



「意識の科学」↔「意識のアップロード」

Masataka Watanabe School of Engineering, University of Tokyo Dept. of Logothetis, Max Planck Institute for Biological Cybernetics MinD in a Device

Hard Problem of Consciousness

Chalmers, 1988



Scientific understanding of consciousness



List of Contents

- Converting the "Hard Problem" to a non-hard problem with Law of Nature
- Neural Algorithm Hypothesis
- Validation of Law of Nature Analysis by Synthesis with artificial consciousness
- Subjective test for artificial consciousness

Necessity of a Novel Law of Nature of Consciousness



"From Biological to Artificial Consciousness"(脳の意識 機械の意識), Watanabe, 2022, 2017

Example candidates of law of nature

- "Dual Aspect theory of Information" by Chalmers
- "Integrated Information Theory" by Tononi
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- •

But...

Is information a good candidate for the objective side of the law of nature for consciousness?

(in terms of not putting too much burden on the law of nature)

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Is consciousness generated from (objective side of the law) information or algorithm?



neural information or neural algorithm?



"From Biological to Artificial Consciousness"(脳の意識 機械の意識), Watanabe, 2022, 2017

"Virtual Reality Metaphor of Consciousness" by Revonsuo



Dreams during REM sleep REM-sleep dreaming is as if you are hooked up onto your own "MATRIX"



The brain mechanism of consciousness in awake conditions resembles VR, hence we posses the ability to dream

Generative Models as Neural Mechanism of Visual Consciousness

Watanabe "Cognitive Neuroscience" Tokyo; Ohm-sha (2010)



Kawato et al. 1993, Mumford 1992

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Putting the battle aside, how can we validate such laws of nature ?



Analysis by Synthesis!





Through an attempt to construct artificial consciousness

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Requirements for testing Machine Consciousness





Philosophical Zombies (Chalmers)

Conscious mill (Leibniz)

We cannot test machine consciousness by either

analyzing its input-output response (philosophical zombies: Chalmers) nor tapping into its internal mechanism (Leibniz's mill argument)

Ultimately, we need to use our own subjective mind, and "see" whether the machine is consciousness.

But...



M A Mandour, 2007

Materials for the Subjective Test



How do we experience integrated bilateral vision?



Two streams of consciousness are integrated via limited interhemispheric connectivity without the full exchange of visual information sufficient for visual awareness

Subjective Test for Machine Consciousness



Watanabe, The Science of Consciousness, Arizona (2013)

Scientific understanding of consciousness

Subjective test for machine consciousness



(subjective test for machine consciousness)

theorization

candidate laws of nature

implementation

Yet another thought experiment?

No, we are damn serious! Preparation of BMI and Machine

The BMI Ultimate BMI to record and write into all interhemispheric connectivity CMOS based high-density double sided 2D electrode array



"From Biological to Artificial Consciousness", Watanabe, 2022

Electron Microscopy image of a human post-mortem corpus callosum

currently available device ->50million channels at 2-3µm pitch



Highly et al. 1999

The Machine

Connectivity of the human brain as synaptic initial state



Felleman and Van Essen, 1991

Zilles and Clarke, 1997

C. Shan Xu et al. 2020

Training of the initial state neural network with advanced deep learning



Working hypothesis for achieving brain-machine consciousness integration

- Consciousness resides in virtual spiking neural networks simulated by digital computers
 - → Validity of the proposed "Digital Fading Qualia" thought experiment
 - \rightarrow We are right about the progress in computer performance
- A Brain Machine Interface that may read/write basically all information from the corpus callosum etc. (Patent approval and experimentation in progress)
- Validity of the Neural Algorithm Hypothesis

 → If the generative model constitutes the objective side of the law of nature of consciousness, it is not too difficult to wire the machine and the brain for integrated consciousness





Uploading Consciousness onto a Machine





Tokyo Univ. based startup

Summary

- Conversion of the Hard Problem to a non-hard problem with the introduction of "Law of Nature" of consciousness
- Laws of Nature cannot be tested using biological brains
- Analysis by Synthesis -> artificial consciousness
- Constraints for testing artificial consciousness philosophical zombies, Leibniz's mill argument
- Subjective test for machine consciousness