Global Brain: Foundations of a Distributed Singularity

Cadell Last

Introduction

Evolutionary theory is a system of abstract knowledge helping humans explain the meaning of change as time in a mechanistic paradigm. However, in meditating on evolutionary theory we rarely consider the fact that human civilization in its structural phase of globalization is perhaps the most obvious example of a rapidly changing system. Here we may think of *globalization as an evolutionary process driven by human civilization* (Modelski et al. 2007). In concrete terms we here define globalization as a real distributed force reducing the constraints of space–time–matter–energy that have previously prevented global cooperation and coordination between all humans (Heylighen 2007a). The force of globalization allows for (but does not dictate deterministically) the possibility of cooperation and coordination via the emergence of hyper-connectivity and international organizations mediated by new forms of virtuality with physical effects.

When we speak of new forms of virtuality with physical effects we are mostly referring to the emergence of the universal medium of the Internet (or Internet of Things), a network of people and information-communication technologies (ICT) (Atzori et al. 2010; Sahal and Simmons 2011; Xia et al. 2012). The Internet has largely been responsible for the acceleration of the process of globalization by allowing humans to globally and instantaneously send and receive information that can be retained indefinitely and maintained at negligible cost. Consequently, the growth of this network has allowed the emergence and increased future potential for more complex levels of cooperation and integration. In this chapter, I argue that this process has the potential to allow our species to transition towards a higher level of

C. Last (✉)
Systems Research, Bertalanffy Center for the Study of Systems Science, Vienna, Austria
e-mail: cadell.last@gmail.com

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system-organization within the next half-century. Throughout this work we will refer to such a phenomenon as a "Global Brain".

History

Scientific and philosophical theorists throughout the modern age have developed concepts related to the future emergence of higher planetary intelligence or consciousness. For example, idealist philosophers Immanuel Kant and Georg Hegel both theorized about the immanence of a planetary civilization. Kant argued that human civilization was destined for universal peace in an international order transcending nation-states (Kant 1784), and Hegel argued that human civilization was destined for the realization of highest aesthetic spirit in art, religion, and philosophy (Hegel 1979, 1807). For Kant the realization of such an order was related to progressive processes of individual rights for freedom, and for Hegel the realization of such an order was related to the historical structure of reason itself (its "cunning").

In the twentieth century, these ideas received speculative dimensions deeply influenced by the revolution of evolutionary theory. For example, paleontologist Pierre Teilhard de Chardin proposed the concept of a "noosphere" describing a future planetary sphere of consciousness emerging from the integration of all human minds (Teilhard de Chardin 1969); and general polymath H. G. Wells proposed the concept of a "world brain" describing a global encyclopedia that automatically updated and synthesized all knowledge making it accessible to all humans (Wells 1938). Teilhard de Chardin's concept has influenced many later thinkers related to New Age spirituality and integrated cosmic evolutionary philosophies which speculate about teleological visions of human mental process. Well's concept has in some sense been realized or is being realized with the recent emergence of the Internet and websites like Wikipedia and Google.

Towards the more modern speculative conceptions of our contemporary global world physicist Peter Russell first introduced the specific term "Global Brain" in an influential book of the same title hypothesizing that the information age would be most fundamentally characterized by the formation of a planetary brain-like structure which would enable a utopian spiritual evolution towards transcendence of subject–object division (Russell 1982). Cyberneticist Valentin Turchin significantly influenced contemporary Global Brain theory with the description of how evolutionary history was structured by new levels of control and cognition and that such a new level of control and cognition could emerge on a planetary level. From Turchin's point of view a planetary level of control and cognition would allow for the coordination of the human superorganism as one "super-being" (Turchin 1977).

Since the Internet emerged as a phenomenon with global influence the modern conceptions of Global Brain theory have been marked by the description of real technological mechanisms (information-communication technologies) to realize such a global entity. In the mid-to-late 1990s theorists such as physicist Gottfried

Mayer-Kress (1995), systems theorist Joel De Rosnay (2000), cyberneticist Francis Heylighen, experimental psychologist Johan Bollen (1996) and mathematician Ben Goertzel (2001) all started to propose ideas related to the immanence of the Internet's development. Theorists like Francis Heylighen and Ben Goertzel, in particular, have made sustained and long-lasting contributions to this literature. Heylighen has developed the idea that the Global Brain will become a medium allowing for the integration of all human knowledge, like science, philosophy, art, and spirituality (Heylighen 2018); and Goertzel has developed the idea that the Global Brain will become a medium integrating all socioeconomic and political activities related to the emergence of a sharing economy (2015).

Metaphor

Metaphors are commonly used by philosophers and scientists in order to better conceptualize phenomena that are highly abstract and complex. For example, when describing the way in which the capitalist economy functioned, economics theorist Adam Smith used the metaphor of an "invisible hand" to describe the way in which the individual self-interested activity of each capitalist producer could paradoxically allow for the self-organized benefit or good of the society as a whole. Or, for example, when describing the way in which the deterministic mechanics of motion operated within an absolute space–time arena, physicist Isaac Newton used the metaphor of a "clockwork" to describe the way in which matter followed predictable logical rules. From this description, we may think of metaphors like the "invisible hand" and "clockwork universe" as "guiding metaphors" for symbolic action (i.e., the symbolic action of economics and physicist professionals) (Last 2019).

In a similar way, the "Global Brain" is a metaphor that is helpful to understand the way in which our modern human society has become mediated by Internet functions like a biological brain. The brain is a useful example of how distributed and self-organizing constituents (i.e., neurons) can produce emergent properties (i.e., intelligence, goal-directedness, consciousness). Here we posit that as brains produce intelligence, goal-directedness, and consciousness, so our species as a whole in human civilization produces higher order intelligence, goal-directedness, and consciousness. Take, for example, two very straight forward functional and structural uses of the Global Brain metaphor:

- **Function**: brains help organisms solve problems; a Global Brain would help the human superorganism solve problems too complex for any lower level of intelligent organization.
- **Structure**: neurons within neural networks process information in a parallel and distributed fashion transmitting information to connected neurons; this is the same basic structural pattern used by humans to transmit information via the Internet.

We can see these higher order functional properties in problem-solving abilities that transcend the ability of any one person (i.e., sending humans into outer space, constructing large stadiums or buildings), goals and aims that function for collectives of people (i.e., trying to end world poverty or instituting universal education programs), and phenomenal identification with experiences that affect society as a whole (i.e., collectively remembering horrors of World War 2, or collectively imagining a future world with higher possibility for everyone). Moreover, we can see these higher order structural properties in the emergence of large-scale social networking platforms that help people share information for a variety of different purposes (i.e., educational, transportation, hospitality, governance, etc.) in a parallel and distributed form.

Therefore, the Global Brain may be a very useful metaphor for describing the idea of a distributed and self-organizing planetary superintelligence emerging from the local activity of humans and ICT interacting and learning via the Internet. At the moment we do not have a complete understanding of how to deploy the Global Brain metaphor to derive the best orientation for symbolic action (logical study). For example, there are various metaphorical representations in which we may categorize the human system. Consider the following three categories: organicism, encyclopedism, and emergentism (Heylighen 2011):

- **Organicism**: the idea that the human species as a whole is structured like a living system (i.e., a superorganism developing a socio-technological nervous system).
- **Encyclopedism**: the idea that our species is building a global database of all information and knowledge (i.e., a memory for the collective species).
- **Emergentism**: the idea that a global consciousness/awareness is emerging as a consequence of our increasing interconnectedness.

In an ideally mature understanding of the Global Brain, we would have a knowledge that was capable of integrating all of these metaphorical representations into an evolutionary or cybernetic theory that could explain mechanistically the way in which hyper-connectivity and international cooperation could actualize a distributed self-organizing superintelligence.

Foundations

Thus, we may have a better understanding of why we start with the name "Global Brain". Global Brain refers to a phenomenon that has a planetary scale, exhibits system-level structure analogous to brain organization, and emergent brain-like properties (e.g., learning, problem-solving, information processing). We recognize that "Global Mind" may also apply and bring to mind concepts like Hegel's "Absolute Spirit" or Teilhard de Chardin's "Noosphere". However, with the signifier "Global Brain" we are specifically referring to the potential phenomenon of self-organizing and distributed intelligence on a planetary scale. This "brain-like"

activity could lead to phenomena that may also be considered "mind-like" in nature, but the primary focus of this theoretical exploration and modeling are directly related to "brain-like" properties and the potential for the emergence of the higher level intelligence necessary to tackle planetary problems.

In evolutionary terms, the Global Brain is a metaphor that invokes the more literal and scientific concept of a superorganism (Gardner and Grafen 2009). Superorganisms are collectives of individual organisms with a specialized division of labor and a generally poor or complete lack of ability to function and reproduce independent of the larger collective (i.e., they have been subsumed into the substance of a higher whole). The most common example of a superorganism can be found in the eusocial insects like ants, termites, and bees, which have been studied extensively under the superorganism paradigm from an evolutionary perspective (Hölldobler and Wilson 2008). Many evolutionary theorists now consider it likely that the human collective functions as a superorganism, especially within the historical process. In history human societies are composed of competing and cooperating "super-entities" characterized by a specialized division of labor, making it difficult for individual humans to function and reproduce independently of the larger collective. Thus, although humans are of a totally other order than that of eusocial insects in regards to the symbolic medium of thought and communication, we share common superorganism-like cybernetic properties.

We can also understand a deeper level of the superorganism concept if we consider the radical level of the phenomenon of the Earth itself. Environmental scientist James Lovelock posited the Gaia hypothesis as the idea that the Earth itself is one global superorganism (Lovelock 1979). Currently, there is still strong disagreement in the scientific community about Earth's status as a literal global superorganism. However, few question the concept of Gaia as a useful metaphor to explore the fact that the totality of the biosphere interacts, defines and reproduces its own environmental boundary in an organism-like way (Dennett 1999). The Earth achieves this via several complex positive feedback loops with diversified internal elements (living organisms). Such superorganism-like processes have been posited as potentially useful for the field of astrobiology in the attempt to identify other "Earth-like" planets (Impey 2011). But more importantly for our inquiry, the idea of the Earth itself as a superorganism asks us to reflect on the possibility that the Global Brain would function as the structure of a nervous system for the Earth's superorganism (Stock 1993). Thus, in the same way that animals started to grow increasingly sophisticated brains so that they could make increasingly better models of the world and eventually models of their own models of the world (self-consciousness), the Earth could be growing a brain so that it can accurately model its surrounding environment (i.e., the universe).

Of course, although a Global Brain is possible and the human species gives many crucial appearances of developing in a convergent direction (i.e., towards the formation of a higher planetary totality), this is not an inevitable phenomenon and cannot be predicted with the scientific accuracy that has come to be expected as standard in the "hard sciences". In other words, between our present moment and the potential formation of a higher planetary level of control and cognition, there is

an ever-increasing space of contingent possibility dependent on social, political, economic and technological factors (Last 2017a). Consequently, there is a high degree of uncertainty and unpredictability in regards to the ultimate fate of the phenomenon of humanity. However, at the same time, the Global Brain is an achievable and even a likely outcome of the evolutionary process of globalization. From the extrapolation of the exponential nature of technological development, it is not unreasonable to suggest that this phenomenon could cause a metasystemic change before mid-century (Stewart 2014).

This is all to suggest that something like a Global Brain as an emerging network is in an embryonic stage of development. This network primarily develops from the continued automation of nervous-system-like properties like storage, transmission, and processing of data through evolving information-communication technologies (Goertzel et al. 2016). The development of this network increasingly results in the coordination of political, social and economic activity via Internet-mediated technologies and platforms (Heylighen 2017). We can see that this development is occurring rapidly as contemporary communication networks are already restructuring and integrating all components of global society away from historical modes of organization and towards qualitatively new forms of distributed organizations in areas of energy, communication, transportation, education, and many other fields (Rifkin 2014).

In the case of its emergence, the Global Brain would be characterized not by the sum of its parts (human individuals and information-communication technologies) but as totally different than the sum of its parts (i.e., a superintelligence consuming the entire field of human activity). Thus, the Global Brain would technically exist everywhere and nowhere: it would be a total planetary phenomenon that is an effect of the collective interactions of human beings interconnected within a technological infrastructure supporting a virtual medium (Heylighen 2015). We can contrast the nature of the Global Brain with the nature of historical "super-entities" like corporations, nation-states, empires or kingdoms, which are not primarily distributed or self-organized but more-or-less controlled from a central location that was easily identified in physical reality (Lenartowicz 2017). Consequently, in a "Global Brain age" or "mature information age", there will likely be no centers of power or organizations because the center will be the whole planet. This would be the full essence of the power of distributed and self-organizing intelligence.

Metasystem

In order to understand the realization of a Global Brain in its psychological, social and technological dimensions the modeling tools of evolutionary theory and cybernetic theory may be the most useful (Heylighen 2007b). From an evolutionary-cybernetic point of view, the Global Brain would be classified as a metasystem transition and understood in terms of an agential framework focused on learning and knowledge processes. Here we would define agents as systems that act

upon their environment using knowledge to achieve goals. In this context the process of globalization is about increasing feedback for selection pressures that allow for faster and better learning. This, in turn, means that the Global Brain metasystem would be increasingly structured by agents who are more knowledgeable and better able to achieve their highest goals with universal significance.

In this context, the Global Brain would ultimately be the result of directional variation and selection towards a more intelligent, knowledgeable, accessible and efficient information society. The direction of this pathway towards a positive-higher dimension is dependent on a number of important evolutionary criteria that include (Last 2017a):

- the need to build a global system of governance that is inherently more integrated and cooperative than the contemporary field of governance composed of nation-states and international organizations;
- the need to transition to a global system of energy that is both abundant (non-rival) and sustainable (renewable) in order to ensure that human activity does not destroy its own ecological foundations; and
- the need to transition towards a post-capitalist economy that is capable of assessing humanist and ecological value at the planetary level above purely profit-driven logic characteristic of international organizations structured on neoliberal principles.

The realization of a global brain metasystem transition would be a novel phenomenon in evolutionary history (Last 2017b). However, historically, the drama of evolution has been punctuated by previous metasystem transitions which can be generally classified as emergent levels of order and control (Turchin 1977). For example, we may think of the history of biochemical evolution as a history structured by metasystems from non-life to life, single-celled life to multicellular life, and so forth (Smith and Szathmary 1995). Such transitions tend to occur when agents differentiate in order to become more specialized in their function and integrative in order to become more dependent on one another for future action. When these twin processes of differentiation and integration accelerate towards the emergence of new control qualities we can say that a new complex aggregate exists: a new metasystem in the hierarchy of evolutionary process.

In order for our system (human civilization) to achieve a new metasystem, there will need to be a dramatic increase in global cooperation and coordination (Last 2015). Here we think about this possibility using the evolutionary-cybernetic concepts of ephemeralization and stigmergy (Heylighen 2007a). Ephemeralization is a concept that describes processes of reducing physical friction and stigmergy is a concept that describes processes of reducing social friction. Both the reductions of physical and social friction will allow for the emergence of more differentiated and integrated agents that possess higher knowledge for repetitively achieving meaningful goal states. In an ephemeralized world, there would be increasing levels of abundance (reduced levels of scarcity) because psychical and sociotechnological processes mediated by the Internet would increasingly be able to "do more with

less". In a stigmergic world there would be higher levels of peace and cooperation because psychical and sociotechnological processes mediated by the Internet would allow a mediator medium that constantly reinforces interactions that benefit the whole.

Ephemeralization (the ability to do more with less) and stigmergy (the ability to reinforce synergistic interactions) are both processes driven by information-communication technologies. Here we can expect that information-communication technologies will follow fairly predictable exponential evolutionary trajectories moving into the near-term future (2020–2050) due to our understanding of past computational advances in processing power. What types of features and forms may become available for agential action across this time scale? Here we classify a few major features of this emerging Global Brain:

1. **Semantic web, neural networks, artificial intelligence, recommender systems**: Increasingly advanced algorithms should be able to aggregate all human knowledge (including subjective, fragmentary and improbable data) and reveal underlying trends and associations. Such systems should be able to adapt to the needs of individual users by recommending context-specific solutions. Therefore, all humans should have access to "flexible" and "robust" solutions to any problem they are confronted with, potentially without having to ask any questions at all.
2. **Massively online open courses, and personally online open courses**: Access to the most advanced programs teaching any academic subject should be free and easily accessible to anyone, anywhere in the world. These programs will likely incorporate a more relaxed, "game-like" architecture. They should also become individually tailored to each user to ensure maximum teaching efficiency (i.e., knowing exactly what each individual already knows, and what each individual wants/needs to know). With such programs available to any human, as well as selection pressures for more advanced education, most humans should have the equivalent of an advanced degree, as well as a broad understanding of many other advanced subjects. These programs could also lead us towards a blending of education and research.
3. **Smart phones, wearable computers, augmented reality, brain–computer interface**: All humans should be able to instantly share and retrieve what is happening at all times within our shared planetary landscape. This is already in an advanced stage of emergence. However, the final stage will include ICT that is connected to our brains that allows us to read and directly understand another person's thoughts, feelings, emotions, etc. as well as respond by generating similar neural signals. These interactions could be within multiple configurations, hosted in augmented realities, and be completely disconnected from geography.
4. **Internet of Things, ubiquitous computing-internet**: Projects already underway to equip everyday objects with simple wireless sensors (e.g., RFID tags), as well as projects to provide high-speed Internet access globally, should culminate in ubiquitous Internet access, and also global "smart environments". All of our

environments will be able to respond to the needs of the agents present as well as efficiently regulate energy, communication, and transportation networks.
5. **3D/4D printing and advanced automated manufacturing**: Emergence and full diffusion of 3D/4D printing should transform the way our system produces and distributes goods and services globally. Production will occur on cellular, molecular and eventually atomic scales, allowing us to manufacture any object, anywhere, for negligible cost. All objects will eventually be able to be shared and distributed via informational blueprints and printed on high-quality printers that should be as ubiquitous as televisions and computers are now.

From these extrapolations of future ICT evolution, it is possible that our civilization could be transformed into a distributed and self-organizing planetary problem-solving system to help us more efficiently tackle global climate, energy use, resource allocation, international conflicts, terrorism, and natural disasters. This will depend on how we direct and use this technology as it emerges and forces us to reconsider the design of our current global environment.

Challenge Propagation: Towards an Organization Theory

Beyond metaphors of a future metasystem and beyond the structural nature of metasystems we have to think the mechanics of action for a metasystem. In order to understand this, we have to work towards a model of distributed and self-organizing intelligence that can be used as a foundation to generate increasingly accurate interventions into modes of action for the becoming of planetary organizations. These models should be useful in helping us test our hypothesis that the process of globalization as driven by ephemeralization (the ability to do more with less) and stigmergy (the ability to reinforce synergistic interactions) is leading to the emergence of a Global Brain (higher collective intelligence and consciousness).

Towards understanding a model that can help us in this aim let us reflect on the idea of challenge propagation (Heylighen 2014). Challenge propagation is a concept meant to describe distributed self-organizing intelligence, whether that be the intelligence of a neural network or a planetary civilization of humans and computers. Here we can define challenge propagation as a phenomenon which elicits action from agents ("challenges") which can then share ("propagate") these challenges within a network of other agents. The precision with which challenges are propagated to agents is the primary determinant of the distributed self-organizing intelligence of the system (Last 2014). Here we can better understand the concept by separating its two fundamental components:

- **Challenges**: We all experience challenges. These challenges can be perceived as a problem or an opportunity. Problems cause our present situation to differ from our ideal situation. Opportunities are things that help us "grow" either physically or mentally. Collectively, problems and opportunities are "challenges" that we

represent mathematically with "negative" or "positive" vector components. Therefore, we conceptualize humans as in the process of "challenge seeking" (i.e., solving a problem), "challenge relaxing" (i.e., exploiting an opportunity), or both.

- **Propagation**: we "share" challenges through our networks if they cannot be relaxed or sought independently. Networks are mathematically represented as weighted links (i.e., differing numbers of connections, just like a neural network). A link between humans or links between other networks of humans can become strengthened through collective and positively reinforced learning rules (i.e., links become stronger the more efficient they are at solving problems and/or exploring opportunities). This is how we represent self-organizing propagation of challenges that lead advances in distributed intelligence.

To internalize a deeper understanding of what self-organizing propagation of challenges that lead to distributed intelligence would mean for our life consider the following definitions of distributed intelligence and self-organization:

- **Distributed intelligence**: agents coordinate over time and space with no centralized "top-down" control, only stigmergic "bottom-up" parallel organization mediated by medium reinforcing synergistic interactions.
- **Self-organization**: agents coordinate in networks with other agents independently building the connection strength of links between other agents who reflect a use value while discarding of counterproductive connections.

In the future, Global Brain-like models of distributed intelligence and self-organization may become implemented to improve the collective behavior of the human system. This may be done through active interventions that improve the way public and private institutions can maximize distributed self-organizing intelligence (Veitas and Weinbaum 2017). Other chapters in this book explore some of these issues from other perspectives (see Chapter "Big History Trends in Information Processes" (Solis and LePoire 2020), Chapter "Plurality: The End of Singularity?" (Plebe and Perconti 2020), Chapter "The Deductive Approach to Big History's Singularity" (Grinchenko and Shchapova 2020) and Chapter "The Cybernetic Revolution and the Future of Technologies" (Grinin and Grinin 2020) of the present collective monograph).

Now if the human system was ever capable of embodying or actualizing these concepts in their full ideality what would be the functional and structural nature of our system? For example, if we reached maximum ephemeralization (the ability to do more with less), maximum stigmergy (the ability to reinforce synergistic interactions) via distributed intelligence and self-organization how could we describe the human system as a totality? The hypothesis posited here is that such a system would represent qualities closely associated with the qualities of omniscience, omnipresence, omnipotence, and omnibenevolence (Heylighen 2015):

- **Omniscience**: whether we are interacting with artificial intelligence via a semantic web or constantly being guided in our education by highly advanced massively online open courses, our future experience in a Global Brain should be one in which billions of highly educated intelligent agents are closely interacting, communicating and collaborating with an omniscient knowledge base. In such a world, the testing of new hypotheses, the development of new theories, and the discovery of new laws should be straightforward as the formulation of a sentence is for humans today.
- **Omnipresence**: With full specialization and integration of advanced ICT (e.g., wearable computing, internal computing) and the implementation of the Internet of Things, all agents and "things" will have the ability to wirelessly communicate and coordinate activity, anything and anywhere, enabling omnipresence. As a result, any perturbations within our system (i.e., damages/disasters affecting infrastructure/people) will be solved through the distributed and self-organizing activity of our wireless communicating ICT network.
- **Omnipotence**: All industrial processes for delivering products and providing services will become informational processes—via 3D/4D printing and nanotechnology integrated into the Internet—allowing any physical object to be designed, shared, and constructed for negligible cost and produced with negligible waste. This omnipotence will allow the Global Brain to be a system of abundance.
- **Omnibenevolence**: A Global Brain is built bottom-up from its constituent components and so one can easily reason that this system will be omnibenevolent, maximizing the potential of all its "neurons". This system can already be seen as emergent as better education, greater wealth, and longer lives seem to be correlated with dramatic decreases in things we consider "evil" on a global scale (i.e., murder, war, slavery, prejudice, suppression, dictatorship, corruption).

In short, the model of the Global Brain places emphasis on a distributed and self-organizing singularity that focuses on the human system as a totality. In the actualization of such a reality, humans would be in an environment far removed from any evolutionary background (either from our pre-historical hunter–gatherer era, or our traditional civilizational era) and within an environment with far higher levels of freedom, democracy, diversity and abundance than ever before (Last 2017b). The difficult task is thinking what would be the actions and transformations possible in such a landscape (Last 2018).

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Cadell Last is an anthropologist (M.Sc.) and philosopher (Ph.D.) with an interest in biocultural evolution, the mind-matter relation, and futures situated within a big historical context. He is currently working at the Bertalanffy Center for the Study of Systems Science (BCSSS) as a post-doctoral researcher, teaching as a professor at the School of Thinking initiative at the Vrije Universiteit Brussel (VUB), and building online courses that focus on the philosophy of subjectivity.