# A Symphony of Information: How Self-Harmonizing Patterns of Activity in Homeostatic Neural Networks Could Explain a Neural Correlate of the Mind

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## Abstract

*There are many theories that strive to explain how our minds emerge from something our brains are doing. Almost all of them assume that the transfer of complex information between various parts of the brain plays a key role, following pathways from sensory regions to "higher" regions like the prefrontal cortex. But despite decades of research, the evidence for complex information transfer over these pathways remains slim, and no good neural correlate for the mind has been found. We may need to explore new perspectives to advance the field. In this paper I will discuss one such perspective: a brain in which the information we experience as a mind can not move at all. Such a brain would need only parts and processes we can directly observe, yet could hold and process unique patterns of information with enough capacity to explain a nuanced human mind. I will first build the argument why I think it is unlikely our brain can transfer the quantities of complex information we experience as a mind. I then propose that the sequential activation of patterns of immobile information can be used instead to explain how our brain processes information. Simple processes would allow this activity to self-harmonize into sequences of informationally coherent patterns. Then, I will use these processes to argue that this allows for attention, associative thoughts, decision making, long-term and short-term memory, and can interact with emotional and motivational states. This new perspective has the advantage that it relies on no unobservable mechanisms or yet-to-be discovered capabilities of our nervous systems, and makes readily falsifiable predictions. As such, this is of interest to researchers in the fields of neuropsychology, consciousness, attention, decision making, and artificial intelligence.*

## Introduction

Recent decades have advanced our understanding of our physical nervous systems by such substantial steps that some scientists have proclaimed a "golden age of neuroscience". Meanwhile, researchers working in the social sciences collect ever more consistent and replicable data on our subjective experiences, disorders, and behaviours. But theories linking the two remain tentative at best. How does the brain process information? How does it recall a memory? How does it select specific sequences of information to think about? And how can it weigh options and make a choice? These are fundamental questions, with far-reaching consequences for almost every facet of our lives. This makes the answer to these questions one of the most important open questions in science: how do our own minds work?

The mind itself is not a well-defined concept, and the fields studying the mind use various terms interchangeably, like consciousness or awareness. Consciousness in particular is a loaded term that has taken on many meanings, from a clinical description (not unconscious) to a philosophical quality that could exist separate from a brain, so I will avoid it. Instead, I will use the word "mind" as shorthand for the complete patterns of information that we are aware of at each instant. These patterns consist of all external and internal stimuli we notice, but also all associations, thoughts, feelings, deliberations, and behaviours, and allows for varying degrees of awareness for each bit of information in the pattern.

If our minds are caused by something our brains are doing, these patterns must be physically held somewhere in our nervous systems. But where is it, and how is it held?

## Information in the brain

What we can clearly observe is a brain in which location matters. Specific areas in the brain are consistently associated with specific kinds of information, like visual areas, motor regions, fear centres, and even areas that seem dedicated to recognising specific objects like faces (Rangarajan et al., 2014), grammar (Broca, 1861) or syntax (Wernicke, 1874, Nasios, Dardiotis & Messinis, 2019). The exact location is not critical. It can vary per person, and if a region is damaged (especially during infancy) other parts of the brain can take over. But these regions stay constant per person, and activity correlates with our awareness of that kind of information. This happens for direct perception, but also imagined or recalled stimuli (Fulfors et al., 2018) or hallucinations (Mosely et al., 2013, Shergill et al., 2001). Researchers have managed to slightly "read" the mind of subjects from fMRI data, and were able to reconstruct visual movies subjects were watching from observed locations of brain activity (Nishimoto et al., 2011).

We also know these regions communicate. While fMRI has a poor temporal resolution, other techniques such as high density EEG or placing electrodes directly on neurons reveal clear sequences of activity (van Vugt et al., 2018). These have been labelled streams or pathways, and distinct streams are associated with different kinds of information. For example when processing a visual stimulus, distinct streams are observed from the primary visual cortex to specialised regions. Wurm and Carmazza (2022) propose three; a lateral pathway that responds to shapes and motions, a ventral one to colours and textures, and a dorsal stream to navigation or spatial organisation. These streams don't completely diverge, as the activity in the dorsal stream also predicts the recognition of objects in the ventral stream (Ayzenberg & Behrmann, 2022).

## Theories of the mind

Similar pathways can be drawn up for our other senses, like hearing (Langers et al., 2014). But where do these paths lead? Ideally we would be able to trace them to a central location where all streams terminate, and find where our minds reside. But it is not so simple. There is no single region in the brain that fulfills all criteria for such a "centre of consciousness". Some regions, like the prefrontal cortex, are slightly better connected to the rest of the brain than others, but interconnections exist between every part of the brain. Instead of a centralised brain where all roads lead to some kind of centre, we observe a decentralised brain where every part connects with virtually everywhere else (Catani & Thibault de Schotten, 2016).

This gives us a question to answer: if there is no obvious place for the information to come together in our brain, how can it result in our experience of a unified mind? One theory trying to answer this question is the Global Neuronal Workspace Theory (GNWT). It explains the regions in our brain associated with specific kinds of information as "processors" of that information. Through a process called "ignition", this information is relayed between regions and a central "hub" that then broadcasts this information to the entire brain (Mashour et al., 2020). In their view, the mind (or "consciousness" as they refer to it) is this broadcast, encoded in specific activation patterns of our neurons.

But the GNWT offers no clear method on how this might work. The issue lies in encoding complex information in activation patterns of single neurons. If information would be broadcast through the entire brain we should be able to measure this in some capacity, but to my knowledge we never have. Similarly, if the process of ignition could relay complex information we should be able to read some kind of code by implanting electrodes in the dedicated neurons hypothesised to transfer this information, but we don't observe this either. Instead researchers find neurons to fire in very regular patterns that vary only in their frequency or time between rapid bursts of activity (Connors & Gutnick, 1990) - a regularity that seems at odds with the expected encoding of large quantities of complex information.

The GNWT is not the only theory relying on activation patterns to transfer information. Seth and Baye (2022) list 22 current explanations of the mind, and most assume information is transferred this way, though none demonstrate how this transfer might occur. But our neurons are also clearly doing *something* when they send signals to each other. It is their activity we measure with an fMRI, and the activity in specific regions is clearly associated with specific information. But with no observable way for them to transmit complex information, what is it that they send? In this theory I will explore a new perspective. Instead of assuming our neurons transfer information, I propose we see their activity as the *activation of information*, held by the unmoving networks and regions in our brain.

## The case for immobile information

Before we can see how a brain might process information without moving it, we need to understand information itself. Let's define it as meaning held by something in the physical world. This can happen if something has options to *vary*. The more options (or configurations) something has to vary, the higher its capacity to hold information. Compare how much meaning can be held by a single letter "a", to the entire alphabet, to a specific sequence of letters like "apple". This meaning can come from a quality of the holder of information itself (the red glow in a piece of metal is caused by its high temperature) or be given to it by something else (a person typing letters). This happens through an *interaction*: variation in one thing changes the configuration of some other thing.

It does not matter what holds the information. Physical matter, electrons, magnetic fields or anything else; as long as it is able to vary and interact in some way it can be made to hold information. But for something to be good at it, its variation must be specific (i.e., each configuration means only one thing) and predictable (i.e., this configuration stays the same, or follows a predictable pattern like a cipher or knowable rate of change). Any introduction of unspecific or unpredictable variation, and the quality of the information decreases: we become less and less sure what the original meaning was. And once information is lost, it is lost for good. Destroyed information can never reassemble itself: we can't unburn a book.

If something holds meaning given to it by something else, its configuration can seem arbitrary. This is because the configuration does not really matter. Compare how different languages can convey the same meaning in very different ways. What matters is that the configurations are specific and predictable, and that they can interact in some way. If we assume the mind emerges from physical processes in our nervous systems, this is our challenge: find how the brain can vary in specific and predictable ways, and a way for these distinct configurations to interact with the input from our senses, neurochemical messengers and hormones, and each other. If we can find how the brain holds information first, everything else follows from there.

## Networks can hold information

The best candidates to hold information in our nervous systems are our neurons. Like a single letter, a single neuron can't hold a lot of information. But neurons can connect with many others to form *networks* consisting of large numbers of interconnected neurons. The number of connections (i.e., synapses) is estimated to be between 1.000 and 30.000 per neuron (Nowinski, 2024), and each synapse has its own individual strength determined by the number of neurotransmitters and receptors in the pre- and postsynaptic neuron. These neurotransmitters can be positive (excitatory) or negative (inhibitory). Both the structure of a network (how each neuron is interconnected) and the strength of each of the synapses can vary in specific and predictable ways: it can hold information. With an estimated 86 billion neurons in an adult human brain estimates for the total synapses are in the hundreds of trillions.

We know a mechanism by which the networks in our brain could get meaning: concurrence. Concurrence means that things happen at the same time. If two neurons that share a connection are active together, the synapse(s) connecting them increase in strength (Hebb, 1949). The opposite also happens. Connections that are not regularly used are removed in a process called pruning. Together, these deceptively simple systems etch information in our nervous systems. If we take an initially randomly (and therefore meaningless) connected brain, and subject it to repeated patterns of input, networks would emerge by themselves as specific combinations of neurons become interconnected. These networks would always activate for this specific pattern, and at no other time: they now hold a basic bit of information.

Concurrence works at any scale in the brain. It can explain how specific patterns of activation in our primary visual cortex come to mean edges or textures, and how networks for shapes or objects emerge from specific repeated patterns of those edges and textures. But it can also explain how this information becomes interlinked to the brain at large. Each time we experience something, specific patterns of activation arrive in our brain through our senses. These would become linked with each other, and any other information it concurs with in our brains. Our image for an object in our visual cortex would connect with the sound of that object in our auditory regions, and the name for it in our language centres. With enough repetition, This would create networks that span most of our brains, connecting relevant sensory, affective, and associative information: our concepts.

Concurrence is a cumulative process: the more often bits of information concur, the stronger the connection between the networks holding those bits will become. This can explain how concepts connect to other concepts through meaningful associations, with stronger connections for more closely associated concepts. This creates an associative web between every bit of information in our brains, with every bit connected most strongly to those most relevant to it. With sufficient experience, concurrence alone can explain how this web emerges - though feedback through neurochemical messengers (which we will get to) plays a massive role as well. This gives us the first part of our puzzle: a massive associative web of immobile information that spans our entire brains.

## But networks can't move

It is long established that humans think associatively, and it seems very likely related to this associative web of information. But it comes with a consequence: networks of neurons can't move, and thus the information they hold can't move either. Unless we find a system that can transfer information from one network to another, the information in our brains can't move at all. The obvious solution would be to encode this information in specific sequences of action potentials, but this would be far from trivial (Levitan and Kaczmarek, 2002):

1. When neurons receive signals, these are *all* added together as an ionic charge in the cell body with no way to determine where each signal came from.
2. When a neuron fires, *every* outgoing synapse its action potential travels past sends its specific signal to the cell it is connected to.
3. These synapses can change their strength as our networks update and we learn.
4. The thresholds for each neuron to fire can change depending on concentrations of neurochemical messengers that it might be sensitive to.

If a neuron has only a single input, like in our nerves, it can reliably copy an activation pattern from one end to the other. But the neurons in our brains are almost guaranteed to encounter unpredictable signals from many neurons at the same time, that are all lumped together. This would destroy any information encoded in these signals except for a total level of activity, which the neuron would propagate without direction through all its outgoing synapses. But these synapses are not random: their strength is determined by concurrence. They channel the flow of activation in meaningful ways; (much) less to irrelevant neurons and more to relevant ones. We can scale this up to entire networks of neurons firing together. One network may not be able to transmit the information it holds to another network, but it can do the next best thing - it can activate it.

## Harmonies of information

The previous section gave us two interesting notions. If we accept that networks of neurons can hold information, the process of concurrence can explain how these emerge and connect together in an associative web of information. Meanwhile, the process of activation can explain how this information interacts. As the neurons in one network fire, they will send streams of activation to the other networks they are connected to. These other networks may then start to fire too. If we ascend one level of abstraction, this means each bit of information can activate other bits of information *directly*, following the meaningful paths that emerged through concurrence.

This theory is built around this notion: the information in our brains is held by many networks of neurons, and they can activate each other. This may sound too simple to explain our minds, but it is surprisingly powerful. With a few well-attested additions, it is possible to explain not only how the brain could process information this way, but also our attention, behaviour, and even the choices we make. It will require us to rethink the nature of our mind, which I will save for last.

### Streams of activation can process information

The brain could process information without moving it by sending streams of activation from networks holding "less" processed information to networks holding "further" processed information. This would follow the paths that emerged from concurrence, and would look like the pathways we discussed earlier. For example, the three visual streams proposed by Wurm and Carmazza (2022) could be explained as streams of activation flowing from a specific pattern of input to networks meaning specific colours, textures, motions or spatial organisation. There would be no need to forward the entire image to these networks. Instead, activation could flow across a specific combination of networks that channel the flow to the network that recognises a specific object, like someone's face.

Processing information like this could happen in a single chain, but many networks would also be able to activate a common network together. This is useful as it allows us to combine information from many sources, like other sensory information or learned expectations, to support one conclusion. It is also very efficient. Each network needs to hold only the absolute minimum information to reliably channel (and modulate) the wave of activation to the correct next network for this to work. For example, a network meaning someone's face would need no information of what that face looks like. As long as it is connected in such a way that it is consistently activated when we see the face, and (hopefully) manages to send a stream of activation to other relevant networks like the one holding that person's name it can do all we need it to do.

But can we test this notion? Aside from measuring activation in various steps along the pathways, a brain like this would have particular difficulties that we could study. As no network could know where the activation it received came from, or which other networks are active, two streams flowing to different conclusions would cause errors - even if the subject is told to ignore one stream. This might explain the often repeated Stroop experiment, which found that subjects are much slower and have more errors identifying an ink colour of a word that spells a different colour than the same colour, or even a random word (Stroop, 1935). Something similar occurs when information from different senses conflict, like the McGurk effect (McGurk & MacDonald, 1976). When a different audio track was dubbed on video's of people speaking, the visual information of the moving lips influenced the audio that was perceived.

### These coalesce into harmonious patterns.

So we can explain how the brain processes information by reframing it as the selective activation of "more" processed information by "less" processed information. But this raises a new question: how does the brain know which information to process? We find no evidence of information being able to move, and know of no system that could scan the entire brain for activity. This means that the only things that can know which bits of information are active in the brain are those bits themselves. But to accurately process information, a system must have access to all the active information in our brain. This leaves only one solution: each pattern of current activation in the entire brain must activate the next pattern together.

To explain this, we need two elements. The first we already covered and is hardly controversial: the associative web of information in our brains. The second is a new introduction in this theory: the *harmony*. Each pattern of active information would consist of many bits of information that all have their own connections. Some of these connections will be shared: multiple active bits of information sending activation to the same networks. As activation is cumulative, these are likely to become highly active. This then activates all bits of information most relevant to them too; bits that might share more connections. Each network in a pattern of information will send activation to all its connections, but most will be received by the best-fitting, mutually reinforcing, and informationally coherent set of networks.

But what of all the other, discordant activity? For harmonies to explain the mind we need not just explain why the pattern of information that we experience as our mind is active, but also why everything else is not. The brain we discussed so far would not be able to discern this; in fact, as each network would send activation to all its connections, I would expect avalanches of brain activity to cause constant epileptic seizures. The simplest way to resolve this would be to include a system that keeps total brain activity on a roughly homeostatic level. If every neuron in the brain would become slightly less excitable as total activity increases, something very interesting would happen: a *competition of information*.

As one harmony swells, all brain activity would be dampened. And since the harmonious bits would likely be more active than discordant bits, they can remain active while the discordant networks (unless constantly activated by persistent stimuli) are drowned out. This would result in a positive feedback loop. Even if two harmonies would be nearly identical in strength, the strongest would activate slightly more information relevant to it. This would tip the balance further in its favour, and before long it would take over most available brain activity. Without any oversight, most activity in our brain would coalesce in a single, harmonious pattern of information: our attention.

I like music as an analogy for this. We could imagine the brain as an ensemble of improvising musicians that can all hear what the others are playing. They will join in with the specific parts for their instrument (the information held in their networks) if they hear a harmony playing they could add to (the networks receive streams of activation). This would cause the harmony to swell, and change, which might induce other musicians to join in with something that fits it, and drown out musicians playing something else. Harmony would lead to harmony as new musicians join in and others stop playing. A symphony of information would emerge that would produce a constant stream of informationally coherent patterns of information: the titular symphony of the mind.

This only works if brain activity is kept in rough homeostasis. Luckily, there are long-standing observations that attest to this. For one, the brain's metabolic rate remains remarkably stable, regardless of the task (Sokolof et al, 1955). This can't be explained by a high "overhead" cost of having a brain, as about 75% of the energy used by the brain is directly related to the signalling of neurons (Atwell and Laughlin, 2001). Both can only be true if the total activity of neurons is kept stable. This is visible in fMRI studies, where as brain activity in one region increases, the activity in other regions decreases (Raichle, 2010). This homeostasis could be kept by simple systems, responding to things like a decrease in blood oxygen (which immediately reduces synthesis of excitatory neurotransmitters serotonin and acetylcholine, McKenna et al., 2011), helped by inhibitory neurotransmitters like GABA (released by one in five neurons in several cortical areas (Naegele and Barnstable, 1989)), or many systems together.

## Directing the mind

Without relying on any unobservable complexity we now have a theoretical brain with many of the capabilities we experience in our minds. The competition of information can explain how the brain trends towards a single harmonious pattern of information at each instant to create our attention. And the resulting sequence of harmonies can explain everything else. Our meandering thoughts, jumping from topic to topic as harmonies of information activate new ones directly. But also our decisions, with two possible paths competing; our learned strategies for self-control, triggered by something we dislike; our memories, as we traverse the immobile networks in our brain to find the information we are looking for; and the execution of our behaviours, which can be explained as patterns of brain activity that happen to be connected to muscles.

This is not bad for activity flowing through a web of immobile information. But we lack something important before we can be confident this can explain the mind: direction. The web in our brains is relatively stable, but we constantly think different things. This can be partly explained by varying inputs. Different stimuli activate different patterns of information, which would result in different harmonies even in the same web. You could explain quite simple nervous systems this way. But our minds are not purely reactive: even for the exact same inputs we can think, perceive, or do vastly different things. If our minds are caused by a competition of information, there are factors at play that tip the balance one way or another.

### Better connected information has an advantage

The simplest is the interaction between the connectedness of each bit of information and its activity. Highly active networks, like those caused by highly salient stimuli (such as loud noises), would have an easier time starting a harmony than not very active networks. This can explain why it is so much easier to concentrate (keep your current sequence of harmonies going) in a quiet library than a noisy building site. But the impact of a bit of information is also determined by the strength of its connections. The stronger its connections, the fewer times it needs to fire to send the same amount of activity. This is best exemplified by a very strongly connected bit of information in your entire brain: the sound of our own name.

A famous experiment demonstrates this interaction neatly: the cocktail party effect (Cherry, 1953). We are in conversation at a party, and understand only the one conversation we are in. Everything else is a bare murmur. But suddenly we hear our name mentioned a little further away. Were we processing every conversation in the room, just in case our name was mentioned? This would require immense complexity to manage. A simpler answer is that the conversation we were following is in harmony with the activity in your brain, and this harmony outcompetes every discordant conversation. Until someone mentioned our name, which is a bit of information *so* well connected that it can start a harmony by itself - one that instantly outcompeted the conversation you were following. Our attention was grabbed.

### Recently activated information is enhanced

A second factor that influences the information in our brain is our short-term memory. With unmoving information this can not be a separate system, so this must modify the sensitivity of our networks themselves. Specifically, recently activated information must stay easier to activate for a short while. This would create a unique balance of information for every situation we find ourselves in, and prevent us from falling in a loop where the same environmental stimuli cause the same flows of activation to repeat. It would also allow for a working memory, as recently activated information related to our exact situation or problem would remain easier to access.

The most likely system for this is called *potentiation*. This is a process that happens in every synapse, where recent stimulation causes a calcium buildup temporarily strengthening it. There appear to be multiple systems, some working in the millisecond to second range, some in the minute range, and long-term potentiation (LTP) that lasts for hours up to two days (Nichols et al., 2001, Bliss and Lømo, 1973). This even works associatively, enhancing all simultaneously activated synapses of a neuron, not just the one that was activated enough times to cause long-term potentiation (Barrionuevo and Brown, 1983). This would temporarily enhance entire networks, and with it the exact patterns of information that were recently activated, for the timeframes that match our experience of a working and short-term memory.

### Neurochemical messengers can create (emotional) states and motivation

But there is one very impactful system we have not covered yet: the suite of neurotransmitters and neurohormones that can also float *between* the networks in our brains. We have well over 50 different ones (some estimates go over 100) that influence the sensitivity or activity patterns of neurons that have receptors to them (Leviatan and Kaczmarek, 2001). These can explain our *states*, like being hungry or seeking status. These can integrate in our web of information through concurrence; neurons sensitive to a specific chemical would concur with relevant information for that state, and get incorporated in those networks. As the balance of these neurochemicals then changes, this specific information would be weighted differently.

This allows signals from our bodies (like an increase in hunger hormones in response to low blood sugar) to interact with the information in our brains by giving all food-seeking related information a competitive edge. But it also allows networks to influence many other networks at once, even those not directly connected to it, by activating specific neurotransmitter releasing cells. This could cause positive feedback loops, which may contribute to the episodic nature of disorders like depression. For example, negatively associated information could cause a certain balance of neurotransmitters to release that makes other negatively associated information more sensitive, starting a downward spiral.

It is out of scope for this paper to list every way in which neurochemicals could interact with the information in our brains, but one category deserves special mention: the catecholamines dopamine and (nor)epinephrine. If we have brains to generate evolutionary advantageous behaviour for us, these bias our brains to the information most likely to impact our evolutionary success: what we should pursue, and what we should avoid. Instead of (or besides) influencing specific bits of information, I suspect these modulate all information by boosting any information *that is currently active*. This can explain motivation, feedback, learning and result prediction in one system.

If a current harmony causes dopamine or norepinephrine to increase, it would be strengthened and drowns out discordant information. But if it doesn't, it would slowly peter off. This gives discordant information the chance to start a new harmony. We'd get distracted, and go do or think about something else. The release of catecholamines in motivation, feedback and result prediction is well established. When animals are trained by giving them a food reward coupled with an unrelated stimulus, this causes a dopamine spike (intrinsic motivation for food). If the stimulus is later repeated, there is a dopamine spike in expectation of the food reward (result prediction). If this fails to materialise, dopamine releasing neurons are suppressed in feedback (Speranza et al., 2021).

For this to work in this theory, the brain must be balanced slightly dampened, so that any sequence of harmonies peters off eventually without a boost. This seems plausible, as the synthesis of new catecholamines is self-balancing (Leviatan and Kaczimarek, 2001). There also needs to be a way to influence only the currently active information. For norepinephrine this has been observed in a rat's hippocampus. It suppresses the process that normally inhibits a neuron after firing, and causes only already active neurons to fire more rapidly (Jones and Adams, 1987). But it could also work directly. Dopamine has been observed to increase the excitability of neurons with certain receptors for them while inhibiting others (Jacob and Nienborg, 2018). These are very common, and account for as much as 60% of all neurons in some regions of the brain (Tritsch and Sabatini, 2012). This would increase the sensitivity of all information, which would help a sequence of harmonies continue.

## Conclusion

If our minds are a form of information, finding out exactly how our nervous systems hold and process this information may be the most important question in answering what it means to be human. The patterns of information that emerge from our brains are not just what we think, but also what we perceive, feel, choose, and do. Our *entire* realities play out completely inside our skulls. As this is such an important question, it pays to have an open mind to the various answers we would consider accepting. The more fleshed-out perspectives we have, the better we can target our studies to eliminate them, and the more certain we can be that our final contender will be (close to) the correct one.

In this theory I proposed one such perspective: a brain in which no information is transferred but information is instead processed by selectively activating immobile networks of neurons. I think this perspective has merit for three reasons. Most importantly, it works with only observable and well-understood parts and processes in the brain. While there is certainly more to learn about our nervous systems, I think it is unlikely we missed the big capabilities other theories rely on. Second, the observable nature of this theory results in measurable predictions. If it is wrong, we will know. And finally, it's simple. It works using a limited number of simple processes that deliver complex results just by the sheer number of their repetitions. This is the type of complexity we would expect to emerge from evolution: simple processes that could be slightly modified, repurposed, or expanded by each subsequent generation.

The real strength of this theory lies in the clear interactions between the information stored long-term in our synapses, the modifying effect of our short-term or working memory on these synapses, and the full suite of neurochemical messengers that directly influence specific neurons. We have well-documented evidence that these influence immobile networks of neurons. How these interact in the self-harmonizing competition of information can explain nuanced human characteristics, like attention,. motivation, instinctual behaviours, emotional states, complex reasoning, addiction, and more. This is a big advantage over theories that rely on the transfer of information, that either don't account for these interactions or need currently unobservable systems to manage them.

There are limitations too. In this paper I have mostly focussed on excitatory synapses and (long-term) potentiation, but synapses can also be inhibitory and networks can be temporarily depressed. I have also only scratched the surface of all the ways in which neurochemical messengers can influence and modulate the networks in our nervous systems. This needs to be accounted for before we can fully understand how our information is managed. But these additions should interact in the same ways as the ones we did discuss, and only serve to add more capabilities and nuance to the nervous system.

The theory also lacks validation, and more research is needed. On a neuronal level, we should be able to test the existence of a homeostasis of brain activity, or dispersed nature of our concepts. On a cognitive level we could test if our attention is the result of a competition of information by measuring if a harmonious pattern is more likely to win than discordant bits of equal salience and connectedness. And on an awareness level we could test if it is indeed impossible to be repeatedly aware of a specific thing without the same networks lighting up consistently in an fMRI.

But the biggest difficulty is perhaps mostly conceptual. Without information being able to move, our awareness must be caused directly by the patterns of active information in our entire brains. There can be no “centre of consciousness”, as there would be no way to move the information there, and nothing that would know which information is active but the bits of information themselves. This is a break from a long tradition searching for such a centre, and, though we have never found evidence for one, many still assume we will one day. This might be compounded by our reluctance to accept that our minds could be caused directly by firing neurons. Moving the mind to an unobservable centre might feel more appropriate, but would do little to solve our problem: this centre would (presumably) still be made from neurons.

So do our minds emerge as a symphony of self-harmonizing information activated in place throughout our brains? A lot more research is needed before we can be sure. But the predictions made in this theory should be readily falsifiable, with technology that we have observing parts we know exist. Until then it’s just a new perspective; one where we emerge from harmony after harmony as our brains continuously play the symphony of our minds.

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