

Ontological Flattening and Neural Data: Missteps in Current Neurotechnological Discourse

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The current neurotechnology discourse focuses on the capability of neurotechnologies to detect and collect neural and biometric data, then make inferences about the individual person based on that data. We argue in this short article that the neurotechnological discourse, and the responding ethical and legal discourse, mistakenly equate a part of the whole person, purportedly represented by neural or biometric data, with the whole person.

We argue that a culture that pervasively flattens complex and distinct ontologies into one measurable feature—neural data, which supposedly captures the human psyche—will negatively impact both how we relate to each other and how we develop ethical and legal responses to neurotechnology.

If the hype is to be believed, Neurotechnology (NT) will permit Artificial Intelligence (AI) to “read” the electrical signals coming from an Electroencephalogram (EEG) or some other brain scanning device (McHugh, 2026). It is imagined that this information can be combined with other biometric information, such as heart rate, blood pressure, and electrodermal activity, to provide insights into “an individual’s mental states, emotions, or intentions” (Magee *et al.*, 2024). Imagine all the dark little secrets it might learn about someone; or imagine all the nefarious things a company can do with this information: to predict the behavior of the person before she knows what she is going to do, or to gently nudge her with a suggestion that shapes her desire. Yet all of these bits of information, these data points, are highly degraded versions of a human psyche; degraded in the sense that they are converted into data and are representations of representations of representations of an ontologically different thing called a human psyche. In this brief essay, we will first describe the imagined problem and the solution articulated by neuroethics scholars; then we will present a phenomenological description and different ontological interpretation of the events in the description, calling for more caution in the imagined problem and more texture in the imagined solution.

FROM BRAIN TO INFERRED MIND

The story goes that we can read mental states from brain states and predict and influence human behavior with novel NTs which are “devices capable of recording, interpreting, or altering the response of an individual’s central or peripheral nervous system to its internal or external environment” (American Medical Association, 2025). For example,

Brain-computer interface (BCI) devices enable individuals to neurally-operate a prosthetic limb through neurotechnological decoding of movement intentions (Hochberg *et al.*, 2012). BCI similarly enables people who have lost the ability to speak to restore their communicative abilities by decoding neural representations of attempted speech through language models that “infer the most probable underlying sequence of words, given both the phoneme probabilities and the statistics of the English language” (Willett *et al.*, 2023). BCI relies on AI to properly infer movement or thought patterns from neural data. Start-up companies are also marketing consumer NT products by exploiting these predictive abilities. The company NeuroSky developed EEG-embedded “brain-sensing technology” that supposedly reveals personal brain insights based on EEG-generated neural data¹ (NeuroSky). NeuroSky claims that their EEG devices generate neural data that help employers “map candidate[] abilities and skills during interviews” provide “cognitive metrics” on student study habits, and track student cognitive inefficiency (NeuroSky). NeuroSky is marketing its EEG-enabled NT device as able to harness neural data to make inferences about individuals and their ability to learn, study, and work. Other EEG-enabled NTs are making similar inferences about mental states from neural data (Genser *et al.*, 2024).

As of 2024, there were 30 consumer NTs on the market (Genser *et al.*, 2024). The consumer market for NT is only expected to grow (Brain Computer Interface Market). Most NTs use EEG to monitor electrical activity in the user’s brain, nudging the user based on inferences made by AI about the user’s mental states. Consumer NTs collect neural data to purportedly make mental inferences about an individual. Neuroethicists are raising ethical alarm bells at the collection of neural data because neural data is thought to be especially sensitive and highly personal due to the data’s origin in the brain and nervous system (Goering *et al.*, 2021). Because of the brain’s special status as the seat of our consciousness, identity, and personality, advocates argue that neural data requires special protections. Other advocates argue that biometric data should be given the same kind privacy protections (Magee *et al.*, 2024).

One can imagine nefarious purposes to which neural data could be put, as are likely the inspiration for advocates of neural data privacy protections. Because BCI-AI technology has the capability to infer cognitive features (content of thought, movement, desire) from neural data picked up from EEG, consumer NT companies are utilizing EEG to enable NT consumers to make inferences about their own mental states. Simultaneously, therapeutic NT capitalizes on AI and neural data to enable individuals to operate prosthetic limbs or to communicate again with loved ones. Yet, even with the possible goods, there is a foundational belief that the information within neural data gives a full, complete, and exhaustive representation of human desires, thoughts, and minds. Thus far, the extent to which neural data exhaustively represents the human mind has remained largely unexamined in the neuroethics literature.

ILLUSTRATION

A cold glass of water sits on the table in front of you. You see the clear glass, cylindrical in shape, contains a clear liquid. Condensation gathers on the glass. You infer that the water inside the glass is cold. The inference stirs something in you, and you notice that you are hot and thirsty. A desire to sate your thirst wells up. Your hand moves up and towards the glass cylinder, the cool condensation touches your fingers, followed by the

¹ NT records “neural data”, which is “information coming from the measurement of the activity of the central or peripheral nervous system” (American Medical Association, 2025).

glass, which presses against your fingers as you grip the glass with the perfect amount of pressure, not so little that it slips out of your hand and not so firmly that the glass breaks. You guide it to your lips at just the right angle so that the cool water flows directly into the mouth. The cool sensation of the liquid flowing over the tongue into the back portions of the mouth, and down the back of the throat is so satisfying. The heat of one's body begins to dissipate; thirst begins to quench.

The whole event—from seeing the glass of water on the table to the cool quenching of thirst—moves in one fluid motion, the demarcations between the different features is seamless.

But now let's step back from this textured description and turn each step into a description of neural data. The demarcation between different features also carries deeper differences of kind. In actuality, the process of drinking water from a glass includes several ontologically distinct features. An ontology is a kind of thing with its own essence. There are differences in kind at every step of the way.

First, you see the glass and immediately recognize it as a glass of water on the table. The glass itself is made up of the amorphous arrangement of silicone dioxide molecules holding the liquid form of H_2O . You also notice that the liquid form of H_2O is contained within the boundaries of the glass shaped, amorphously arranged silicon dioxide molecules. You recognize that both the glass and the water have some sort of identity in their solidity, as does your hand as it grasps the glass. Yet, contained in the information is a sense of the differences in their solidity, namely the glass is more solid than the water and the hand is less solid than the glass and more solid than the water.

But you also know that as your hand compresses the glass, the temperature and pressure sensors in your skin transform the coolness and pressure into an electrochemical signal; each signal travels separately up neurons running the length of the hand and arm and into the spinal column, where the electrochemical signal is transformed into a neurochemical signal, which travels across the synapse where it is again transformed into an electrochemical signal, moving upward to the brain, where it passes into memory regions of the brain, that somehow reconstructs all of these signals into a symbolic representation, and image of glass, coolness, wetness, liquid with water, each represented by a picture image and a word image of a "glass of water."

And somehow the symbolic representation stirs one to recognize that one is hot and thirsty, stirring desire for the cool glass of water. The desire is converted from symbol into signal to reach out beyond oneself to the physical glass, which has its own being and the physical liquid substance, which has its own being. Identity and difference are in play. The glass is not like the signal; the signal is not like the symbol. The desire is not experienced as either signal, or physical thing.

Identities and difference are picked up and lost along the way. At each level, something of the being is lost at each level of the transformation. It is a mistake to conflate a neuronal signal and a mental representation of the image of water glass. The signal transmitted between neurons is not the same kind of "thing" as the image of the water glass represented in the person's mind. Mental representations (whether a "picture" of the water glass or the word "water glass") and mental intentions are different from the signals of sensory input or motor outputs, which are different from the water glass. At each level something is transformed into something else—a water glass into a neuronal signal and the neuronal signal into a symbol. Each is of a different kind, different ontology. A rapidly beating pulse can be associated with anger, fear, excitement, desire for water, and many, many other features of our being-in-the-world.

It would be a mistake to flatten the whole process into a single kind of "thing," where even "thing" is the wrong word. Yet it is common to do so in the hype of neuroscience.

Some cognitive scientists conceptualize the mind and brain as computer-like, where all mental content originates in areas or networks of the brain. For them, this “flattening” is not a flattening at all, but a proper depiction of how the mind and brain work. Scholars in psychology, neuroscience, and philosophy have all pushed back against thinking that collapses all parts of mental representation into a flattened process (Lindquist *et al.*, 2012).

David Chalmers, philosopher of mind, explains that while there is information-processing occurring when someone has a conscious experience, they also have a simultaneous experience of what it feels like to have the conscious experience (Chalmers, 1996). Both the physical process of the mental state and the experience of what it’s like to be in that physical state make up the cognitive state, though the former could be measured and the latter cannot. Chalmers acknowledges that it is tempting to collapse both aspects of conscious experience into just one of the categories—usually the physical process that “causes” the cognitive state to come about—but Chalmers warns against giving into that temptation.

Neuroscientist Russell Poldrack warns against scientists explaining the results of their studies via the “reverse inference” fallacy (Poldrack, 2011), claiming that when a brain region “light up” it indicates a mental state is “located” there. Instead, the active area of the brain is likely one part of many areas of the brain involved, and may be correlated with a mental state but requires further evidence to conclude causality. Poldrack also argues that “the ability to accurately decode mental states or functions is fundamentally limited by the accuracy of the ontology that describes those mental entities.”² Poldrack argues that the ontology of, for example, working memory, is not well enough described as an ontology for us to know that working memory could be found in the physical processes of the brain.

THE PROBLEM OF ONTOLOGICAL FLATTENING

Despite the ontological complexity of a single physical motion, consumer NT companies are claiming that their technology can infer an individual’s productivity, stress levels, and sleep quality based on EEG data. NeuroSky claims that their NT can “reveal students’ innate strengths, guiding personalized course and major selection” (NeuroSky). They assume that life decisions such as choosing a college major can be based on neural data, as though physical brain processes can reveal personal strengths, weaknesses, interests, and other individual traits by reading body/brain states. These claims flatten the person to the output of their neural or biometric data. Similarly, claims that NT can “read minds” overstates what NT like EEG or BCI can do. Instead, consumer EEG is “distinguishing the neural response to a target stimulus from others” by detecting a neural response based on contextual clues and priming of the subject to think of something in particular (Wexler, 2019).

Because NT companies overstate the capabilities of EEG, the legal and ethical responses to these claims also overstate the technical and ontological capabilities of NTs such as EEG. For example, proponents of “neurorights” argue that neural data is highly sensitive and personal because the data originates in the brain and nervous system (Genser *et al.*, 2024).

Oddly enough, neurorights activists similarly flatten the ontology of the person to the physical processes of the brain. The drive to heighten privacy standards for neural data

² Poldrack, 2011.

assumes that neural data is the same as the person. But neural data is simply a reflection of a physical process occurring in the brain. It is a bridge too far to claim that neural data contains personal and sensitive information about an individual's thoughts, intentions, and fullness of the self, and so they accept the same flattened ontology. Thus, the primary ethical and legal solution to privacy to neural data is therefore not nearly as protective of the person as advertised.

Flattening complex and distinct ontologies into one measurable feature—neural data, which supposedly captures the human psyche—will change how we relate to each other. There is more to a person and what they are thinking, emoting, and valuing than the physical processes that led them to those thoughts, emotions, and values. Wholes are always greater than the sums of their parts. Our claim here is supported by physicalists who believe we cannot simply find “thought” or “emotion” in the brain, but instead must rely on a hierarchy of mechanisms that lead to “nonfundamental” explanations for mental phenomena (Craver, 2007). Not only are the physical brain processes more complex than an EEG can account for, but there are ontological features of cognitive activity that are not captured by the physical processes because they are distinct ontological kinds.

The problem is far deeper than what neurorights activists are considering. By ignoring the ontological complexity of mental states, we may leap to devastating conclusions about a person. When we take a complex phenomenological event with several ontological kinds and compress those kinds into one kind—the brain process—we misunderstand the events that are occurring. The approach to the ethical use of NT requires a realistic understanding of the technical and ontological capabilities of NT. Clarifying and even complicating these ontological differences will help deepen ethical and legal approaches to NT.

REFERENCES

- MCHUGH C. (2026), “Silicon Valley Wants to Put a Chip in Your Brain,” *Politico*.
- MAGEE P., IENCA M. & FARAHANY N. (2024), “Beyond neural data: Cognitive biometrics and mental privacy,” *Neuron*, 112, pp. 3017-3024.
- AMERICAN MEDICAL ASSOCIATION (2025), “Resolution 503: Safeguarding Neural Data Collected by NTs, Adopted by Consensus, AMA House of Delegates.”
- HOCHBERG L.R. *et al.* (2012), “Reach and grasp by people with tetraplegia using a neurally controlled robotic arm,” *Nature Letter*, 485, pp. 372-375.
- WILLETT F.R. (2023), “A high-performance speech neuroprosthesis,” *Nature*, 620, pp. 1031-1036.
- WEXLER A. (2019), “Separating neuroethics from neurohype,” *Nat Biotechnol*, 37(9), pp. 988-990, <https://doi.org/10.1038/s41587-019-0230-z>
- GENSER J., DAMIANOS S. & YUSTE, R. (2024), “Safeguarding Brain Data: Assessing the Privacy Practices Consumer Neurotechnology Companies,” *Neurorights Foundation*, pp. 1-100.
- GOERING S. *et al.* (2021), “Recommendations for Responsible Development and Application of Neurotechnologies,” *Neuroethics*, 14, pp. 365-386.
- LINDQUIST K.A. *et al.*, “The brain basis of emotion: A meta-analytic review,” *Behavioral Brain Science*, 35(3), pp. 121-143.
- CHALMERS D.J. (1996), *The Conscious Mind*, pp. 3-29.

POLDRACK R.A. (2011), “Inferring mental states from neuroimaging data: From reverse inference to large-scale decoding,” *Neuron*, 72(5), pp. 692-697.

PRECEDENCE RESEARCH (2026), “Brain Computer Interface Market,” <https://www.precedenceresearch.com/brain-computer-interface-market>

CRAVER C. (2007), *Explaining the Brain: Mechanisms and the Mosaic Unity of Neuroscience*, Chapter 1, pp. 15-16.