Biosemiotics
https://doi.org/10.1007/s12304-023-09547-6

REVIEW

Consciousness as Telos: An Evo-Devo Approach

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Received: 23 June 2023 / Accepted: 26 October 2023

Abstract

Simona Ginsburg & Eva Jablonka (G&J), in *The Evolution of the Sensitive Soul (2019)*, explore the nature and status of the mind and subjective experiences from an evolutionary perspective. They raise a fundamental question about 'the origin of animal consciousness during evolution' (pg.1). The book begins by tracing the roots of consciousness studies from the Aristotelian perspective on the sensitive soul, referring to the dynamics of the living organization, percepts, and feelings. They use "subjective experiencing" to refer to both sentience and consciousness. They argue that to have an evolutionary account of subjective experiences, we need to develop an understanding of minimal consciousness or a marker like unlimited associative learning (UAL) indicating subjective experiences. In the book, the origin of life is marked by the evolution of goal-directed systems where the system can manifest unlimited heredity. They state that all the questions about the origin of minimal consciousness deal with 'the emergence of new types of goal-directed systems' (p.1).

Keywords Evo-devo · Consciousness · Sentience · Cognition · Evolutionary epistemology

In *The Evolution of the Sensitive Soul (2019), Chap. 1*, G&J develop an account of consciousness as a goal-directed process. The goal-directed behavior in plants is nutritive, in animals (sensitive), and in humans (rational). They ascribe the function of consciousness as having telos, unlike by analogy, with a function attributed to teeth (to chew) or kidneys (to filter) or eyes (to see). The activities, like navigating a complex route, can be performed without being aware of these activities in autopilot mode. The autopilot mode activities suggest that consciousness has no function like teeth, eyes, or a kidney. This understanding of *Telos* is parallel to the teleological

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Published online: 13 December 2023

hierarchy (where humans are envisaged at the top due to the capacity for reasoning, followed by animals and plants) asserted by Aristotle in the form of nutritive (plant), reproductive/sensitive (animal), and rational (human) souls. Although G&J adopt the Aristotelian hierarchy, their way is very 'non-Aristotelian' (p. 12), as the non-evolutionary approach of Aristotle does not tell us much about the continuity between the nutritive (plants), sensitive (animals), and rational soul. It also does not discuss the temporal changes and gradations of the different types of souls. G&J focus on the 'sensitive soul.' Bees, dogs, and humans all possess sensitive souls. G&J get interested in knowing if there are differences in the souls of bees, dogs, and animals, and how the divide between inanimate matter and animate beings may be bridged (p.5). This apparently unbridgeable gap was first acknowledged by Israeli philosopher Leibowitz (1985). G&J examine when and how the transition between inanimate and animate matter occurred by elaborating upon organizational principles and processes.

In Chap. 2, G&J emphasize the history of consciousness studies where they analyze Lamarckian (the physiological evolution of the mind), Darwinian (selection theory; regarding the account of emotions), Spencerian (the law of progressive evolution), and Jamesian (consciousness as a selecting agency) accounts as the associationistic ones (mental activities are an association of ideas) (p.69). From an associationistic perspective, they endorse an evolutionary approach toward the origin of mental life. Associationists 'connect ideas with sensations and sensations to physiology' (p.42). G&J adhere to the teleofunctional (biological functional) and the associationistic viewpoint. They assert the evolutionary account on the origin of mental-physiological processes while explaining the origins and development of mental life.

Chapter 3 focuses on the history and issues related to subjective experience with the rise of computer science and neuroscience methodologies, translating the traditional mind-body (mind-matter) problem to the mind-brain problem. G&J show how various neurobiological frameworks have emerged to argue for the naturalistic explanation of consciousness, suggesting some solutions to the Cartesian mind-body problem. For computer scientists and neurobiologists, 'consciousness is a weekly emergent phenomenon that arises due to the interaction between lower-level parts of a highly structured neural system' (p.96). Some common characteristics like global activity, learning, emotions, self, and many others are individually necessary and jointly sufficient to define consciousness. These characteristics conceptualize consciousness as an ongoing bodily sensorimotor activity where the brain plays the role of organizer and integrator.

Neurobiologists embrace evolution and argue that consciousness has functional significance, but their accounts are mostly focused on animals with more highly evolved brains, i.e., mammals, and moreover do not address the phylogenetic distribution of consciousness (p.101). As a result, their account often neglects some crucial questions about the distribution of consciousness in the living world: how one can trace the origin of consciousness, what the preconditions for the emergence of consciousness are, and many more. Their evolutionary account does not exhaust the evolutionary biologists' questions about cognitive evolution. Consequently, these theories fail to address a comprehensive account of the taxonomic distribution of consciousness.

Chapter 4 assesses the philosophical implications of neurobiological theories of consciousness by revisiting classical questions like what is qualia? Is Consciousness a teleological system? Can Mary get new knowledge when she encounters the red colour for the first time? More precisely, G&J show how the biological approach, i.e., the evolutionary approach helps frame and address such philosophical questions better.

G&J discuss the reactions and factors contributing to an autopoietic system. The autopoietic system is a dynamically self-organized system. They apply the autopoietic system approach to construct a model for the possibility of minimal consciousness as a teleofunctional account of consciousness. G&J state that consciousness is a new intrinsic mode of being. The intrinsic mode of being is a metaphysical conception drawn from the teleological approach provided by Aristotle in the *nutritive, sensitive*, and *rational* soul. The *nutritive* one is restricted to survival and reproduction, the *sensitive one engenders* responses, and the *rational* ascribes value to the concepts. G&J explain that the addition of function (living organisms), motivation (conscious/sensitive organisms), and teloi —— the ascription of values to encountered objects (rational organisms), are the hallmarks of the teleological transitions.

G&J offer an unlimited associative learning (UAL) model as the evolutionary transition marker for minimal consciousness. They contrast conceptual limited associative learning (that can respond to simple stimuli) with unlimited associative learning. UAL is 'open-ended and ascribes values to stimuli' (p. 191). It is acquired by sensitization and habituation. Limited associative learning increases the *adaptability* under evolution. While in UAL, this adaptability is compounded due to compounded stimuli and novel approaches. UAL entails open-ended evolutionary gains leading to complexity in organismic behaviour and function. It is a positive marker of consciousness —— indicating the presence of minimal consciousness. Even if the UAL is not manifested (cases of neonate and anencephalic person) due to developmental or pathological reasons, the person or animal will be minimally conscious as it possesses a pre-existing UAL-supporting minimal organization. As a living autopoietic system without unlimited heredity cannot survive, the same is the case with animals that have lost UAL and will become extinct. G&J expect and assert that the animals' lineage that loses the ability for UAL will eventually lose sentience within due course of the evolutionary timeline. Animals without UAL would lead to extinction because the animals will face hurdles in open-ended behavioral adjustments having functional effects enabling open-ended evolution. They also mention how losing an unlimited heredity of living autopoietic systems would lead to their extinction (Ginsburg & Jablonka, 2019, p. 225–226). Since UAL, unlimited heredity, and open-ended behavior are intricately under evolutionary pressures. Their loss would entail the extinction of organisms and even sentience. But the existence of animals without UAL, if there are, challenges the point of getting extinct without UAL. Perhaps, G&J's hypothesis hints at a linearity in UAL, but with the evolutionary dynamicity, UAL can't act and function as an all-or-none phenomenon for the existence of the animal lineages.

If UAL is the marker of consciousness, how did it evolve with time? What is the evolutionary relationship between learning and consciousness? G&J define learning (in general) as an ontogenetic adaptation (p.228), which leads to long-lasting

behavioural changes. The long-lasting changes entail mnemonic processes involving encoding, retaining, and recalling. The evolution of memory is the key to the evolution of learning. Do all animals possess learning from simple to complex? Or is learning linked with the development of special structures like in vertebrates? G&J discuss about the evo-devo approach regarding the levels of biological complexities under evolutionary transitions. To discuss the building blocks of UAL, they suggest origin of a new individual: neural and mobile. They further claim that action potential as a "language" appeared with the evolutionary development of neurons. The neuronal capacity of action potential is understood as the currency of communication. Neurons' origin and development furnished a unifying "language" with action potential as currency for cellular communication. It adheres to and accepts the phylogenetic and ontogenetic *a priori* position of neural development. G&J don't engage in the discussion regarding the graded potential, it also is a candidate as currency for cellular communication (Ginsburg & Jablonka, 2019, p. 251).

In Chap. 6, G&J explore how neurons communicate across gaps in the nervous system and assume that the neurons help in storing the information and using relevant information for survival. But how do neurons generate memory and learning from the evolutionary angle? Another question is, how did the nervous system first appear? Can cnidarians (as they have dispersed nerve nets) be called the precursors of primordial consciousness? G&J maintain that the transition to unlimited associative learning would have occurred in several evolutionary stages. Associative learning (henceforth AL) is one of the revolutionary adaptations during life's evolution, enabling contingent relationships between animals, their stimuli, environment, and actions. AL has transitioned to Limited Associative Learning (henceforth LAL) over time, and this transition has also involved changes in how neural information was encoded, stored, and retrieved (Chap. 7). They note that animals with LAL have brains, are bilateral and were most probably evolved in the Cambrian era.

They go on to argue that transitioning from LAL to UAL gave rise to subjective experiencing and, more precisely, sentience. UAL has resulted in the hierarchal levels of storing information in neurons, giving rise to integrating functional units. According to G&J, UAL led the evolutionary emergence of subjective experiences and sentience through novel neuronal hierarchal levels where information gets stored. Such newly formed functional units act in integrating signals (sensory, motor, reinforcing types, and memory). This integration is a crucial evolutionary function achieved with UAL over LAL (Ginsburg & Jablonka, 2019, p. 347).

UAL leads to new hierarchized integration and integrated functional units, not new sensory-motor systems.

G&J suggest a toy model (Chap. 8) showing how these functional units interact. UAL results from two significant evolutionary developmental changes, i.e., the addition of hierarchal levels within and between sensory modalities and the motor system, and in the addition of general purpose in brain organization. G&J conceptualize two significant and interlinked evo-devo changes in brain organization that resulted in driving UAL (in contrast with LAL) involving representations of stimuli and actions. These changes are about the modalities and association units in the system. The first change is 'the addition of hierarchical levels within and between motor-neuronal system and sensory modalities. The other one is the addition of more

general-purpose, high-level integrating, value units, and memory centers' (Ginsburg & Jablonka, 2019, p. 397). The brain evolved along with the neural innervation and other non-neural morphological structures of the body. By general purpose in brain, G&J indicate toward the higher integrating purposive units. Animals with UAL tend to have complex regions with large ganglia distributed throughout the body, helping them control their motor activities. The central nervous system enabled associative learning, leading to positive feedback loops to facilitate learning-based adaptation. The learning-based adaptation resulted in an evolutionary arms race that eventually led to UAL, enriched with behavioural and morphological adaptations in arthropods and vertebrates. However, UAL could lead to overlearning, causing stress, neurosis, and illness in organisms. As a result, forgetting has also coevolved due to strong selection.

G&J utilise Dennett's (1995) framework for describing different levels of goal-directedness that include, Darwinian organisms- having limited flexibility, Skinnerian organisms- that can learn throughout their life by trial and error, Popperian organisms- can choose between imagined recalled alternatives without having to execute them, and Gregorian organisms- having the ability to extend minds through the human social environment. They further describe how UAL and minimal consciousness facilitated the evolution of Popperian organisms, which is the major transition in the evolution of cognition, learning, and consciousness. Popperian animals are animals endowed with imagination (Chap. 9), where imagining deals with the construction of virtual episodes that were experienced in the past (p. 439). G&J define this type of memory as episodic-like memory (henceforth ELM). ELM is not found in all the organisms with UAL. It is found in mammals, arthropods, and some birds and fishes. G&J hold that the transition from NAL (non-associative learning) to LAL has a precondition of having a nervous system for the transition to consciousness (Ginsburg & Jablonka, 2019, p. 192). They discuss some evolutionary aspects of consciousness transition from invertebrates to vertebrates and mammals. Still, concerning specific transitions of NAL-LAL-UAL-ELM in the case of reptiles/amphibians, they don't showcase in-depth analysis, as is done with other Taxa. They examine the associative learning models abstractly and conceptually. According to them, LAL animals are not minimally conscious, as they don't show the fusion of sensory stimuli that allows them to discriminate among differently composed patterns of identical elements (Ginsburg & Jablonka, 2019, p. 343). They acknowledge the limitation of whether the evolution of ELM happened independently, parallelly, or in common with ancestors of birds, mammals, and reptiles; it is presently unclear (Ginsburg & Jablonka, 2019, p. 443). In other words, G&J remain silent on such taxonomic classification with non-UAL and UAL, non-ELM and ELM animals.

There is an evolutionary continuity between ELM and UAL. UAL is the foundation on which ELM architecture is constructed. Animals with ELM have extended temporal thickness, which means that 'the neural effects need to persist to get captured and to become conscious' (p.100). Temporal thickness helps animals in sustaining information. As a result, animals with ELM are richer in consciousness than those with merely UAL. The last chapter argumentatively scrutinizes the evolutionary approach and reflects upon the UAL thesis. The book's main argument is that through 'reverse engineering' from UAL architecture, one can understand

embodied, conscious, and biological systems (p. 452). This reverse engineering is very much similar to how an archaeologist reconstructs history and how a paleontologist reconstructs an organism through fossils. In this way, UAL architecture is an appropriate candidate for an evolutionary transition marker of consciousness, allowing 'reconstruction of the enabling system of which it has been a part of' (p. 227). G&J recognize the limitation of any evolutionary reconstruction while analysing that the 'reverse engineering' of an embodied, conscious being is not plausible due to the lack of a Gantiesque /chemoton analog (1971/2003) of minimal consciousness (where a chemoton is an autopoietic system having machinery for maintenance and repair, like a living cell). This theoretical analysis looks promising but provides no reasonable ground to fathom 'minimal consciousness'.

G&J assert that consciousness has a telos rather than a function. It seems a profound argument, but we find this teleo-functional notion of consciousness incomplete. Since it is unclear whether they refer to 'goal as a function' or 'function as a goal.' If it is a 'function as a goal,' then it is teleomatic or teleonomic? Mayr (1974) presented an insightful analysis of the telos, arguing that teleology means goal-directedness. Goal directedness is finalistic in nature. It can be interpreted as an end-directed process. End-directedness is of two types: teleomatic and teleonomic. Teleomatic processes are observed in inanimate objects. These inanimate objects and physicochemical processes are the results of natural laws. Their end-directedness is passive and automatic; they are regulated by external forces and conditions. For example, when thrown from a height, a rock reaches the end state by coming to rest because of gravity. On the other hand, goal-directed behaviour in living organisms is teleonomic. Mating, migration, and ontogeny possess goal orientation. Mayr (1974) proposed the definition of teleonomic as follows: 'A teleonomic process implies goal direction that is dynamic in nature rather than static' (Mayr, 1974, p. 98–99). Thus, there are two significant features of a teleonomic system; one is a program, and the other is an endpoint or terminus. The terminus is foreseen in the program. Mayr defines the program as something material. It exists before the teleonomic process and goes well with the causal explanation. Is G&J's teleological position similar to Mayr's? Do G&J distinguish the difference between teleology and teleonomy? Perhaps, not emphasised due to the treatment they adhered to. Their UAL thesis accounts for cognition (more precisely, cognitive processing) rather than consciousness. They do not differentiate between cognition and consciousness. Cognition entails learning; therefore, UAL, as the positive marker of consciousness, doesn't explain what happens when UAL is absent, unlike workspace theory by Baars (1997) that uses contrastive phenomenology to give an account of conscious experience. Dehaene (2014) frames the negative picture of the conscious mind by eliminating the unconscious processing. So, can any negative marker for consciousness exist with all-none-nature of consciousness? G&J argue that such a question is misleading in conceptualizing an all-none-nature of consciousness having a sharp threshold. "We do not have any such sharp threshold, switch, or metaphorical lightbulb to account for gray areas; therefore, we do not have such a negative marker for consciousness" (Ginsburg & Jablonka, 2019, p. 455–456).

Consequently, the book maintains that there is continuity between life and consciousness. It attributes minimal cognition to bacteria, archaea, plants, fungi, and

sponges. The book maintains the distinction among them on the level of cognition. G&J provide an extensive historical account of the origin of sentience with philosophical insights. It is not feasible to cover the depth and breadth of all the arguments from the book in this brief review due to the paucity of time and words. However, some questions about the evolution and origin of consciousness remain still unanswered, like what is minimal consciousness? What is cognition? How are life, cognition, consciousness, and agency related evolutionarily? How are sentience and consciousness different from each other?

Overall, the book is a useful source for conceptual understanding and clarity about diverse topics in cognitive science and consciousness from an evolutionary perspective. The UAL, LAL, ELM, and other related arguments seem quite significant in developing the ideas further from an evolutionary epistemological perspective as well.

Author Contributions All authors contributed equally in writing and reviewing the manuscript.

Funding IIT Kanpur.

Data Availability N.A.

Declarations

Ethical Approval N.A.

Informed Consent N.A.

Competing Interests The authors declare no competing interests.

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