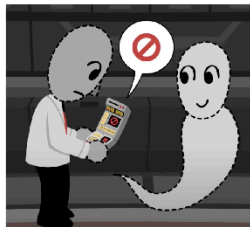


An Overview of Consciousness and Mind-Body Problem

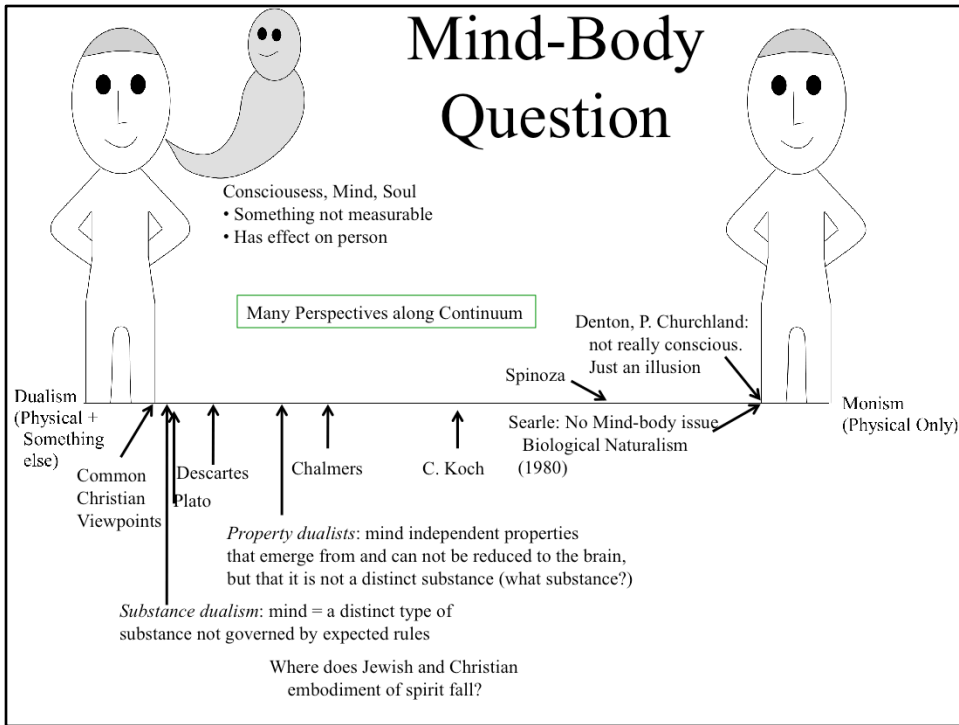
Jennifer Hasler



Picture of J. Hasler on the fountain at the Moore building at Caltech, 2011.

Drawing from CGP Grey, Video: The Trouble with Transporters, YouTube, 2016, <https://www.youtube.com/watch?v=nQHBAAdShgYI>

Mind-Body Question



(Star Trek) Transporter Problem

Major Plot Device in Star Trek Science Fiction Series

A system:

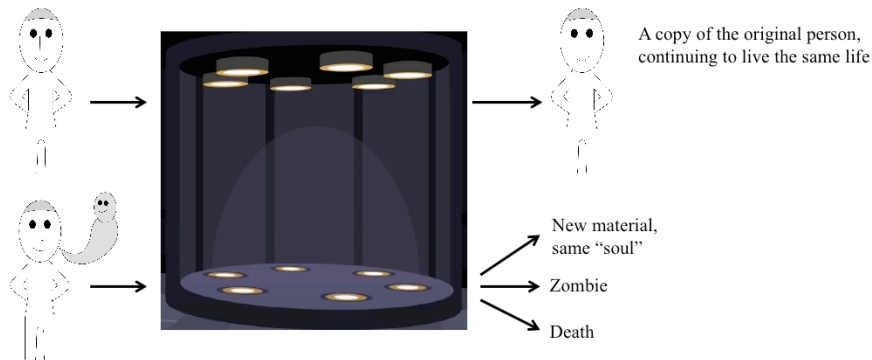
- scans the individual's molecular makeup,
- converts your mass into energy
- moves the energy and information from one place to another, and
- the energy is becomes matter that's in the shape of the person.

The transporter vaporizes the person and a near-perfect facsimile comes out the other end.



Likelihood seems really low to make this device

Is it you on the other end?



•An Excellent overview of this question is found in the CGP Grey Video: The Trouble with Transporters, YouTube, 2016, <https://www.youtube.com/watch?v=nQHBAAdShgYI>

v=nQHBAAdShgYI

•Zombie = Functioning but not Conscious

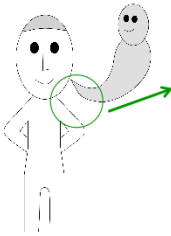
• is the organism functional, is it the same person, will the person think they are the same person?

• Maybe the mechanisms of soul of the individual stay coupled with the physical body reconstructed elsewhere. Seems unlikely, and yet if things are coupled, maybe that coupling can be transported.

Consciousness / Mind-Brain Mechanisms

Consciousness: One case of something of the person that is not measurable from the outside

- If it can not be measured, it can not affect anything (are we measuring the right things?)
- And yet, there is something unmesasurable that seems to make a difference
- Consciousness is the only thing we are individually certain



How does the immeasurable interact?

- Nonlinear dynamics: Necessary \rightarrow Real value computing (Aleph₁)
nothing about interaction
- Chaos: Allows for small inputs or noise to make large changes in result
(a mechanism, but says nothing further)
- Quantum Theory: Heisenberg Uncertainty describes behavior of waves,
joint uncertainty of time and frequency
- Higher Dimensional Theory (Universe is not only 3 Dimensions + Time)

In general, our measurements are limited

“noise” = aspects we can not predict
(natural phenomena)

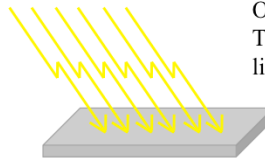
Measurements have limitations / irregularities

Limitations *might* lead to effects in the world

Key Quantum Phenomena

Quantum Theory: Heisenberg Uncertainty describes behavior of waves,
joint uncertainty of time and frequency

Some measurable properties utilize
instantaneous variability in energy / momentum
(Light absorbed by some materials)

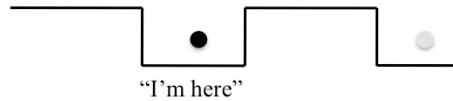


Silicon is
Opaque
To visible
light

Non-local interactions

Measurement: Electron Tunneling (essential to Si devices)

An electron in a
confining potential well



"I'm here"

"Sometimes
I'm here"

And yet, nothing mysterious more
than any other physical phenomena

Could also add linearity, so many waves can co-exist: superposition

Can one Upload a Person to a Machine?

Imagine we could build a Si Human Brain

- Research directions already asking these questions
- Initial technical research projecting that possibility
- Maybe 20 years away, but coming soon enough

Will it be conscious?
Will it be human?



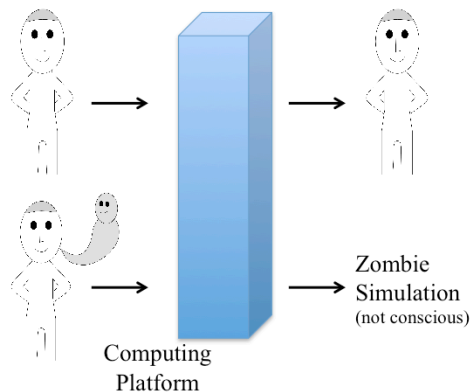
If we can build such a system, can we transfer a living person into that synthetic substrate?

- Must be a physical system, not a digital system (computation over Reals and not Integers)
- Maybe store the physical states in 1m³? (e.g. A refrigerator)

Will it be conscious?
Will it be self aware?
Will it be human?
Will it be immortal?

Synthetic machines and robotics, even with advanced AI, hard-code the high-level operation of the machine

What if something is still missing?



For potential of building a Si human cortex / brain: J. Hasler, H. B. Marr, "Finding a Roadmap to achieve Large Neuromorphic Hardware Systems," *Frontiers in Neuroscience*, vol. 7, no. 118, September 2013. pp. 1-29. Does not handle all of the molecular aspects, and yet, one could imagine a pathway along these lines for integrating such useful physics into the structure. One discussion on the possibilities of computing with Real (Physical) vs. Integer (Digital) computation: J. Hasler, "Opportunities in physical computing driven by analog realization," *IEEE International Conference on Rebooting Computing*, 2016. pp. 1-8.

So are we sufficiently motivated
to ask about the Mind-Brain
Problem and Conscious now?

History of Mind-Brain / Consciousness

(before 1990)

Dualism (Descartes): Mind independent of physical substance (1701)

- An Ancient Greek Perspective (e.g. Plato: “Forms”, Aristotle: soul is property of the body)
- Heavily influenced early Christianity (e.g. Soul good, body bad)
- Aquinas: soul/mind and body are one, but the soul survives after death

Locke on definition of Consciousness (1690):

“Consciousness is the perception of what passes in a man's own mind”

Julien Offray de La Mettrie: *Man a Machine (L'homme machine)* (1748)

Organization of matter at a complex level resulted in human thought.

Early Monist: Spinoza (1670)

Thomas Nagel, 1974: “What does it Like to be a Bat?”

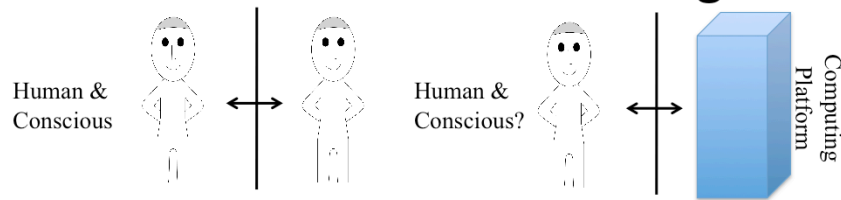
Pg. 163: “Consciousness is what makes the mind—body problem really intractable. Perhaps that is why current discussions of the problem give it little attention or get it obviously wrong”

Locke: An Essay Concerning Human Understanding, Book II, Chapter I, section 19, 1690.

Spinoza, Baruch (1670) Tractatus Theologico-Politicus <
https://en.m.wikipedia.org/wiki/Tractatus_Theologico-Politicus>

Thomas Nagel, 1974, Book = Mortal Questions: Canto, Chapter 12, “What is it like to be a bat?” Cambridge University Press, 1979.

Conscious Machines? Turing Test



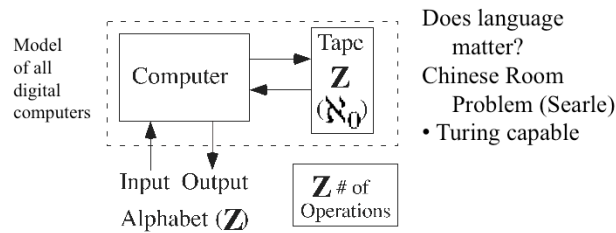
Could we make a computing machine to be conscious?

Turing Test: Can a computing system seem to another human to be human / conscious?

Daniel Dennett (& D. Hofstadter) → anything passing the Turing test is conscious

David Chalmers → a philosophical zombie could pass the test, yet fail to be conscious.

Who is Alan Turing? Turing Machine (1931)



Koch and Crick: Consciousness Research

Francis Crick and Christof Koch, 1990

Neural Correlates of Consciousness (NCC)

How does neuroscience inform consciousness?

Find correlations and *hope* for causation

Started by noticing 35-75Hz Neural Oscillations

- a basis for consciousness?
- surprising visual effects show consciousness?

Something sufficiently complex is conscious

- Φ for the level of complexity (Tononi, 2004-)
- Integrated Information Theory (IIT) (V3, 2014)
- complexity of a dynamical system?

Stimulate the brain, different patterns when conscious

- zap and zip technique
- a consciousness meter?

Koch: "How do you define consciousness?"

I can't." (2005)



Picture in San Diego (before Crick died)

Another related reference: G.M.. Edelman and G. Tononi, A universe of Consciousness: How Matter becomes Imagination, Basic Books, 2000.

Hard Problem of Consciousness

David Chalmers (1995, Tuscon, AZ)

A-consciousness: mechanistic terms (imagine can be solved someday)
(examples?)

P-consciousness: >> challenging, **The Hard Problem of Consciousness**



On A-Consciousness: “If these phenomena were all there was to consciousness, then consciousness would not be much of a problem. Although we do not yet have anything close to a complete explanation of these phenomena, we have a clear idea of how we might go about explaining them” → should we call these phenomena *awareness*?

On P: “The really hard problem of consciousness is the problem of *experience*”
“It is undeniable that some organisms are subjects of experience”

“the very fact that it (consciousness) arises is the central mystery”

Consciousness as fundamental: “Fundamental entities are not explained in terms of anything simpler... We know that a theory of consciousness requires the addition of *something* fundamental to our ontology, as everything in physical theory is compatible with the absence of consciousness... by taking experience as fundamental... Nothing in physics tells us why there is matter in the first place, but we do not count this against theories of matter”

David Chalmers (1995). "Facing up to the problem of consciousness". Journal of Consciousness Studies. 2: 200–219.

More quotes: On P: “an organism is conscious if there is something it is like to be that organism, and a mental state is conscious if there is something it is like to be in that state.”

Chalmers Critique of Consciousness Science

“The ambiguity of the term "consciousness" *is often exploited by both* philosophers and scientists writing on the subject. It is common to see a paper on consciousness begin with an *invocation of the mystery of consciousness*...worrying that so far we have no theory of the phenomenon. The topic is clearly the hard problem - the problem of experience. In the second half of the paper, the tone becomes more optimistic, and *the author's own theory of consciousness* is outlined. Upon examination, this theory turns out to be a theory of *one of the more straightforward phenomena* - of reportability, of introspective access, or whatever. At the close, the author declares that *consciousness has turned out to be tractable after all*, but the reader is left feeling like the victim of a bait-and-switch. The hard problem remains untouched” – Chalmers, 1995

“The moral of all this is that *you can't explain conscious experience on the cheap*”

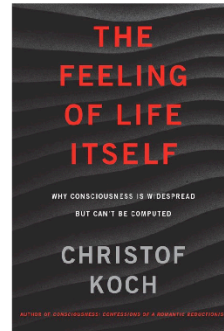
David Chalmers (1995). "Facing up to the problem of consciousness". Journal of Consciousness Studies. 2: 200–219.

Chalmers 1995: Such a theory (NCC) would be valuable, but it would tell us nothing about why the relevant contents are experienced. Crick and Koch suggest that these oscillations are the neural *correlates* of experience. This claim is arguable - does not binding also take place in the processing of unconscious information? - but even if it is accepted, the *explanatory* question remains: Why do the oscillations give rise to experience?

Christof Koch Quotes

“I think the earliest desire that drove me to study consciousness was that I wanted, secretly, to show myself that it couldn’t be explained scientifically. I was raised Roman Catholic (alter boy, Jesuit school), and I wanted to find a place where I could say: OK, here, God has intervened. God created souls, and put them into people”... then assured...long ago abandoned such improbable notions (closer to Spinoza's God than Catholic; “Have to grow up”) – Christof Koch, 2014

“how it is that a physical organ like the brain can give rise to feelings? That seems distinctly odd... Consciousness is a not a clever hack. Experience does not arise out of computation” – 2019



MIT Press 2019: “Christof Koch on ‘The Feeling of Life Itself’ and how new technology may allow us to see consciousness for the first time,” Oct. 17, 2019.