quantum case, there seems to be an intimate relation between the type of computation (the algorithm) and the hardware substrate that it is performed on and these cannot be simply separated.

I am not saying that we need quantum physics for consciousness. I dont know that. I dont know whether it is sufficient for consciousness. What I do believe is that classical physics is not sufficient for consciousness. We have to look outside classical physics if we want to understand consciousness.

**Daniel Kolak**
William Paterson University, USA

## Alternative One: The Only Observer in the Universe is You

My theory of Open Individualism (Kolak, I Am You, Springer 2004) that we are all the same person results from a detailed analysis of recent formal work in personal identity (e.g. Parfit, Nozick). Variations have been voiced periodically not only throughout the ages (e.g. the Upanishads, Averröes, Bruno, Royce) but also by prominent 20th century physicists (e.g. Schrödinger, Hoyle, Dyson). Remarkably, Hugh Everett considered it a possible solution to the measurement problem in quantum mechanics ("Alternative One" of his doctoral dissertation written under Wheeler). In my talk I will explain why: the physical universe has only one mind, the only observer is you.

**Lana Kühle**
Illinois State University, USA

## Novel Features in Sensory Perception: An Embodied Account

The embodied mind position states that our body plays a constitutive role in our conscious mental lives. The body is far more than merely the vehicle that houses the brain, rather it is part and parcel of our consciousness. In this talk, I defend such a view by showing how this constitutive role is played, in large part, by interoception. Interoception is the sensory system responsible for the inner, visceral elements of the body. I argue that interoception is a key contributor to the generation of novel phenomenal feature in our perceptual experience. More precisely, interoception is an all too often overlooked element in the multisensory integration process involving all our perceptual senses. Via emotions and bodily states, interoception contributes to multisensory integration in a way that brings about qualitative changes in our perceptual experiences of the world — it creates a unique tone to our experiences that reflects their intrinsic embodiment. In short, interoception is the mechanism by which the perceiver becomes an embodied perceiver and all her perceptual experiences reflect this fact. As a result, I show how our body plays a constitutive role in consciousness, thereby further defending the view that the mind is truly embodied.

**Hans Liljenström**
SLU and Agora for Biosystems, SE

## On the neurodynamics of intention, decision and free will

What is the role of consciousness in volition and decision making? Are our actions fully determined by brain activity preceding our decisions to act, or can consciousness instead affect the brain activity leading to action? This has been much debated ever since the famous experiments by Benjamin Libet in the 1980s, where the current most common interpretation is that conscious free will is an illusion.

Intentionality, which can be seen as a precursor to conscious (free) will, is central in Freeman neurodynamics of the action-perception cycle, where intention would precede our conscious decision to act. Consciousness may be seen as an emergent property of the neural activity of the brain, but in order for consciousness to play any role in our (choice of) actions, we must also consider downward causation in the nervous system. In addition, there may be circular causation in the action-perception cycle, and hence it is crucial to study causal pathways in the brain during volition.

In this presentation, I will descibre a newly started project, where neuroscience, computational modeling and philosophy will be applied to elucidate the ancient enigma of free will. Computational modeling of brain parts involved in intention, decision, and action will complement experimental studies with EEG, MEG and fMRI to explore and map the causal relationships. Already, we have developed a neurocomputational model of the neurodynamics involved in decision making, involving both emotional and rational processes. In addition to individual experiential decision making, we also study the influence of the social and natural environment on human decisions. Our results so far confirm the notion that if decisions have to be made fast, emotional processes and aspects dominate, while rational processes are more time consuming and may result in a delayed decision. From some recent experiments in our consortium it appears that the readiness potential found in Libet's experiments with arbitrary choices are not found for more deliberate choices, where free will is more likely to come into play.

**Kristjan Loorits**
University of Helsinki, FI

## Perspective-Induced Mystery of Consciousness

When it comes to explaining consciousness, illusionism and panpsychism are usually conceived as diametrically opposed approaches. According to illusionists, consciousness can be fully analyzed in functional terms (at least in principle, if not in practice), and the impression that some sensory content (like the experienced blueness of a bright summer sky or the distinctive smell of a rose) is irreducibly qualitative and functionally unanalyzable, is an illusion. According to panpsychists, that sensory content is indeed irreducibly qualitative and functionally unanalyzable and must be therefore accepted as a fundamental and irreducible aspect of reality. I would like to propose an interpretation of illusionism that would allow to accept the key panpsychist premise according to which some content of consciousness is functionally unanalyzable. Accordingly, the problematic qualitative content would be illusory, but illusory in the sense of being a perspectival artefact and not a theorists' fiction or absolute nothingness. Thus, when it seems to the subject that some of her sensory content is qualitative rather than purely functional, she perceives a perspective-induced artefact whose content cannot be described in purely functional terms. However, since that content is always tied to perspective, there are no functionally unanalyzable entities in the underlying perspective-independent domain. The resulting view allows us to ignore sensory qualities in the context of natural sciences while acknowledging their importance in the moral, aesthetic, and philosophical context. The proposed perspectivist interpretation also provides an account of how the perspective-induced qualities can be genuinely observed and talked about despite having no autonomous causal powers.

This research has been funded by the Finnish Cultural Foundation.

**Sabrina Maniscalco**
University of Helsinki, FI

## Quantum Walk on Complex Networks: from the Internet to Biological Systems

Most social, biological, and technological networks display substantial non-trivial topological features, the connection between their elements being neither purely regular nor purely random. These networks are often referred to as real complex networks. During the last decade, tremendous advances in complex network science have led to a powerful statistical framework to understand structure, function, dynamics, and growth of such systems. In my talk I will explore a new and speculative topic: what happens at the interface between quantum information theory and complex network science? How does transport and dynamics behave on a quantum real network?

To answer to these questions I will introduce the concepts of continuous-time **quantum** walk and spatial search on a network. I will then apply these concepts to a real network, such as the Internet. Finally, I will speculate about the consequences of this exploration for biological networks.

**Liad Mudrik**
Tel Aviv University, IL

## Taking a neuroscientific-philosophical approach in studying free will and consciousness

For centuries, questions about the nature of consciousness or the existence of free will were considered outside the realm of scientific investigation. Yet in recent decades, studies in neuroscience and cognitive science have taken a stab at these questions, giving rise to new empirical findings and novel theories. In this talk, I will describe three attempts to translate these long-lasting philosophical questions into empirically testable ones, regarding the role of consciousness in voluntary action, the relations between conscious experience and neural activity, and the possible dissociation between phenomenal consciousness and access consciousness. I will further highlight some of the challenges entailed in such works, and suggest that our understanding of these highly complex and intricate phenomena can substantially benefit from a multidisciplinary dialogue, tying together experimentalists and philosophers.

**Riikka Möttönen**
University of Helsinki, FI

## Unlocking adults' implicit statistical learning by cognitive depletion

Statistical learning mechanisms enable extraction of patterns in the environment from infancy to adulthood. For example, they enable segmentation of continuous speech streams into novel words. Adults typically become aware of the hidden words even when passively listening to speech streams. It remains poorly understood how cognitive development and brain maturation affect implicit statistical learning (i.e., infant-like learning without awareness). I will present our recent study showing that the depletion of the cognitive control system by noninvasive brain stimulation or by demanding cognitive tasks boosts adults' implicit but not explicit statistical language learning (Smalle et al., 2022, PNAS). These findings suggest that the adult cognitive architecture constrains statistical learning mechanisms that are likely to contribute to early language acquisition and opens avenues to enhance language-learning abilities in adults.

# **Sir Roger Penrose**
## University of Oxford, UK

Roger Penrose was born, August 8, 1931 in Colchester Essex UK. He earned a 1st class mathematics degree at University College London; a PhD at Cambridge UK, and became assistant lecturer, Bedford College London, Research Fellow St John's College, Cambridge (now Honorary Fellow), a post-doc at King's College London, NATO Fellow at Princeton, Syracuse, and Cornell Universities, USA. He also served a 1-year appointment at University of Texas, became a Reader then full Professor at Birkbeck College, London, and Rouse Ball Professor of Mathematics, Oxford University (during which he served several 1/2-year periods as Mathematics Professor at Rice University, Houston, Texas). He is now Emeritus Rouse Ball Professor, Fellow, Wadham College, Oxford (now Emeritus Fellow). He has received many awards and honorary degrees, including knighthood, Fellow of the Royal Society and of the US National Academy of Sciences, the De Morgan Medal of London Mathematical Society, the Copley Medal of the Royal Society, the Wolf Prize in mathematics (shared with Stephen Hawking), the Pomeranchuk Prize (Moscow), and one half of the 2020 Nobel Prize in Physics, the other half shared by Reinhard Genzel and Andrea Ghez. He has designed many non-periodic tiling patterns including a large paving at entrance of Andrew Wiles Mathematics Building, Oxford, and the Transbay Center, San Francisco, California. Sir Roger is widely acclaimed for fundamental advances in understanding the universe. His 2020 Nobel Prize in Physics was bestowed for showing that black holes are robust predictions of Einstein's theory of general relativity. Roger has also proposed a solution to the measurement problem in quantum mechanics ('objective reduction', 'OR'), which he suggests is also the origin of consciousness, leading to a theory of brain function ('orchestrated objective reduction', 'Orch OR'). And Roger's concept of Conformal Cyclic Cosmology ('CCC') posits a serial, eternal universe, with the Big Bang preceded by a previous aeon which had its own Big Bang, that aeon preceded by another and so on.

**Anu-Katriina Pesonen**
University of Helsinki, FI

## Sleeping brain in learning and emotion processing

Contemporary sleep research has challenged our everyday thinking of sleep as unified states of brain activity. For example, the simultaneous presence of sleep and wake in brain is well demonstrated in many animal species. This question is more complex in human sleep and the information is increasing. The challenge of extracting local and global features of sleep, and different brain activity patterns during sleep can reveal important aspects of brain function during sleep. This information can also help to understand sleep-related phenomena, such as insomnia and dreaming. However, the question of sleeping brain activity is even more extensive. Current experimental sleep research has an emphasis on how brain activity during sleep can fundamentally modulate and shape memory representations and patterns of emotional reactivity. This activity may not be randomly occurring, but influenced by sleep qualities and daytime information processing.

**Huw Price**
University of Cambridge, UK

## Time for Pragmatism

The philosophy of time has long been familiar with debates between those who take features such as the past–present–future distinction, the open character of the future, and apparent 'passage' of time to be features of the world in itself, and those who take them instead to reflect the human perspective on the world. Views of the latter sort have much in common with pragmatism, though few within these debates are aware of that connection, and few of the leading proponents of such views would think of themselves as pragmatists. For their part, few pragmatists are properly aware of this central and highly congenial application of their methodology. (Some mistakenly associate pragmatism with the other side of the old debate in the philosophy of time.) In this piece I begin with this link between the philosophy of time and pragmatism, but then argue that it only scratches the surface of the deep two-way dependencies between these two topics. The human temporal perspective turns out to be deeply implicated not merely in our temporal notions themselves, but in many other conceptual categories – arguably, in fact, in all of them, and in the nature of language and thought themselves. In this way, reflection on our own temporal character vindicates James' famous global pragmatism: "the trail of the human serpent is thus over everything.

**Paavo Pylkkänen**
University of Helsinki, FI

## Information, causation and consciousness in Bohmian quantum ontology

It is common in contemporary philosophy of mind to say that conscious experience does not fit into the picture of nature implied by the natural sciences. This has given rise to radical doctrines such as eliminativism and illusionism which suggest that conscious experience does not exist or is an illusion of some kind. However, some of us think that the concept of the physical world typically presupposed in debates in the philosophy of mind does not actually reflect very well the implications of modern quantum and relativity physics. Could it be that some of the new fundamental properties of nature implied by these theories, such as information and dynamic wholeness, might make the physical universe more consciousness-friendly? Yet it has been difficult to articulate an alternative new coherent view, which perhaps explains why philosophers of mind typically still stick to the classical Newtonian-Maxwellian mechanistic world view. But even if we do not yet agree about what our best physics says about the physical world, we do know that the mechanistic world view of classical physics is a limited and incorrect characterization of nature as a whole. So if we want to tackle the question of the place of consciousness in nature in a scientific way, we really have no choice but to try to sketch a new view. This has of course been attempted, in various ways, by physicists such as Niels Bohr and later by Roger Penrose. One particularly ambitious attempt was made by the physicist David Bohm, who proposed a specific "ontological interpretation" of quantum theory (which gave information a key role in physical processes), as well as a more general "implicate order" approach (emphasing a dynamic unity of nature). In this talk I will discuss how mental processes and even conscious experience might find their place in the Bohmian universe.

**Amber Ross**
University of Florida, USA

## From Spot to HAL: How the study of consciousness in animal minds can inform the philosophy of AI

It is tempting to think of consciousness as an all-or-nothing phenomenon—either a system is conscious, or it isn't. Over the past half-century, progress in the philosophical and scientific study of animal minds has been leading us towards a compelling alternative perspective: 'consciousness' can instead be viewed as an umbrella term that covers multiple distinct but interconnected mental faculties and attributes, which can be more or less present in different creatures to different degrees.

When investigating whether, why, or to what extent AI might be conscious, we would do well to look to this more familiar set of conscious-but-not-humanly-conscious agents and attempt to apply the same framework that we use for understanding their consciousness to our understanding of consciousness in AI.

**Anna-Mari Rusanen and Otto Lappi**
University of Helsinki, FI (*)

## From Fly Detectors to Action Control: Representations in Reinforcement Learning

In this talk, we analyse how reinforcement learning (RL) is used to study action control. RL is a computational framework in which the focus is on automating goal-directed learning and decision-making. The heart of RL is an elegant and efficient trial and error algorithm. Its goal is to learn an optimal action policy, which maximizes the expected rewards in a given environment. The RL algorithm learns by exploring the possible actions and by observing the consequences of them.

Crucially, RL-based action control is given a representational interpretation. This interpretation, however, differs from the portrait of representationalism drawn by recent antirepresentationalists. For example, in enactivistic arguments, the paradigmatic case of a cognitive representation is a "percept", a sensory-like state that is used to "represent how things are with the world" (Hutto & Myin, 2020). The task of representations is to provide information about the environment, to which they are connected via sensory contact (Hutto, 2015).

(*) with Jesse Kuokkanen and Jami Pekkanen, University of Helsinki, FI

**Tuomas E. Tahko**
University of Bristol, UK

## What Is Reductionism about Consciousness?

The notion of reduction has always had a key role in discussions about higher-level phenomena like consciousness and mental states. Reductionism in general has fallen out of fashion, largely driven by a new appreciation for the complexity of higher-level phenomena, which do not follow a neatly hierarchical structure. But what exactly is the threat that reductionism poses? What would it even mean to reduce consciousness to biology, chemistry, or physics? In its simplest form, the threat seems to be that reduction undermines reality. For instance, if composed entities are reducible to their components, then the composed entities can be eliminated, they do not seem to be real. However, there are more nuanced forms of ontological reductionism available. I will outline one form of this view and demonstrate, via some case studies, that even though reductionism does have a price, it does need to not undermine reality.

**Hannu Toivonen**
University of Helsinki, FI

## Why Don't Airplanes Fly South for the Winter? Ruminations on Computational vs. Human Creativity

Artificial intelligence (AI) is used to produce texts, images, music, designs, and solutions to problems. It is changing the ways in which we create – as well as how we think about creativity. Airplanes do not flap their wings like birds but we don't question their ability to fly. We frown, however, at the idea of a creative computer because it challenges our views of creativity as a characteristic specific to humans. In the first part of this talk, I will consider creative AI from the point of view human creativity, discussing how creative AI matches classic views of creativity. In the second part, I will draw from the field of computational creativity and discuss what creativity could mean in the case of a computer program.

**Martti Vainio**
University of Helsinki, FI

## Sound-Action Symbolism: Linking the Physical World with Meaning

Words are the central units of human language. They carry the bulk of what constitute the situated meanings of human utterances in our communicative exchanges. As signs their forms appear to be mostly arbitrary, and in many instances their referents are abstract enough to warrant nothing but discrationary forms constrained only by the linguistic rules governing the sound structure of a given language. Sound structures -- on the other hand -- are constrained only by the human articulatory capabilities; the sound producing capabilities of our actions in terms of articulatory gestures.

There is, however, a pervasive and universal phenomenon in languages around the world that goes against the notion of arbitrariness of linguistic form, namely sound-symbolism. Certain words and sounds are consistently linked to usually physical aspects of their referents. We have words, for instance, that mimic the sounds produced by the objects they refer to, as in the name of many bird species. Very often languages use certain sounds to refer to physical size of objects and so forth. Some sounds are associated more often with smallness than others.

Forms of signs is not in itself a controversial subject. Language sciences have determined the forms of spoken language successfully for a relatively long time. Symbols are formed by agreed association of signs with referents. We commit to their meanings through this agreement.

Meaning, however, is a much more elusive concept illustrated by the fact that most dictionary definitions of the term are circular. Signs and signals become symbols by the virtue of aqcuiring meaning via the aforementioned links that are maintained by agreement within social groups. The purely arbitrary links are not grounded on anything, but the ostensible linking of arbitrary symbols with each other provides them with meanings that can be described with the system that they create -- namely language. Thus arbitrary language is not grounded on anything but agreement. Quasi-predictable communicative behaviour, that is. Putting

aside all philosophical problems that arise from this view, everyone can attest to its power; both as a product and a vehicle of cultural evolution.

This view stipulates sound-symbolism as a peripheral and problematic phenomenon rather than a potential proponent for autonomous and arbitrary language in our phylogenetic and ontogenetic evolution. Moreover, it has detached language sciences from natural sciences, whereas seeing sound-symbolism as foundational could provide us with the ability to explain both how language came to be and how it actually functions as a communicative tool. It can potentially impart us with the ability to explain how linguistic symbols, and therefore meanings, are grounded in our shared environment.

I my talk, I will present results from our recent studies on sound-symbolism as an action based and multi-sensory phenomenon linking articulatory gestures (and therefore sound) with other bodily gestures, mainly involving hands and arms. Our results show that there are strong links between the articulators and other effectors in our 1) motor system, 2) the pre-motor system, as well as 3) the perceptual system. These connections utilise environmental affordances for systematic signaling of physical features of the environment.

**Aku Visala**
University of Helsinki, FI

## Conscious Access and Moral Responsibility – A Skeptical Challenge

A number of free will and moral responsibility skeptics (like Gregg Caruso) have argued against basic desert moral responsibility. Basic desert responsibility is often taken to require that the person fulfill two conditions. First, the control (or the free will) condition according to which the person exercises appropriate control over her action; second, the knowledge (or epistemic) condition according to which the person has relevant knowledge of the reasons of her action and its moral consequences. The skeptical argument targets both these conditions. In my talk, I will focus on those skeptical challenges that involve an appeal to our lack of conscious access. The skeptic argues that most persons lack significant control over their actions, since the causes of their actions are outside their conscious access. Moreover, the skeptic argues that most people lack conscious access to their mental processes as well as the consequences of their actions. So, the skeptic concludes that it are no grounds to think that anyone deserves blame or praise, because of how their consciousness works. I will assess two kinds of responses to the skeptical argument. According to the first, no conscious access of any kind is needed for responsibility, so the skeptic's case fails. I will suggest that this is not a promising response – or at least it is very counterintuitive. According to the second, consciousness is required for both control and relevant knowledge but – contrary what the skeptic would have us believe – the conditions can be fulfilled after all. Here I will suggest that existing responses lack a sufficiently detailed account of control and an account of the connection between knowledge and control.

# Abstracts of Contributed Poster Presentations

**Merve Akca**
University of Oslo, NO (*)

## Tracing the temporal limits of auditory information processing with pupillometry

When people attend to a target within a rapid sequence of information, human attentional mechanisms appear to fail for a short period of time, reflecting a temporal limit in our information processing ability at a conscious level. This phenomenon is called the 'attentional blink' (Raymond, Shapiro, & Arnell, 1992). Previous research has introduced pupillometry as a useful marker of cognitive information processing in the visual attentional blink paradigm (e.g., Zylberberg, Oliva, and Sigman, 2012; Wierda, van Rijn, Taatgen, and Martens, 2012). Thus far, no study has investigated the auditory attentional blink phenomenon using pupillometry. In an experiment with 56 participants, we tested the amount of mental effort (as measured via pupillary dilations) associated with selectively attending to various sounds using the auditory attentional blink paradigm. The results show that human voice targets may be able to overcome the temporal limits of processing and selectively attending to auditory information. Our findings also indicate that the auditory attentional blink (or lack thereof) can be traced through the eye's pupillary dilations.

(*) with Laura Bishop (1), Jonna Katariina Vuoskoski (1) and Bruno Laeng (1)
(1) University of Oslo, NO

**Uziel Awret**
Inspire Institute, USA

## Susskind's sphere and the conceivability of zombies.

Is it possible to conceive of an empirical finding about the NCC that would protect physicalism from the conceivability argument? This question is essential to current claims that the hard problem will not be 'solved' as much as dissolved, much like the 'hard problem' of life.

I will begin with arguments against the likelihood of such empirical discoveries based on Kriegel's principle of empirical equivalence ("Beyond the NCC", 2020) arguing against the possibility of making empirical discoveries about the NCC that could lend support to some theories of mind but not to others and Howy's objections to the uncritical acceptance of the search for a minimal NCC.

Next I will argue that such arguments can be circumvented by adopting a version of Ross & Ladyman's Principle of Naturalistic Closure holding that any metaphysically significant claim about the NCC should consist of at least two premises whose conjunction explains more than they explain separately and where at least one of these premises borrows from fundamental physics.

So what could possibly count as an empirical finding about the physical/neural correlates of consciousness, involving fundamental physics, which would explain the anti-physicalist problem intuitions giving rise to the conceivability argument?

Here I will introduce Stoljar's ignorance hypothesis (claiming that we are ignorant of physical facts whose knowledge would protect physicalism from the conceivability of zombies) and consider both standard physical facts and non-standard physical facts. Stoljar argues that while the conceivability argument is valid when based on standard physical facts this is not so in the case of non-standard physical facts, but the problem with this argument (see Papineau's critique of Stoljar's "Ignorance and Imagination", Notre Dame phil. Rev.) is that such non-standard physical facts are very hard to imagine since they have to be strange enough to establish the impossibility of zombies without appealing to futuristic, or extra-theoretical, physics.

Here I respond to Papineau's challenge arguing that it is possible to conceive of standard (albeit current novel and highly counter-intuitive) physical facts, or scenarios, related to the NCC that would protect physicalism from zombies by adopting a recent thought experiment by Leonard Susskind ("Dear Qbitzers, ER=EPR", 2018) that is based on his radical interpretation of the AdS/CFT Holographic Correspondence equating entanglement in the 2-D CFT with wormholes in a 3-D AdS space (different than the lab space!) where both dual spaces are considered real and metaphysically dependent.

Susskind considers a 2-D conformal quantum computer shaped like a spherical shell where the only way to access the AdS space internal to the shell is to upload a technician unto the shell computer, which is a bit far out. However (assuming Susskind is right), discovering that some sub-systems of the NCC is massively entangled and governed by conformal quantum field theory (providing an inaccessible representationally rich dual 'private' space) would be enough to protect physicalism from the conceivability of zombies since this physical scenario is both non-standard enough to undermine the conceivability argument and standard enough to count as standard physical.

**Richard Davies Gill**
Independent, UK

## Arrangements, Causality and the Explanatory Gap

Many modern ideas about the mind are based on physicalism, but this makes it difficult to understand things of the mind. I will argue that this view is mistaken and that all things in the world are not physical but are arrangements. These extend from the strings and quarks of the physical sciences to living creatures and our minds in a great hierarchy with more complicated things resting on simpler, more basic things. At the deepest, most fundamental level of particle physics, there is a sea of ignorance in 10 or 11 dimensions. I will present my view that much more complicated things, including ourselves and our minds, are also arrangements: and that there are no arrangements over and above the things of our minds. Additionally, events are successions of arrangements developing in time, never in contradiction with the fundamental laws of physics but not determined by them. These concepts form a non-reductive philosophy of neutral monism, and suggestions will be made as to how they can be applied to some of the traditional problems in the philosophy of the mind.

It has always been thought difficult to understand how the mind can have any causal effects as it is argued that physical objects are causally closed and that this gives 'no room' for anything else. While it is true that small, totally isolated objects are causally closed, large complex objects such as ourselves that interact with their environment cannot be fully understood in this way. The role of initial conditions is important, and an example will be given as to how the specification of these conditions allows things of the mind to creep into our understanding of complex objects and provide the most parsimonious explanation of our behaviour.

At the top and most complex level of the hierarchy that exists in an animal's mind are its experiences. However, it cannot communicate them to us except in indirect ways. We have the power of speech and can transmit some of our ideas directly and exactly. However, we have difficulty in explaining to another the nature of our experiences in the sense that we can recreate in them a similar version of our own experience. This creates an explanatory gap, a concept introduced by Levine, and this is regarded

as a difficulty for physicalists. However, there is a simple explanation that depends on the enormously different complexity of our thoughts and experiences compared with the relative simplicity of what can be expressed in words. A person hearing us speak receives an exact copy of our words but has to interpret them into something of their own, which will not be the same as our experience, particularly if we are reporting a visual experience. This is because of the very low bandwidth of speech compared with that of our visual and neural systems. We will never be able to properly transmit our experiences, and here lies the gap.

**Riina Hannula**
University of Helsinki, FI

## Microbial Medi(t)ation

Microbial Medi(t)ation is an ethnographic substudy for the PhD project called The Assemblage of care of the vagus nerve science. It is carried out at the University of Helsinki, sociology department within Microbial Lives: Practices of New Human-Microbial Cultures -project.

This doctoral thesis looks at the vagus nerve sciences by combining science and technology studies to an art-based approach. Microbiome research and certain studies on the vagus nerve can be interpreted as suggesting that microbes think and feel with and for us via the vagus nerve. The Vagus nerve is a significant factor in mediating the communication between the brain and the gut and creates thus a caring multi-species assemblage. This sociological research aims to understand how what we know about the vagus nerve shapes the traditional perception of the bodies, and their relation to accompanying microbes. Offering an art-based method to investigate the experiences of the vagus nerve it is possible to open up ways for alternative conceptualizations of the human-microbial relations.

Microbial Medi(t)ation is an audio exercise and immersive artwork, with which lay experts participating in the study are interviewed about their vagal and microbial experience. Lay expert in the context of this study is a person who has already a conscious, at least emerging relation to their microbiome or vagus nerve. The purpose of this fieldwork is to challenge participants to create knowledge along with the Microbial Medi(t)ation that serves as a platform for speculative thinking-feeling. This basis is also a wider research position of the thesis stemming from new materialist and posthumanist theory. Without establishing the meaning of the vagus nerve sciences this study makes space to think and imagine the nervous system and human-microbial relations via the notion of care. Entering into relations with claims about the vagus nerve as the most important signaling pathway of the brain-gut axis we embody novel perceptions of the bodies as holobionts, human-microbial consortiums.

The gap between scientific representation and experience of the vagus nerve deploys art-based practice of Microbial Medi(t)ation. It allows to approach vagus nerve as a multispecies caring apparatus. Microbial Medi(t)ation produces human scientific knowledge with art-based and speculative method inviting participants to feel and imagine how to understand the vagus nerve and facts produced from that. Yoga poses are incorporated into the exercise as they are studied to activate the vagus nerve. However, the executor of the research is not a health expert, and the knowledge emerging with participants are not medical facts. The study strives rather understand what implications the holobiont-paradigm entails in a social scientific context.

**Ilmari Helin**
University of Helsinki, FI

## Two Paths of Mind-Studies

In this abstract I will consider the relationship between *Ethos* and *Theoria.* Do mind-studies' content follow from its chosen starting point or more generally, *Ethos*? I will compare two differing approaches to the study of mind, namely that of Contemporary Science of Mind and Buddhism.

The *Ethos* of Contemporary Science of Mind (CSOM) and that of Buddhism differ from the beginning. Where CSOM is concerned with mapping the mechanism of how mind works, Buddhism is concerned with the goal of enlightenment or correct understanding, which will lead to lessening the human suffering.

The *Ethos* of CSOM includes validating our understanding of thought processes through reduplicating cognitive functions in mechanical way. This approach has been successful in practical applications such as calculators and computers. The *Ethos* of Buddhist mind-studies includes getting rid of errant thoughts and patterns, the process will result in deliberating from Moksha, errant thought and therefore suffering.

How do these two traditions validate their understanding of Mind? In case of CSOM it could be by making an automata, a machine, whose thought can not be distinguished from a human, a la Turing test. In Buddhism, the only result of achieving correct understanding of how mind works is the right use of it, and therefore what is perceivable outside is only correct conduct.

Both of these traditions have been using self-reflection as means to understand the workings of mind. Early history of CSOM formulated approximated thought-processes of mind and Buddhism has been distinguishing the correct mind-processes from the incorrect.

The interchangeability of results between these two traditions seems at best dubious, but some reflections on Mind from Buddhism might give perspective to our current understanding of mind. For example, Panpsychisism has strong similarities to interconnectedness of all things and Panconsciousness. Indra's net being one example.

Comparing Contemporary Science of Mind and Buddhism leaves us with very fundamental questions about Mind. What is it that the Mind does? How could we explain the intentionality of Mind by using only causal explanations? What is mind like without perception?

**Ilmari Hirvonen**
University of Helsinki, FI

## Why Qualia Do Not Matter

Qualia are generally defined as raw phenomenal feels that are purely intrinsic. This means that they do not have any relational properties. It is argued in this poster that even if qualia exist, one cannot justifiably include them in one's ontology. The case against qualia presented here is based on Epistemological Relationalism, the view that it is possible to obtain knowledge or information only of relations.

Epistemological Relationalism is argued for and illustrated through a thought experiment concerning qualia. Assume that someone goes to bed normally, but a scientist changes the individual's experience of red and green qualia during the night. (If one does not consider it possible that merely two qualia can change places, they can reformulate this thought experiment as involving all colour qualia, as in the case of the inverted spectrum.)

However, the scientist keeps all the relational properties of the colours intact. Therefore, when the individual sees grass from their window in the morning, they will witness the red quale instead of the green one, but all their memories and attitudes (e.g., whether they like the colour green) have also changed. In other words, they will remember that grass has always looked like that, and if they liked the colour of the grass, they would still like it (after all, this is not an intrinsic property of the grass).

Moreover, if the shade or grass was lighter than, say, the drapes in their window, that too will remain so for our subject. Being darker or lighter than another colour is a relational property, and all relational properties will stay invariant. It is argued that when the individual wakes up, they will not notice any difference. Their experience might have changed, according to some, even drastically, but they cannot see any difference. They cannot know that something has changed.

It is also argued that Epistemological Relationalism implies Ontological Relationalism: if only relations are knowable, then one can justifiably claim that only relational properties exist. Of course, this does not mean that there are no non-relational properties. However, if they exist, we

cannot know about their existence or even what their existence could mean. Hence, the existence of qualia cannot be justifiably added to one's ontological commitments.

From this, it follows that the existence or non-existence of qualia makes no difference, for instance, to our behaviour or speech acts – even those concerning qualia! The old pragmatist adage states that "what makes no difference in practice, should not make any difference in philosophy", or indeed in science. From here, one can infer that a respectable philosophy of mind, and indeed a respectable science of consciousness, will have no use for qualia or other such nebulous concepts.

**Janne P. Hukkinen**
Inrobotico, FI

## Towards a Checklist of AGI Implementation – Can a Critic be a Solutionist?

We should try to implement artificial general intelligence (AGI), because replicating it is the best way to understand a complex system like a human being as a cognitive organism. Second, the endeavour would streamline used conceptualizations and speculations, and perhaps reprioritize related problem definitions. Third, borrowing the "white hat" approach from computer security, the best way to improve security of a system is to try break it, unlimited by its intended use. Likewise, some crucial technical and ethical weaknesses of AI/AGI systems could very well be found only by probing a ready system. Also, not building AI/AGI systems does not protect us from the fallout of adversarial entities building these systems and using them against us or our ethical priorities, be they from commercial free market or nation state motivations.

In cognitive science academia, the focus is often on AI/AGI criticism and doomerism. Critics strive to pinpoint why a particular contemporary machine learning algorithm (family) will not produce AGI, although it was not designed for that. AI/AGI doomerists focus on problems of speculative technology implying that solving these problems within AI/AGI were crucial, although these or similar problems could as well emerge independently also with human organizational/corporate behavior (e.g. externalities beyond incentives) or other emerging technologies outside of AI/AGI (e.g. proof-of-work blockchain technology can be seen as a paper clip problem).

Here, I invite an informal discussion for critics and doomerists: For the critics in the spirit of "From AI/AGI critic to solutionist", facilitated with a taxonomy-like overview of different (humane) cognitive capabilities, properties, and other cognitively relevant behavioral-empirical findings and algorithmic/machine learning techniques, as a work-in-progress checklist of knowns and unknowns for AGI. The doomerists I invite to discuss on how their discovered problems and causal-systemic understanding could be realized and multiplied in other fields, on humanity's journey towards society-level consciousness.

**Zoia Kharybina**
University of Helsinki, FI (*)

## Is the whole brain critical?

An increasing body of evidence suggests that healthy brain operates near critical state. Scale-free distributions of neuronal avalanches, the hallmark of criticality, have been described in cortical networks in a variety of species. Yet, the avalanche dynamics in deeper brain structures has remained unelucidated. Here we describe neural avalanches in the amygdala in comparison with the prefrontal cortex in the developing brain using in vivo multielectrode recordings in urethane anaesthetized juvenile rats (postnatal days 14-15).

Scale-free statistics of neural avalanches in the cortex are expressed in power-law avalanche size distributions with cut-off corresponding to the maximum number of recording sites as also found in our study. However, in the amygdala the cut-off was preceded by a sharp peak at the maximum number of recording sites, meaning that the avalanches spanning over all the electrodes were most abundant in the amygdala. Smaller decay exponents indicated that small avalanches are less prevalent in the amygdala than in the cortex. We further characterized the spread of activity by calculating branching ratio. In critical systems the mean branching ratio is close to one. In line with previous findings in cortical networks, our results show that it is true for the prefrontal cortex whereas avalanches in the amygdala are characterized by higher branching ratio. Taken together, our results suggest that in the amygdala, unlike in the cortex, activity tends to stretch rapidly over the whole region indicating supercritical state.

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## Top-down resolution of visual ambiguity – knowledge from the future or by footprints from the past?

Background: Current theories about visual perception assume that our perceptual system weights the a priori incomplete and noisy sensory information with previous memorized perceptual experiences in order to construct stable and reliable perceptual interpretations. These theories are supported by numerous experimental evidence.

Theories about precognition have an opposite point of view. They assume that information from the future can have influence on perception, thoughts and behavior at the present moment. Several experimental studies provide evidence for precognition effects, other studies found no such effects and/or failed to replicate the previous findings.

One problem of the vast majority of precognition studies may be that the experimental precognition paradigms did not systematically control for potential effects from the perceptual history. In the present study we used the Necker cube in order to systematically disentangle influences from the past and from the future on the perception at a present moment.

Methods: We presented ambiguous Necker cube stimuli and disambiguated cube variants in alternation and systematically tested in two separate experiments whether perception of a currently observed ambiguous Necker cube stimulus can be influenced by a disambiguated cube variant, presented in the immediate perceptual past (perceptual history effects) and/or in the immediate perceptual future (precognition effects).

Results: We found perceptual history effects, which partly depended on the length of the perceptual history trace but were independent of the perceptual future. Results from some individual participants suggest at first glance a precognition pattern, but results from our second experiment make a perceptual history explanation more probable. On the group level, no precognition effects were statistically indicated.

Discussion: The perceptual history effects, found in the present study, are in confirmation with related studies from the literature. The precognition-like patterns were restricted to selected individuals and did not allow for general conclusions. Overall, the present study demonstrates that any future experiment about sensory or extrasensory perception urgently needs to control for potential perceptual history effects and that temporal aspects of stimulus presentation are of high relevance.

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## The associations between metabolic profiles and sexual and physical abuse in depressed adolescent psychiatric outpatients

Metabolomics has been applied in the study of various psychiatric disorders and is a promising future tool for precision psychiatry. One important theme in psychiatry is the role of psychological traumas in psychiatric illnesses and their consequences on a systemic level. Experiences of sexual and physical abuse are often associated with psychiatric problems later in life, and a history of traumatic life events is more common in patients with depression than in the general population.

In this pilot study, we investigated the associations between a history of sexual or physical abuse victimization and metabolomic alterations. We interviewed 76 patients diagnosed with depressive disorder (MDD or dysthymia). The patients' serum samples were analyzed with HPLC-MS, and associations between the concentrations of 102 metabolites and factor scores of the sexual and physical domains of the Trauma and Distress Scale (TADS) were assessed with linear regression analysis.

Of these patients, 67% had a history of either sexual or physical abuse. Sexual and physical abuse were correlated with the levels of several metabolites associated with mitochondrial function, one-carbon metabolism, oxidative stress, and inflammation. These fundamental biological pathways are interconnected and overlapping, affecting each other's functions. In future studies, these results should be replicated with a larger cohort, and possibly including groups of diagnosed PTSD patients and healthy controls.

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## Impaired integration of subjective illusory contours in adults with ADHD

Attention-deficit hyperactivity disorder (ADHD) in adults is associated with neuropsychological deficits in visual attention processing: inhibition of interference, saliency processing, and sustained attention (Sergeant, et al, 2002). While these aspects of attention have been well-studied in isolation, their interaction is underrepresented in the literature on ADHD, despite this interaction being exactly what is required to perform complex naturalistic tasks. We have thus constructed a protocol to probe the interplay between these cognitive processes during visual attention.

The data was collected from 53 adults with ADHD (25 male, 28 female, aged 18-60) and 18 matched healthy controls measured with high-resolution electroencephalography. Participants performed a novel Primed Subjective Illusory Contour Attention Task (PSICAT), which presents gestalt-stimuli targets with distractor primes to induce interference inhibition during ecologically-valid sustained attention task. On a behavioral level, trial-wise reaction times were used to find subject-level parameters of ex-Gaussian distributions (mu, sigma, tau). Neural analysis involved event-related components (ERP) analysis to probe participants' processing of congruency and shape conditions, and their interactions.

Behavioral results showed a somewhat typical picture: ADHD reaction times did not differ from CTRLs on average, but demonstrated greater variability (sigma) and slowing (tau). This pattern suggests a possible compensating mechanism, by means of which ADHDs can keep the same performance speed at expense of accuracy and variability.

On the neural level, the difference between groups was found in the response to primer condition of shape: Control group showed a positive-going wave that peaked 190-250ms post-stimulus only in response to non-shape primer, while ADHD group reacted similarly with a prominent positive peak to both shape and non-shape primers. The underlying mechanism might reflect a cognitive matching system comparing visual inputs with stored memory, which is likely to be impaired in ADHD, reducing their

ability to utilize full information from trials. Besides this, ADHD patients showed reduced N2 and P3 amplitude in all four conditions in comparison with Controls, which goes in line with previous literature (Kaur et al., 2019), highlighting deficits of inhibition of interference, stimulus categorization, and attentional resources in adults with ADHD.

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## Pan(proto)psychism, C-Field and the Combination Problem

According to fundamental physics, the world consists of 12 fields. We cannot deduce consciousness from these fields nor from their respective particles. As a matter of fact, it seems that we cannot deduce consciousness from anything. But it must come from somewhere. Just like spacetime. Or, maybe it is fundamental (unlike spacetime)? There is more to the world than just these fields and particles. Still, structures like the brain or the mid-brain (or whatever might be the "threshold entities" and candidates for consciousness and mind) may not produce consciousness nor minds per se. Physics remains to be physical and about structures. There seems to be nothing new in this picture (though there are possibilities such as those given by the Bohm interpretation of quantum theory and its notion of active information). Consciousness might come to be as a novel, emergent phenomena to the later universe, or it might have its origins in the fundaments of the universe. One possibility is that there exist more fields that the 12 physical fields. For example, there might exist some biological or bio-chemical fields. Speculating further, might there exist a field that could support mind and consciousness? I propose to call such a field a "C-field". This is a panpsychist or more precisely, a pan-proto-psychist idea.

It might be reasonable to take away the "pan" so that we have a proto-psychist view, but the main idea remains. The proposal is that there might exist a fundamental field supporting consciousness and mind. That would be the C-field. This means that nature would support everything that there is from the very "beginning" without any sort of "ontological emergence". All emergence would be epistemological, hence, about ignorance.

Science seeks a natural explanation for the conscious mind. No brains, no minds. This is probably right. What we are saying here is that brains more likely process this C-field than cause it, or the other way around, the C-field is processing brains or whatever threshold entities there are to be processed. Some of these entities might become conscious depending on

their capacity to respond to the putative C-field. This is one "proto-psychist" version of a possible naturalistic-physicalist view of consciousness.

If we cannot explain consciousness and mind at any level we know (biological or otherwise), then we might want to look deeper. So, what is this C-field like? It must have some of these properties that we recognize as mental and conscious. Hence the panpsychist sentiment.

But might these properties come as granular? This would give rise to the so-called combination problem. The C-field resolution would be that each capacity would process a C-field according to the capacity in question. Small entities would process C-field as small and big entities (capacities) as big. This solution may remove the combination problem, but it requires the acceptance of C-field.

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## Solving the Quantum Measurement Problem within Mental Monism

The Measurement Problem (MP) of Quantum Mechanics (QM) may be termed the 'Hard Problem of Physics' by analogy with Chalmers' Hard Problem of Consciousness. Even a complete theory of physics would not solve MP as it is a problem for philosophy, rather than physics. It is a substantive problem if you are a realist about other conscious minds. For a consciousness denier, Schrodinger's cat and Wigner's friend are non-sentient objects that can go into superposition unproblematically. But. if other conscious minds do actually exist, then MP poses the concrete question of "What is the state of a conscious mind when its physical correlate is in quantum superposition in relation to another conscious mind?"

In QM, any physical system evolves by the continuous Schrodinger wave function, which defines a probability distribution of values for each observable, collapsing to a definite value upon measurement. If a system contains an observer and a quantum measurement device, and if conscious minds really exist, there is a contradiction: QM says an outside observer finds that the system (including the inside observer) follows a continuous time evolution, and goes into superposition until she (outside observer) makes her observation, but at the same time the inside observer must find that the wave function collapses when she (inside observer) makes her observation of the quantum device in the system.

There is an implicit assumption that the conscious mind is reducible to, or supervenient on, the tangible brain. But when the brain goes into superposition, it is ill-defined what happens to the associated mind. What if we relax that assumption, and allow the conscious mind to function independently of the associated brain? Two doctrines would make this possible: substance dualism and mental monism.

Substance dualism is infeasible because of incoherence in the supposed interaction between the mind and the brain. But mental monism (the theory that only minds exist and that the physical world is a construct) is internally consistent: there is no explanatory gap because the interface

between the personal mind and the physical construct is just an interface between different structures within consciousness.

In mental monism, the universal set of experiences is partitioned into subsystems constituting personal minds (Lloyd 2019): conscious minds are not situated in space-time; and the subject (the agent of conscious observation and volition) cannot be individuated: therefore there is a single, universal, conscious observer situated outside spacetime (Lloyd 2020). I will refer to this as 'subject singularity'. Hence, whenever any nominal conscious observer makes a quantum measurement, that measurement is, in effect, made by all nominal observers, and hence the Wigner's Friend paradox disappears.

Mental monism illuminates MP exotica such as delayed quantum erasure experiments. Moreover, Frauchiger & Renner's (2018) thought experiment potentially offers a test for subject singularity. This would make mental monism falsifiable in Popper's sense. Furthermore, it requires that the Born rule be an exercise of volition by consciousness: this is akin to Stapp's (2007) theory, although here the conclusion is not ad hoc, but is entailed by mental monism.

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## A Quantum Model for Numerosity Perception

Humans share with animals, both vertebrates and invertebrates, the capacity to sense the number of items in the environment. The pervasiveness of this skill across the animal kingdom suggest that it should emerge in very simple populations of neurons. Current modelling literature however has struggled to provide a simple architecture carrying out this task, with most proposals suggesting the emergence of number sense in multi-layered neural networks [1,2].

We present a simple quantum spin model with all-to-all connectivity where numerosity arises from the dynamical spectrum of the transient signal in several system observables. We present this paradigmatic out-of-equilibrium open quantum simulation approach [3] as a new way to encode information processing in neural systems beyond using it for a microscopic description of neurons. We analyze our results whose behaviour complies with Weber's Law [4], one of the hallmarks of numerosity perception across the animal kingdom, and compare them with a classical network of units. We highlight the regimes where the classical counterpart fails to reproduce the experimental predictions without the addition of non-trivial complexity.

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## Fixational eye movements as a potential spatial and temporal window of human perception

Principal novelty of the project is a prediction that spatial and temporal scales of human perception depend on a pre-filtering process used as a reference. A potential pre-filtering process is fixational eye movement (FEM), which occurs a few times per second within visual fixation. The project includes several psychophysical experiments in humans accompanied by simultaneous eye tracking at 1000 Hz, which detected eye movements up to 0.1°. In the first set of experiments, fine stereoacuity under FEMs was studied. In the next experiment, multi-modal perception of temporal synchrony was studied.

In the first set of experiments we asked how fine stereoacuity can be achieved under FEMs. Stereo vision creates representation of space from disparities between projections to the two retinae, and the binocular disparities are affected by FEMs. In experiment, a stimulus presentation of about 200 ms should minimize the effect. However, many repeated trials are required. Thus, stereo information can be lost due to the visual fixation shift at the start of each trial, determined by FEM aptitude in the specific conditions. Similarly, under natural conditions, stereo information can be lost between FEMs during fixation.

For a stereo stimulus at eccentricity 0.15°, firstly, the stereo thresholds were found to be less than individual stereo resolution limits between two point sources. The limits were estimated from distribution of binocular disparity by the fixation shifts between experimental trials of a common block. Secondly, joint uncertainty of binocular disparity coordinates was found. Finally, change in eye position within a trial depended on stimuli parameters, such as the left or right side from the centre of fixation. We concluded that only distinct patterns of FEMs can appear to allow for fine stereoacuity only along distinct directions.

The problem of deriving 3D scene from pairs of 2D projections is ambiguous considering humans do not have precise readout of their eye positions. An assumption about stability of spatial position of objects

potentially reduces the ambiguity. A perceived scene does not change with FEMs during fixation, thus we hypothesise that a common solution is assigned to pairs of 2D projections formed from a given scene during possible FEMs. The detected fixation shift between trials disrupts stereo stimuli in a way that the initially presented disparity becomes unreliable. Therefore, search for invariants over changes created by FEMs is a plausible strategy for fine stereoacuity. Accordingly, our findings support the oculomotor hypothesis about spatio-temporal encoding of visual information, and the active vision paradigm.

In the next experiment, we ask if FEMs play a role in adaption to temporal asynchrony between sensory modalities. Observers watched the same videos with good synchrony between audio and visual streams, or with 350 ms asynchrony. Potentially, coarser microsaccades helped observers to adapt to the asynchrony. Thus, FEMs could also serve as a plasticity mechanism in perception of multi-modal objects.

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## Minds and Modalities

Lately, in the philosophy of mind and metaphysics, it has been suggested that conceivability is a reliable guide to metaphysical possibility. Perhaps the best-known example of this is David Chalmers' philosophy and his claim that philosophical zombies are metaphysically possible.

In this poster, it is argued that this view is mistaken, and there are two arguments given to support this conclusion. The first one is based on a case from the history of mathematics, namely, squaring the circle. For centuries mathematicians tried to find a method for squaring the circle, that is, transforming a circle into a square of equal area in finite steps using only a compass and a ruler. Clearly, these mathematicians did not consider their task impossible or inconceivable, for if they had, they doubtless would have stopped their efforts. However, as it turns out, squaring the circle is impossible. All of those mathematicians who tried to accomplish it, and thought they had conceived of it, were mistaken.

Hence, one can err in taking something as conceivable. Note that there are external, intersubjectively evaluable criteria for determining whether a circle can actually be squared. Now, we are left with two options: (1) Claim that the mathematicians who tried to square the circle had not, in fact, conceived of squaring the circle. They merely thought they had. So, then, the problem will be knowing when one has indeed conceived of something. If external, intersubjective criteria are lacking, this task seems impossible to undertake; there will be no intersubjective way of justifying whether one has indeed conceived of something or merely thinks that one has. (2) They had conceived of squaring the circle, but the task just happens to be impossible. Then the link from conceivability to possibility will be severed. Therefore, the conceivability-to-possibility principle is either bunk or limited in its scope because it requires less limited beings than mere humans. If the principle is not reliable in mathematics, why would we take it to be reliable in a field where justification is even harder to come by, namely metaphysics?

The second argument is based on Peter van Inwagen's modal scepticism. He argues that if conceivability is a guide to possibility, then we need to conceive all the required steps for really conceiving the thing. Van Inwagen's examples are transparent iron and purple cows. If someone claims that these things are metaphysically possible because they are conceivable, then they should actually conceive the things in question on the physical and chemical levels. That is, what things in the DNA of the cow make its colour possible, or what in the structure of the iron could make it transparent, similarly with squaring the circle. If one really takes it to be conceivable, one should conceive all the relevant steps needed for the squaring. However, this would entail actually squaring the circle or giving mathematical proof of its possibility. What role would then be left for conceivability to play?

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## Temporal patterns in physiological arousal are linked to deviations from predicted task performance

Moderate physiological arousal can be considered to reflect attention towards task-relevant stimuli and therefore to be connected to performance improvements, while too high or low arousal is detrimental (known as the Yerkes-Dodson law). However, the level of arousal during a task does not remain constant over time but is subject to habituation, i.e. gradual decrease related to repetitive stimulation. Therefore, rather than mapping out an absolute desirable level of arousal, we should look at changes in arousal during task performance.

Recently, a habituation model was successfully used to capture temporal aspects of physiological arousal during performance in repeated trials of a high-speed steering task, and sustained arousal (low habituation rate) was linked to performance improvements (Tammi et al., 2019). Within a predictive processing framework, habituation during task performance can be interpreted in terms of predictability and significance of task events, possibly reflecting changes in attentional processing during learning. It has also been suggested that sustained arousal in a continuous task reflects high uncertainty (low temporal predictability) and explorative behaviour (Shalev & Nobre, 2022). Here, we aim to replicate the prior habituation model results (Tammi et al., 2019) and deepen the understanding of the relationship between arousal changes and performance.

Participants (N = 18) each played a total of 40 trials (in 8 sessions) of a high-speed steering task over a period of 2-3 weeks. The task became gradually more challenging within each trial if the participant did not make mistakes, therefore continuously matching challenge with the participant's skill level. A linear mixed model (LMM) was used to analyse the task-related skin conductance response frequency over trials within each session, from which we were able to determine rates of arousal habituation. Predicted performance was determined by fitting individual power-law learning curves, and LMM model residuals were used to explore the relationship between habituation and deviations from predicted performance.

We successfully replicated the habituation model in capturing changes in arousal during the steering task: arousal was found to decrease with repeated trials for all participants in nearly all sessions. Furthermore, sustained task-related arousal (low habituation rate) was connected to better performance both between and within participants. Importantly, within participants, sustained arousal was associated with better-than-predicted performance, and vice versa. Participants with lower habituation rates were also generally better at the task.

Taken together, these results suggest that temporal changes in arousal during learning and performance reflect crucial patterns in bodily states for exceeding oneself in a challenging visuomotor task. As the task becomes ever more challenging, task events become less predictable and require more attention, resulting in high arousal. Accordingly, sustained arousal may reflect higher perceived significance of the task – motivation of keeping up with the challenge.

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## The Dream Challenge for the Theory of Extended Conscious Mind

Philosophy of mind has traditionally conceived mental processes as something that occur exclusively in the brain. However, in the recent couple of decades, an increasing number of philosophers have questioned the brain-boundedness of the mind, and instead characterised mental functions as processes that include also the body and the environment. According to the 4E-framework (see Newen et al. 2018), the mind is not merely restricted within the head, but is also based on interactions between the rest of the body, the environment and the tools in it, and on social, intersubjective and cultural aspects.

One of 4E's central branches was Clark and Chalmers' (1998) Extended Mind thesis, according to which the constitutive basis of certain cognitive processes is not restricted inside the bodily boundaries, but can extend to include devices and tools. However, there has been a growing number of publications recently that argue that not only the material basis of cognition, but also the material basis of experiential states can be spread outside the head and body (e.g. Noë 2004; Ward 2012; Kiverstein & Kirchhoff 2019).

According to the theory of Extended Conscious Mind (ECM), the material basis of certain experiential states can be extended outside the brain and body, into the tools we incorporate. In this paper, I will scrutinize one of the most common counterarguments against ECM: the "dream challenge". The challenge is the following: if conscious experiences are (partly) realised by external elements as ECM claims, how are states such as dreams and hallucinations possible, as it seems that they are realised exclusively in the head? If the interaction with the environment is not a necessary feature for these certain experiences, how can it be part of the constitutive basis for experiences in general? This is the challenge that dreams and dream-like states posit for ECM and externalist views in general.

My aim is to show that empirical dream research doesn't contain anything that would necessarily lead to an internalist account of the mind, and that there are no philosophical obligations either. I discuss four different options to answer the dream challenge, and conclude that the last two of them are the most convincing, hence the emphasis will be on third and fourth options. The third option is "weak enactivism", that stresses mastery of skills and understanding or knowledge of sensorimotor contingencies rather than actual interactions between the subject and her environment. The fourth option is that we can simply accept that experiences don't have to extend in all cases. In the spirit of multiple realizability, it is possible to hold a view that certain veridical waking-life perceptual experiences have an extended base, whereas some other instances of experiences, such as in dreams, hallucinations and imaginations, are brain-based. I claim that the reason why the dream challenge cannot refute ECM is a combination of the two options I described above. The most important reason is simply the following: for ECM to be a sound theory, it is not necessary that all kinds of experiences are extended.

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## External causes of bias in moral judgment

Artificial intelligence (AI) becomes increasingly important in real-life decision-making, including ethical dilemmas (e.g., self-driving car scenarios; jury decisions). Studies such as the moral machine experiment by Awad et al. (2018) have shed light on preferences of people in different cultures in ethical dilemmas, and how these could guide AI models.

After outcries about biases in datasets and algorithms, this topic is high on the agenda of AI research. To train AI models, human decisions are taken as input. Several talks of this conference concern unconscious biases that are imminent to the people who make such decisions. Whereas much is known about biases in datasets, I introduce another source of (unconscious) biases that might affect datasets used for AI models and decision-making.

In this study, I explored moral judgment in the immersive theater play "Terror" by Ferdinand von Schirach. The play describes a court case about a military pilot, who—contrary to his orders—shot down a passenger plane that was hijacked by terrorists, potentially targeting a fully occupied football stadium. After watching the court case on stage, audience members are asked to judge whether the pilot should be acquitted or found guilty. This question poses an ethical dilemma.

The play has been performed in 25 countries and audience judgments varied greatly by country and culture, similarly to Awad et al. (2018). In general, the majority of audiences acquitted the pilot: 92.11% of the performances ended with the pilot being acquitted. This is in line with findings from Awad et al. (2018), that people favor sparing many lives in contrast to few lives.

The majority of the performances (N = 1460) were staged in Germany. Within the data from Germany, I explored further effects that might affect moral judgment. From research on jury decisions in court cases, it is known that more attractive suspects receive more lenient punishments. This is known as the Attractiveness Leniency Bias (Abel & Watters, 2005). To explore the effect of attractiveness, I asked 49 raters (19-61 years, 45%

female) to rate the attractiveness of 30 German actors enacting the pilot. In addition, I coded whether a terror attack had happened in Germany within the last 7 days of performance and whether the performance was on a workday or on a weekend. A 3-level hierarchical linear model showed that audiences were less likely to acquit the pilot when he was more attractive when a terror attack happened, and on weekends compared to workdays.

Thus, in this data, the attractiveness of the target of the moral decision (unconsciously) influenced audience decisions, as well as contemporary events, and the day of the week.

Strikingly, these results are contrary to the Attractiveness Leniency Bias, and it is unclear how theater audiences vary across the day of the week. Nevertheless, this research might inform work on training datasets for machine learning models involved in moral decision-making. The attractiveness of the target that is rated, the weekday and contemporary events such as terror attacks should be considered to potentially play a role.

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## Brain and Mind, Organism and Life – Puzzles or Counterinstances?

One of the core presumptions of the 20th century scientific worldview is that life is not a problem – that the synthesis of the theory of evolution with genetics (first with Mendelian and subsequently with molecular) suffices to situate the phenomenon of life unproblematically into the same picture of the Universe with inert, physical matter. Because of this presumption, the fact that what thinks tends to be also alive is often bypassed in philosophy of mind; it is perceived that the problem is to explain how is it possible for matter to be conscious, rather than to explain what it means for a living organism to be sentient. However, just as our Western scientific tradition is better equipped for conceptualizing the brain than the mind, modern biology finds it much easier to speak of the physical-structural organism than of its life. Indeed, hardly anything in our experience of the world is as obvious as the difference between the presence of life versus the absence of it; for instance, it seems that something dramatic happens at the moment when an organism dies and, in particular, something that might be expected to be generalizable independently of the particular material-structural constitution in which such an event happens to take place. Yet, it is far from obvious how to conceive in scientific terms what it is that was, and no longer is, as the organism passes away. In my poster presentation, I heuristically employ Thomas Kuhn's concepts of an anomaly, a puzzle, and a counterinstance for portraying this organism-life problem in a historical-philosophical context which, I think, suggests several important insights concerning the interestingly analogous brain-mind problem.

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## Distractor-related cognitive control during calculation

Arithmetic skills are critical in everyday life, and cognitive control is a crucial part of arithmetic thinking. During calculation, demands for cognitive control are likely to vary based on, for example, problem complexity and the specific type of arithmetic task performed. Furthermore, in real-life situations, external factors, such as distracting noise in a classroom, often require further focusing efforts when performing calculations. In the present study, we examined the brain mechanisms that enable focusing on arithmetic problems while being exposed to auditory distraction.

Healthy young adults (n=20) took part in a functional magnetic resonance imaging (fMRI) experiment where they performed three types of numerical tasks: 1) Solve arithmetic problems of varying complexities (e.g., '6-4='? or '3·(3-1)='?), 2) Create equations (e.g., '8=?' given as a target solution, to which, e.g., '2+2+2+2' or '16:2' can be given as an answer), and 3) Match numbers (e.g., '68' is shown and the participant clicks '6' and '8' as a solution). The tasks were factorially combined with four auditory distraction conditions: 1) Meaningful speech, 2) Nonsense speech, 3) Modulated white noise, and 4) No distraction. The data were analyzed for main effects of Task and Distractor, and their interaction. Arithmetic tasks were observed to modulate activity in regions previously associated with arithmetic processing, such as the dorsolateral prefrontal cortex (DLPFC), intraparietal sulcus (IPS), and posterior inferior temporal cortex. Additional task-related activations were observed in the superior temporal gyrus and sulcus (STG/STS), probably relating to differential auditory processing of the distractors depending on task. Distractor-related activity was also found in the STG and STS, but, interestingly, even in the DLPFC and IPS, possibly indicating interference effects on task-related processing. Interactions of Task and Distractor were observed in the left STG, also relating to varying distractor-related processing during the different tasks. The more demanding the task was, the lower the activity in this auditory region, possibly indicating suppression of auditory processing when more resources are required in calculation.

To our knowledge, our results represent the first attempt to understand the neural basis of focusing on arithmetic problems during auditory distraction. These results have implications for the cognitive neuroscience of arithmetic processing and distration-related cognitive control.

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## The Intertwining of Spirituality, Business, and Technology – Conscious Leaders on a Conscious Planet

Our complex world (Morin & Postel, 2008) where ''critical situations define boundary between the deterministic order and the unpredictable chaos'' (Damiani, 2003), requires creative solutions and new frameworks to consciously interpret reality and act with responsible awareness. The multidisciplinary empirical research ''The intertwining of spirituality, business, and technology'' in the international business leadership studies explores the interactive dynamics occurring between: a. spirituality meant as creativity - the way in which creation manifests itself within human beings through their creative potential, b. business, here meant as the business of humans, and c. technology as a physical infrastructure possibility to support human infrastructures and intelligences.

The research is a qualitative multiple embedded case study conducted at JAMK School of Business at JAMK University of Applied Sciences in Finland in the academic years 2019-2020 and 2020-2021 on three practical teaching instances. The work started with a pilot leadership course in the semester of Fall 2016, and it is still active and implemented in several courses in international business leadership and management. In the courses, the use of contemplative practices, ISHA Upa-Yoga and meditation (https://isha.sadhguru.org/uk/en), theatre, dance, and artistic expressions are integrated as pedagogical tools suitable to facilitate the students in expanding and cocreating a conducive space and to sustain the blossoming of conscious personal growth. In their experiential learning process besides lectures, workshop activities are presented and experienced through the concept-design EspressoSkillsLAB© (https://zellainternational.org).

In fact, by reducing the distance between the personal and professional development paths while simultaneously activating various aspects of intelligence and other human dimensions, they learn and create new methods to approach the shift from the ego-centric to the eco-centric social system (Scharmer, 2013) and lay the foundations for a ''good society for all'' (Lagus, 2020). The co-creative process facilitates the human-driven

conscious skills and attitudes (Zoccoli, 2022) of the students who are trained and can practice the possibility to become conscious leaders on a conscious planet through their human transformative leadership experience (Zoccoli 2022, 2020) both on an individual and collective level, in the face-to-face and/or digital environments.

The study contributes to the current societal and scientific paradigm change from different perspectives, transforming challenges into possibilities. The study analyses three types/levels of social relationships: system (macro), groups (meso), and interaction (micro) emerging from the experiential learning activities (Kolb, 1984) designed and delivered by the researcher-teacher. Her project-based and awareness-based leadership courses are holistically framed by combining transformative learning theories (Blackburn Miller, 2020) and Theory U (Scharmer, 2007).

Through the experiential learning feedback of the students, and that of the researcher, who becomes herself an object of the research, the quality of the leadership vocabulary, the storytelling, the renewed attitude to the communication and decision-making process makes evolving the study of the discipline of leadership. Conscious sociological values, sensorial, emotional, and spiritual human skills, focused work purposes, ethical-cultural attitude, and relational adaptations are essential attributes - shared and needed - when willing to consciously lead organizations, companies, and institutions aiming to thrive in a conscious society.

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