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integrating neural models of consciousness and of the web

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ABSTRACT

The world-wide web has been conceptualized as a global brain for humanity due to its neural network-like organization. To determine whether this global brain could exhibit features associated with consciousness, we review three neuroscientific theories of consciousness: information integration, adaptive resonance and global workspace. These theories propose that conscious states are characterized by a globally circulating, resonant pattern of activity that is sufficiently coherent to be examined and reflected upon. We then propose a correspondence between this notion and Teilhard de Chardin's concept of the noosphere as a forum for collective thinking, and explore some implications of this self-organizing dynamics for the evolution of shared, global understanding.

KEYWORDS

noosphere, global brain, consciousness, world-wide web

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1 THE WEB AS A GLOBAL BRAIN

A recurrent metaphor used to understand the long-term development of the World-Wide Web is that of a *global brain* [8, 12, 18], i.e. a collective central nervous system for humankind. There are several aspects to this analogy.

First, the web, and more generally the Internet, is a network of communication links that transfer signals between the different elements of the global superorganism [14, 23]—the system formed by individuals, organizations and machines collectively—thus helping them to function in a coordinated manner. Second, the web is a repository for nearly the whole of human knowledge, thus acting like a collective memory for the species. Third, the knowledge in the web is structured like an associative network of documents connected by hyperlinks [2]. This is similar to the associative structure of semantic memory in the brain. Fourth, additional links are created either manually or through recommendation systems that learn from the way documents are being used in the same context in order to suggest related documents. This is similar to the mechanism of Hebbian learning [16, 17] in the brain, which can be summarized as "neurons (documents) that fire (are used) together, wire (become linked) together". Finally, when the knowledge in the web is structured according to a consensual ontology, as proposed for the Semantic Web [2], its links can be used to perform automatic inferences and thus answer queries across distributed memory elements.

The theories of distributed cognition [7] and of the extended mind [5] have shown that these brain-like functions are not just metaphorical: the information stored, processed and propagated across the web effectively extends our individual and collective mental capabilities. Thus, they are becoming increasingly integrated with the processes inside our brains—a development that may reach its apogee with direct brain-computer interfaces [10], as envisaged e.g. by Neuralink, the company recently founded by Elon Musk.

2 CONSCIOUSNESS

Still, there is one crucial feature of the brain that does not have a clear equivalent in the web: *consciousness*. We will here define consciousness as the ability to monitor, examine and, if necessary, intervene in mental processes [13]. In contrast, subconscious processes happen automatically: information propagates immediately from stimulus (input, data) to response (output, interpretation) in a direct, reflex-like manner, leaving no occasion for assessment or intervention. Conscious processes, on the other hand, allow intermediate reflection, i.e. the conception, consideration and evaluation of different possibilities for interpretations or conclusions. Thus, consciousness is the crucial condition for voluntary control or "free will": the ability to consider and decide between different courses of action. Note that this understanding corresponds to what the philosopher Ned Block has called "access consciousness" [3], which he distinguished from "phenomenal consciousness" or what we prefer to call "subjective experience", a topic we will not address in this paper.

Applied at the collective, global level, this conception of reflective consciousness corresponds to what the visionary scientist and theologian Teilhard de Chardin has called the "noosphere": the sphere of thought that envelops the Earth in which new ideas are formed through discussion [19, 21, 24]. Anticipating to some degree the birth of the web, Teilhard described the emerging global network of communications with the same metaphor of a "brain of brains" that would allow humanity and its technological support systems to reflect on itself. However, Teilhard's writings on this topic have been criticized for being vague, obscure and mystical, lacking a scientific foundation. Given our presently much more advanced understanding of both the web and the brain, we now

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seem to be in a position to develop a clear foundation. For that, we can draw inspiration from the most recent neuroscientific theories of consciousness in the brain.

3 THE NEUROSCIENCE OF CONSCIOUSNESS

Giulio Tononi's *Information Integration Theory* of consciousness [26] is most directly extendible to cognition outside the human brain. It observes that consciousness is characterized by the fact that activity in different parts of the brain is strongly correlated or coherent. The degree of coherence can be determined using measures of mutual information between activities in different regions, leading to the overall information integration function Phi. Tononi posits that any network, organic or not, of which the states of the components change in a sufficiently integrated way exhibits consciousness. Since the definition of Phi merely depends on probability distributions for the states of the different components, it can in principle be computed for the web.

On the other hand, according to this theory, purely physical systems, such as crystals or electromagnetic fields, can in principle also exhibit high information integration, and therefore consciousness. We have proposed a related (but different) panpsychic perspective in earlier work [15], noting that physical systems can indeed be conceived as exhibiting mind-like features in an abstract sense. However, here we wish to focus on the more concrete "access" interpretation of consciousness as the capability for self-monitoring and reflection. This does not seem to have an equivalent in purely physical systems, making information integration insufficient as an explanation.

Adaptive Resonance Theory, developed by Stephen Grossberg and Gail Carpenter [4, 9], proposes that conscious states in the brain are characterized by activation circulating back and forth between different neural regions, and in particular between lower perceptual layers (incoming data) and higher level concepts that explain or predict the perceptions (potential interpretations). This self-reinforcing "resonance" between zones in the brain's neural network produces a pattern of activation that is sufficiently intense and stable—yet fluid—to create a clear focus of attention and eventually to become assimilated into long-term memory, while still being able to adapt quickly to novel input. This suggests that the coherence of conscious brain states is produced by circulating signals that keep activity in different components aligned and synchronized.

This could be applied to the web by looking for coherence in the dynamics of message postings. As a possible illustration, Ceyda Sanli and Renaud Lambiotte have examined the temporal pattern of tweets on a certain topic (identified by a hashtag), using a measure developed for neural spike trains in the brain [20]. They found that for topics that became a focus of collective attention (such as national elections) the pattern was regular rather than "bursty", suggesting that in this case tweets elicited further tweets so quickly that the train of signals became self-sustaining.

The last neuroscientific theory of consciousness we wish to review, the *Global Neuronal Workspace*, was proposed by Bernard Baars [1] and elaborated in particular by Stanislas Dehaene [6]. Its main idea is that neural activity becomes conscious when it is "broadcasted" across the global workspace, which is a central crossroads of neural connections in the brain. As such, this activity can be examined by different more specialized brain modules that otherwise have few connections. The global workspace functions like a public forum or shared medium where these modules, functioning as the agents that constitute the "society of mind", can enter in a conversation so as to come to a consensus on what to do. Broadcasting requires widespread and intense activation that "reverberates" or circulates across the workspace network. For a subconscious stimulus to become conscious the initial activation must be non-linearly amplified until it crosses the threshold for "ignition" [6], when the circulating activity is strong enough to become self-sustaining and reach all parts of the workspace. That allows it to be maintained for a while in working memory, where it can now be consciously examined and processed by more specialized brain circuits. This theory confirms that conscious activity is characterized by widespread, coherent circulation, but adds that this allows it to be scrutinized and if necessary redirected, thus supporting the access perspective.

4 NOOSPHERIC CONSCIOUSNESS

We are now in a position to distinguish different types of distributed consciousness supported by the web. First, we will envisage the different agents (human as well as technological) communicating via the web as the equivalent of neuronal circuits in the brain, and their communications as equivalent to the "action potentials" or "spikes" transmitted from neuron to neuron. The network structure of the web then becomes equivalent to the associative network in which information is stored for use by cognitive processes of retrieval and inference. That means that it functions as a *collective memory:* shared knowledge available in websites, databases and computer programs that can be consulted and used when needed, but is otherwise passive.

Information propagates immediately and automatically via the existing links, for example when we download a book, watch the video produced by a remote camera, or order a pizza. This information is retrieved, used, and occasionally updated, but without active reflection or discussion. For example, we can find any info we need about tuberculosis, including ways to deal with it, but are at the moment not further interrogating that knowledge. Similarly, when we send an email, that message is transmitted automatically to the right address, without anyone wondering what path it took to get there. This is undoubtedly a form of distributed cognition, extending the information processing inside our individual minds across the globe. However, from the present perspective this type of process is not conscious, since it is not being examined, pondered or circulated. Therefore, the information that is standardly available on the web can be viewed as the noospheric equivalent of the subconscious.

Noospheric consciousness would then refer to those ideas that are actively circulating, being propagated from person to person or from webpage to webpage, while being scrutinized and discussed. That means that these ideas are likely to be questioned, rejected or elaborated before they become accepted as common knowledge or as agreed-upon strategy. For example, global society is presently discussing the different factors that promote the COVID-19 pandemic as well as the strategies to most efficiently combat it. Thus,

we can say that at the moment, the global brain is consciously attending to COVID-19. On the other hand, it is not consciously attending to tuberculosis or to billions of other pieces of knowledge and processes that are available for retrieval or use, but that remain in the background.

The noosphere then is the equivalent of a *global workspace* for the global brain. The web, and in particular social media, provides the shared forum where inputs from many different, more specialized sources come together, complementing, contradicting or confirming each other, while circulating between individuals and systems. Ideas that are passed on, discussed and elaborated sufficiently frequently may start to "resonate" or "reverberate", thus being amplified until they reach "ignition", i.e. widespread, global circulation that maintains the overall pattern for a while in global "working memory".

5 SELF-ORGANIZATION OF NOOSPHERIC PATTERNS

As elegantly modelled by the mathematical formalism of Chemical Organization Theory, a network of circulating processes tends to self-organize in a self-maintaining, autopoietic pattern [11]. This pattern creates coherence between the different processes, confirming the *information integration theory* of consciousness. It does this by amplifying mutually supporting or synergetic ideas, as noted by the *adaptive resonance theory* of consciousness, while eliminating or filtering out ideas inconsistent with this emerging pattern. Once the pattern has consolidated in this way, it becomes common knowledge or general opinion, and is eventually registered in long-term memory (e.g. a Wikipedia page about the causes of COVID-19, or a new protocol for email transmission). Then, it no longer needs to be discussed and can move to the background. Thus, it becomes part of the collective subconscious—the implicit knowledge and processing we all have access to.

However, the results of this process can be situated on a continuum stretching between two poles. At the pole of *closed consciousness,* ideas organize in a collective theory or narrative that is impervious to new ideas. This is a strongly self-confirming pattern of activity. It rejects or filters out all information inconsistent with its assumptions, while filling in any gaps by postulating ad hoc explanations. Examples are fundamentalist religions, cults, conspiracy theories, and certain rigid ideologies and totalitarian systems, like the one that dominated the former Soviet Union. The danger is that when inconsistencies accumulate, the pressure to change becomes so strong that the pattern no longer is able to deal with the new conditions. As a result, the whole system may eventually come crashing down, as happened with the Soviet Union.

At the pole of *open consciousness,* the consensual narrative emerging from discussion continues assimilating any new observations that may appear, so that the pattern is constantly evolving and adapting to the circumstances. The system is resilient or evolvable. The mental equivalent is more like a fluid "stream of consciousness" rather than the kind of obsessive thoughts that characterize rumination, however, while still consolidating and registering the really good ideas in memory. Here, the Noosphere truly functions as a global forum of conversation and reflection. An example of such a dynamic is the open-ended discussion that characterizes the scientific enterprise and that inspired Tim Berners-Lee to create the web as a medium to facilitate such information exchange.

6 TOWARDS SELF-AWARENESS OF THE NOOSPHERE

To ensure that collective consciousness remains open, we may need the more advanced stage of *noospheric self-awareness.* Here, the autopoietic organization formed by ideas circulating and being discussed has become aware of its own dynamics, so that it can intervene to make its collective thought processes more effective. This is necessary in particular to prevent premature closure, which would otherwise keep local narratives from assimilating ideas coming from other sources, thus maintaining conflicts and divisions, while preventing global information integration. The present discussion on how to redesign the propagation of messages on social media so as to mitigate the production of fake news, echo chambers and polarization [22] is an example of such emerging noospheric meta-awareness. Another example is the noopolitik for the noosphere strategy proposed by Ronfeldt and Arquilla [19], in which they argue for the creation and dissemination of narratives that are more encompassing and inclusive in order to prevent conflict and foster a more open, caring and sustainable society.

More broadly, the international Human Energy Project [25] aims at fostering such noospheric self-awareness by:

- clarifying what the noosphere is and how it functions,
- developing a compelling narrative (called "the Third Story") about its origin and evolution,
- formulating strategies for its healthy development towards open, self-aware consciousness, and
- disseminating such insights towards the general public via videos, the web and social media.

We propose the present paper as a contribution to achieving these objectives. We hope that it will inspire other researchers to investigate web-supported, global consciousness not just as a metaphor or as a spiritual ideal, but as a concrete, real-world phenomenon that can be observed, modelled and eventually engineered to function more effectively.

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REFERENCES

[1] Baars, B.J. 2007. The global workspace theory of consciousness. *The Blackwell companion to consciousness.* (2007), 236–246.
[2] Berners-Lee, T. and Fischetti, M. 1999. *Weaving the Web: The Original Design and Ultimate Destiny of the World Wide Web by Its Inventor.* Harper San Francisco.
[3] Block, N. 1995. On a confusion about a function of consciousness. *Behavioral and Brain Sciences.* 18, 2 (1995), 227–287.
[4] Carpenter, G.A. and Grossberg, S. 2010. *Adaptive resonance theory.*
[5] Clark, A. and Chalmers, D., J. 1998. The extended mind. *Analysis.* 58, 1 (1998), 7–19.
[6] Dehaene, S. 2014. *Consciousness and the Brain: Deciphering How the Brain Codes Our Thoughts.* Penguin.
[7] Dror, I.E. and Harnad, S.R. 2008. *Cognition Distributed: How Cognitive Technology Extends Our Minds.* John Benjamins Publishing.
[8] Goertzel, B. 2002. Creating Internet Intelligence: Wild computing, distributed digital consciousness, and the emerging global brain. Kluwer Academic/Plenum Publishers.

[9] Grossberg, S. 2013. Adaptive Resonance Theory: How a brain learns to consciously attend, learn, and recognize a changing world. *Neural Networks*. 37, (Jan. 2013), 1–47. DOI:https://doi.org/10.1016/j.neunet.2012.09.017.

[10] He, B. *et al.* 2013. Brain–Computer Interfaces. *Neural Engineering*. B. He, ed. Springer US. 87–151.

[11] Heylighen, F. *et al.* 2015. *Chemical Organization Theory as a modeling framework for self-organization, autopoiesis and resilience*. Technical Report #2015– 01.

[12] Heylighen, F. 2011. Conceptions of a Global Brain: an historical review. *Evolution: Cosmic, Biological, and Social, eds. Grinin, L. E., Carneiro, R. L., Korotayev A. V., Spier F.* Uchitel Publishing. 274–289.

[13] Heylighen, F. 2020. *Mind, Brain and Body. An evolutionary perspective on the human condition*. Technical Report #2020– 01.

[14] Heylighen, F. 2007. The Global Superorganism: an evolutionary-cybernetic model of the emerging network society. *Social Evolution & History*. 6, 1 (2007), 58–119.

[15] Heylighen, F. and Beigi, S. 2016. Mind outside Brain: a radically non-dualist foundation for distributed cognition. *Socially Extended Epistemology*. A. Clark, ed. Oxford University Press.

[16] Heylighen, F. and Bollen, J. 2002. Hebbian Algorithms for a Digital Library Recommendation System. *International Conference on Parallel Processing* (Los Alamitos, CA, USA, 2002), 439.

[17] Heylighen, F. and Bollen, J. 1996. The World-Wide Web as a Super-Brain: from metaphor to model. *Cybernetics and Systems' 96* (1996).

[18] Heylighen, F. and Lenartowicz, M. 2016. The Global Brain as a model of the future information society: An introduction to the special issue. *Technological Forecasting and Social Change*. (2016).

[19] Ronfeldt, D. and Arquilla, J. 2018. *The Continuing Promise of the Noösphere and Noöpolitik: Twenty Years After*. Technical Report #ID 3259425. Social Science Research Network.

[20] Sanlı, C. and Lambiotte, R. 2015. Local variation of hashtag spike trains and popularity in Twitter. *PloS one*. 10, 7 (2015), e0131704.

[21] Shoshitaishvili, B. 2021. From Anthropocene to Noosphere: The Great Acceleration. *Earth's Future*. 9, 2 (2021), e2020EF001917. DOI:https://doi.org/10.1029/2020EF001917.

[22] Spohr, D. 2017. Fake news and ideological polarization: Filter bubbles and selective exposure on social media. *Business Information Review*. 34, 3 (Sep. 2017), 150–160. DOI:https://doi.org/10.1177/0266382117722446.

[23] Stock, G. 1993. *Metaman: The Merging of Humans and Machines into a Global Superorganism*. Simon & Schuster.

[24] Teilhard de Chardin, P. 1959. The Formation of the Noosphere. *The Future of Man*. Image Books Doubleday. 165.

[25] The Human Energy Project: https://humanenergy.io/. Accessed: 2021-05-16.

[26] Tononi, G. 2008. Consciousness as integrated information: a provisional manifesto. *The Biological Bulletin*. 215, 3 (2008), 216–242.