Biological mechanisms contradict AI consciousness: The spaces between the notes

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ABSTRACT

The presumption that experiential consciousness requires a nervous system and brain has been central to the debate on the possibility of developing a conscious form of artificial intelligence (AI). The likelihood of future AI consciousness or devising tools to assess its presence has focused on how AI might mimic brain-centered activities. Currently, dual general assumptions prevail: AI consciousness is primarily an issue of functional information density and integration, and no substantive technical barriers exist to prevent its achievement. When the cognitive process that underpins consciousness is stipulated as a cellular attribute, these premises are directly contradicted. The innate characteristics of biological information and how that information is managed by individual cells have no parallels within machine-based AI systems. Any assertion of computer-based AI consciousness represents a fundamental misapprehension of these crucial differences.

1. Introduction

The assertion that intelligent AI is an oxymoron has been previously argued (Svensson, 2023). However, the charge that the concept of 'conscious AI' is inherently contradicted by cell-centered biological mechanisms has not been specifically articulated.

Pronouncements about AI achieving consciousness or shortly being able to do so have featured prominently in academic articles, science blogs, and the news. For example, a recent New York Times article, ' How to tell if your A.I. is conscious', discussed a range of theoretical considerations that must be satisfied to make that determination (Whang, 2023). In 2022, a Google engineer claimed that their LaMDA Chatbot was conscious. Although largely dismissed, the general belief among cognitive and computer scientists is that consciousness might eventually achieved if a system is provided with sufficient 'computational functionalism' (Aleksander and Morton, 2013; Butlin et al., 2023). Accordingly, a general expectation exists within the AI community that consciousness would eventually emerge given enough computations, layering, and connections (Butlin et al., 2023). In effect, the enigma of consciousness can be realistically reduced to passing enough pieces of information back and forth in the correct order.

The strength of this belief is sufficient that a recent multi-author article vigorously asserted that the issue of AI welfare should be deliberately explored so that AI systems can accorded appropriate levels of moral concern as conscious entities (Long et al., 2024).

Notwithstanding such claims, there are fundamental disagreements among neuroscientists, research scientists in other disciplines, and philosophers about the definitional characteristics of consciousness (Yaron et al., 2022; Seth and Bayne, 2022). Disputes revolve around whether our human 'higher-level' form of conscious intelligence differentiates from what some consider a more primitive non-conscious general organismal intelligence encompassing 'lower' animals, plants, and cells (LeDoux et al., 2023). Others assert that these arguments are misplaced: a human-centric conception of consciousness is an invalid litmus for consciousness at other scales (Reber et al., 2023, 2024).

Many vigorously disagree with that latter stance. Some scientists believe that all organisms other than humans merely experience biochemical reactions to stimuli independent of selfhood as a form of competencies without 'knowing'. Even in humans, they further argue, there are forms of non-conscious perception (Amir et al., 2023). For others, even our 'knowing', human appreciation of phenomenal experiences is trivial. As Wang (2023) notes, some scientists insist that a

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digital machine can be an intelligent and emotional 'humanoid' because humans are nothing more than "meat machines" whose conscious stance can be recreated electronically. All that is needed for such a humanoid is "direct programming, reverse engineering, and making the system complicated enough so that the soul emerges automatically" (Wang, 2023, p. 69).

Some direct questions can be posed in this complex debate. Does consciousness fundamentally diverge from practical, general living intelligence? If there is a difference, is it merely a matter of information density, or are there other factors that contribute, forming experiential sentience? Is consciousness simply a matter of pattern detection and covariations in a Cartesian, cognitive framework or are feelings and experiences an essential element of conscious decision-making as requisite Spinozan affective states (Damasio, 1994; Ravven, 2003)?

Given thus dispute, one potentially productive approach is to consider conscious life as a combination of communication and problem-solving (Popper, 1999; De Loof, 2015, 2017; Miller, 2016a, 2018, 2022, 2023a; Miller et al., 2020a; Torday and Miller, 2020; Reber et al., 2023, 2024). Accordingly, whether AI can be conscious can be effectively reduced to examining whether computers and living organisms problem-solve in the same manner as living systems. Any consequential, definable differences would specify differential features distinguishing living consciousness from machine intelligence.

These differential features can be stipulated, enabling the categorical separation between living consciousness and machine intelligence. These differences derive from a single governing principle: all biological information is ambiguous (Miller, 2016a, 2018, 2022, 2023a, 2023b, 2022; Torday and Miller, 2017).

All biological information is uncertain because environmental signals can only reach cells by transiting physical media such as interstitial spaces where they are subject to degradation. Further, the information content of environmental cues acan only be analyzed by cells after transiting a complex external plasma membrane and further assessed within the crowded, active cellular environment. Consequently, all cellular information experience high levels of noise and undergo obligatory distortions. Furthermore, as each cognitive cell is an independent, active, and subjective observer-participant, obligatory differential gaps exist in their individual settlement of any quantum superpositions (Proietti et al., 2019), which are governed by a fundamental uncertainty relationship (Gabor, 1946). Several further subjective participant-observer variables affect the assessment of all sources of environmental information, such as antipodal information and 'distinction on the adjacents' (Marijuán et al., 2015) as additional subjective quantum variables, explained in detail in Miller (2023a). Furthermore, individual subjective participant-observer differences exist that are unique to the living state, including information anticipated by some observers and not others and the value and subjective meaning of the spaces between points of information, as will be further discussed,

This crucial biological reality defines the living state and sets the terms of consciousness, unequivocally distancing the living frame from all abiotic systems. Correspondingly, distinct contrasts in information content, assessment, and management between the living state and digital computer information systems explain why exclusively machine-based AI is not presently conscious and will not become so. These differences can be metaphorically compared to music: AI systems can intelligently play the notes; living consciousness dwells in the spaces between them.

2. The modern context of AI

The intellectual foundations of AI were launched in 1956 by John McCarthy, a mathematics professor at Dartmouth. He organized the Dartmouth Summer Research Project on Artificial Intelligence with twenty distinguished computer and cognitive scientists, including Claude Shannon at Bell Laboratories, Marvin Minsky at MIT, and Nathaniel Rochester at IBM. There was no original intent to achieve machine consciousness. Instead, the new field of 'artificial intelligence' was projected "to proceed on the basis of the conjecture that every aspect of learning or any other feature of intelligence can in principle be so precisely described that a machine can be made to simulate it." (Dick, 2019).

From that nucleus, the current study of artificial intelligence focuses on "designing of intelligent systems that include their environment and take measures that increase their chances of success." (Aggarwal et al., 2022, p. 116). Recent developments in computer power, memory storage, data analytical methods, and software networks have enabled highly robust machine learning methods, such as Deep Neural Networks (Fischer et al., 2020). The combination of machine learning involving these neural nets, novel knowledge extraction techniques, and Large Language Models (LLMs) mobilize AI to assist in many problematic areas of data analysis, including image recognition and decision-support systems. These capacities have developed with astonishing rapidity and to such an extent that many are convinced that AI simulates the workings of the human brain (Nwadiugwu, 2020).

The competence of AI systems and their burgeoning faculties is enormously impressive and accompanied by an increasing apprehension of their intimidating, seemingly limitless potential powers if unchecked. Nonetheless, many sources of error are inherent to AI construction, in addition to the daunting complexity of attempting to mimic human thought. Building artificial intelligence (AI) systems involves various complex algorithms, and errors can emerge at different points (Cabrera et al., 2021).

Data quality and bias represent fundamental concerns, as incomplete or biased training data can hinder a model's ability to generalize to diverse scenarios. Data imbalance where certain classes dominate the training set poses a risk of biased predictions favoring majority classes. Algorithmic issues further complicate the landscape, emphasizing the importance of selecting appropriate algorithms and managing model complexity. Suboptimal algorithm choice or overly complex models may compromise performance, with potential consequences such as over-fitting, where a model becomes too attuned to training data nuances.

Training issues, including insufficient and non-representative training data, can limit a model's capacity to adapt to novel situations. Over-fitting also exacerbates this challenge by hindering the generalization of new data. As a result of over-fitting, the model performs well on the training data but poorly when placed into real-time testing (Pothuganti, 2018).

Feature engineering plays a crucial role, necessitating careful selection and scaling of features to enhance a model's learning capabilities. Hyper-parameter tuning is another critical consideration, as improper settings can lead to suboptimal modeling results (Schratz et al., 2019).

Deployment and integration challenges arise when the deployment environment differs significantly from the training setting, impacting model performance. Furthermore, integration difficulties hinder the effective use of AI in existing systems or workflows.

Pertinently, security concerns loom large with AI models vulnerable to adversarial attacks that manipulate input data for incorrect predictions. The current complex mechanisms used to generate AI systems are systematically vulnerable to adversarial attacks, which can exploit underlying weaknesses and alter AI behavior for destructive purposes, either for amusement or profit (Bertino et al., 2021).

There has been a valuable flow of concepts between studies of learning in humans and developers of AI systems, such as in patterns of reinforcement learning (Neftci and Averbeck, 2019). Significantly, though, how biological systems learn and problem-solve differs substantially from artificial agents. The context of biological learning centers within dynamic environments and multiple inputs is one in which unstructured flexible assessment is paramount. By contrast, AI learning systems focus on single complex problems modeled within static environments (Neftci and Averbeck, 2019).

Accordingly, although some sources of error can be compared to

biological mechanisms, such as over-fitting data to inappropriate sample size or to fit preexisting biases, the types of interactions used to generate AI systems do not specifically overlap biological circumstances. Indeed, reinforcement learning is the only available AI methodology for approximately simulating the human brain (Singh et al., 2022). AI is a 'co-variation detector.' It finds a word in a data stream and records other words associated with it, in the sense that they occur with it. As it progresses through a document, it captures all co-occurrences of these words. In short, it logs words that co-vary. With billions of snippets of data fed in, a huge information base builds Still, at its core, it remains a product of all the words that co-vary with each other. This co-variation detector mechanism is precisely what humans do in "implicit learning" – the core process that underlies the theory of unconscious cognitive functioning (Reber and Allen, 2022) The difference between how we carry out these implicit processes and AI is that we are limited in the temporal and spatial linkages we find and associate. If the items' co-variations are not proximate, the association does not get formed. On the other hand, AI has an absolutely huge capacity for detection and storage and can therefore represent more remote and distant links. This scale gives AI statistical, representational power and offers the illusion of genuine creativity. But, of course, none of these operations has a biological basis, precisely because there is no self-referencing.

Thus, to the largest degree, the formal mechanisms by which computers acquire knowledge bear no close resemblance to the learning patterns in conscious human beings (Kao and Venkatachalam, 2021). Just as there are features of AI intelligence that overlap human capabilities, some sources of error have similarities but are not specifically alike. For example, image compression techniques constitute noise in the system and can cause data perturbations. However, this differs from the type of noise that living systems experience. Furthermore, just as humans have deeply ingrained biases, so can computer systems. Deep learning models are derived from humans who intentionally or unintentionally become sources of biased data retrieval, data assessment, or predictive modeling (Schwartz et al., 2022).

Notwithstanding these limitations, AI can exhibit what might be considered creativity in some contexts, even if not directly creative in our human manner. AI systems can generate outputs based on patterns and data they have been trained on, and this can sometimes result in novel-appearing or unexpected solutions. AI demonstrates its form of creativity through various mechanisms. One avenue is through generative models like Generative Adversarial Networks (GANs) and Variational Autoencoders (VAEs) (Hughes et al., 2021). These models have the capability to create diverse content, such as images, music, or text, resembling human-generated material. By leveraging statistical patterns from extensive datasets, AI systems simulate internal creativity based on learning and replicating complex patterns found in human-created data.

Another facet of AI creativity is problem-solving. AI algorithms excel in finding innovative solutions to specific challenges, particularly in optimization tasks. In some instances, these algorithms unveil unconventional and efficient solutions that may elude human thinking. This feature showcases AI's ability to exhibit creativity through the exploration of unconventional problem-solving approaches (Garbuio and Lin, 2021). Moreover, AI systems contribute to creativity by analyzing extensive data sets, revealing trends, correlations, and patterns not easily discerned by humans. This data-driven approach can lead to creative insights and breakthroughs in various fields, including scientific research and business analytics. Additionally, AI augments creativity in artistic domains, assisting artists, designers, and writers by generating ideas, suggesting improvements, or creating content based on their input. While AI itself may not possess true spontaneous human creativity, it acts as a productive supplemental tool that enhances and complements human creative processes (Halina, 2021). Researchers recognize that although AI is independently creative outside of consciousness, that creativity is highly context-dependent with inherent limitations and deficiencies. However, rather than necessarily representing a barrier to valuable creativity, that is not necessarily so: "the

objective of trying to purely mimic human creative traits towards a self-contained ex-nihilo generative machine would be highly counter-productive, putting us at risk of not harnessing the almost unlimited possibilities offered by the sheer computational power of artificial agents" (Esling and Devis, 2020, p. 1).

Presently, most experts agree that current AI systems are far from achieving human-like intelligence or consciousness. However, many researchers presume that AI consciousness is just a matter of time. Chalmers (2023), for instance, asserts that despite current obstacles such as deficiencies in recurrent processing, global workspace, or inherent agency, successors to today's nascent large language models might become conscious shortly.

Butlin et al. (2023), a group of 19 distinguished experts, examined the current AI models, concluding that none are conscious. However, given the rapid progress in AI, a tableau of fourteen 'indicator properties' that could be used to assess AI consciousness, centered on a basic thesis of computational functionalism, was offered. In these terms, AI consciousness is both possible and tractable to human assessment. Further, that determination is best determined through current neuroscience theories, including recurrent processing theory, global workspace theory, computational higher-order theories, attention schema theory, and predictive processing and coding. Additional criteria for identifiable indicators of conscious AI include measures of agency and embodiment that involve learning and feedback and the ability to model contingencies to encompass perception and control.

Notably, however, this comprehensive paper about the probability of AI consciousness and putative metrics to assess it is expressly framed within their perspectives as cognitive and computer scientists. Consequently, their standards are neurocognitive, brain-centered ones. Its deficiency is not having any discussion of how individual cells receive, measure, and communicate information to resolve stress, leading to problem-solving at scale. AI systems accumulate data but do not develop in any living manner. Nor do they socialize in the way living organisms do. Unicellular organisms were once considered solitary, but recent research confirms that they nearly universally aggregate in large groups to exchange information and share resources (Garde et al., 2020; Puri et al., 2023). Further, and tellingly, words like 'ambiguity', 'uncertainty', 'doubt', or 'preference', all of which permeate our living frame, are absent from AI systems.

3. biological consciousness is cell-based

3.1. The terms of cellular cognition

Whether cells should be deemed individually conscious remains controversial, however, a consensus exists among biologists that cells are intelligent and cognition is a fundamental living property at all scales (Quevli, 1917; Maturana and Varela, 1980; Margulis and Sagan, 1995; Margulis, 2001; Ford, 2004, 2009, 2017, 2023; Baluška and Mancuso, 2009; Miller, 2013, 2016a, 2018, 2023a, 2023b; Miller, 2013, 2016a, 2023a,b; Lyon, 2006, 2015; Reber, 2019; Baluška and Reber, 2019; Miller et al., 2019, 2020a; b, 2021, 2023a,b,2024a,b; Torday and Miller, 2020; Shapiro, 2011, 2021; Lyon et al., 2021; Baluška et al., 2022a, 2022b, 2023a, 2022b, 2024a, b; Reber et al., 2023, 2024; Slijepčević, 2024). Scientists across disciplines agree that cells demonstrate basal cognition, generally defined as the suite of self-referential cellular competencies permitting the reception, assessment, communication, and deployment of information to enable individual and collective problem-solving to meet environmental conditions (Miller, 2016; Lyon et al., 2021; Miller et al., 2024b). Accordingly, all life is cognitive, utilizing information derived from the surrounding environment and its internal structures as embodied infocomputation (Dodig-Crnkovic, 2020; McMillen and Levin, 2024). Pertinently, since all conscious beings are made of cognitive cells, consciousness at whatever scale is judged appropriate is necessarily a cell-based phenomenon. Therefore, understanding the obligate conditions of cellular cognition are highly

pertinent to considering the possibility of consciousness in AI machines.

Although the concept of information is fundamental to understanding cognition, its precise definition remains a subject of contention. That debate has been influenced by Shannon's information concept, which is highly useful in the digital realm but inapt for use within the living frame. Pertinently, Shannon information is a theory of communication and not an information theory (Schroeder, 2017). The difference between digital data used in telecommunications and living information can best be expressed as '(living) information = data + meaning'. This definition directly implies that information has been received, subjectively analyzed, and assimilated by the recipient of the message (Farnsworth et al., 2013).

Within the cognitive framework, MacKay (1969) offers a highly constructive definition of information as "a distinction that makes a difference". This was later rephrased by Bateson (1973) to become the most frequently used practical definition of information, which we therefore use in our approach. An elementary unit of information represents a "difference that makes a difference". Bateson later amended that definition to include "over time". Significantly, this approach separates Shannon communication (data) into meaningful information that expresses into subjective biological action. In biological terms, information enables (means) a self-referencing, valence-loaded, decision-making process (cognition/consciousness) based on subjective observer-participant status. Crucially, 'meaning' in the living frame signifies that the subjective observer knows that its information is imperfect (uncertain) as will be further explained.

Seven fundamental determinants separate abiotic physical states, including all mechanical, digital, and current AI systems, from our cell-based cognitive living frame and their use of information.

First, self-referential awareness can be defined as the state of 'knowing' that existence is constituted within the obligatory condition of informational uncertainty (Miller, 2016, 2018, 2023a,b; Torday and Miller, 2017, 2020; Miller et al., 2019, 2020a,b, 2021, 2023a,b; Baluška et al., 2021, 2022a,b, 2023a,b; Reber et al., 2023, 2024). All cells exhibit this self-referential awareness of uncertainty, forming the epitomic centrality of their cogntive sense-awareness. AI architectures so not have these characteristics.

Secondly, since all cells receive environmental cues as imperfect information, each cell must individually and internally measure its information. Consequently, each cell self-produces its information (infoautopoiesis) (Cárdenas-García, 2020, 2023; Miller et al., 2020a,b,c; 2023a,b, Baluška et al., 2021, 2022, 2023a,b; Miller, 2023a,b; Reber et al., 2023). Machine microprocessors do not process information in this manner.

Third and correlatively, since each cell self-produces its information, each cell constructs its individual, self-referential, representational interpretation of reality based on its assessment of that self-generated information. Accordingly, no two cells share an identical assessment of the environment, and the same is true for all organisms at all scales. Each generates its own self-referential interpretation of reality. The ambiguity of biological information requires its internal assessment, which then constitutes its only available information as its representation of what lies external to it (Miller et al., 2020a,b, 2023a,b, Baluška et al., 2021, 2022, 2023a,b, 2024a,b; Miller, 2023a,b, Reber et al., 2023). Obviously, no machines perform these actions.

Fourth, issuing from the prior, cells as 'knowing' agents engaged in internal infocompuation attempt to harness informational ambiguities as one means of problem-solving (Miller et al., 2023b). This cellular necessity forms the basis of the cell-cell communication that enables multicellular collective problem-solving as the cellular form of the 'wisdom of crowds,' representing collaborative problem-solving from which creativity can emerge. (Miller, 2018, 2023a; Miller et al., 2020a, b, 2023a,b; Baluška et al., 2023a,b, 2024a,b; Reber et al., 2023, 2024). Machine processing arrays do not perform similar actions.

Fifth, problem-solving intelligent cells can individually and collectively harness stochastic inputs based on their individual infocomputation of uncertain environmental cues that can be directed towards living solutions as continuous problem-solving (Miller, 2016, 2018, 2023a,b; Miller et al., 2020a,b, 2023a,b; Reber et al., 2023, 2024).

Sixth, all these cognitive faculties support individualized states of preferential homeorhetic flux, representing the essence of the self-referential state (Miller, 2013, 2016, 2022, 2023a; Reber et al., 2022, 2023, 2024). The measurement of information by cells as internal infocomputation produces both value and valence (Reber et al., 2022, 2023, 2024). The cell must assess its internal state of equipoise to determine the value of its available information, thus determining the cellular deployment of resources and its willingness to communicate with other cells and trade resources. This linkage of internal measurement of information to its internal self-referential state is the fundament of cellular sentience (Miller, 2018, 2023a,b; Miller et al., 2020a,b, 2023a,b; Reber, 2019, 2022; Baluška et al., 2022a,b,c, 2023a,b, 2024a, b; Reber et al., 2023, 2024). No processing unit in AI systems has preferences or experiences.

Seventh, since cells must measure information internally and can communicate their assessments, they engage in both individual and collective prediction, anticipation, and inference (Miller, 2016a, 2018, 2023a,b; Miller et al., 2020a,b, 2023a,b; Baluška and Reber, 2019, 2022; Baluška et al., 2022a,b, 2024a,b; Reber et al., 2023, 2024). These faculties derive from individual and collective cellular measurement of environmental cues, forming the basis of natural cellular-viral co-engineering that produces phenotypes (Miller et al., 2023 a,b; Miller, 2023a,b). Living organisms predict and anticipate as essential features of sustaining their homeorhetic balance. Even communication is a prediction, making the assumption that such communication merits the deployment of limited cellular resources (Miller, 2018; Miller et al., 2019).

Crucially, cellular cognition is conditioned within four specific biological features unique to the living state. Cognitive cells require:

- Competent boundaries serving as Markov blankets (Friston et al., 2020; 2021; Miller, 2023a,b).
- A seamlessly integrated senomic architecture (Baluška and Miller, 2018; Miller et al., 2020 a,b; Miller, 2023 a,b; Baluška et al., 2021, 2022a,b, 2024a,b, Reber et al., 2023).
- Multiple forms of retrievable and deployable memory (Miller, 2023 a,b; Reber et al., 2023).
- A collective attachment to information space-time (N-space), constituting the entire informational field (Miller 2016, 2018, 2023a,b, Miller et al., 2019, 2020a,b; Baluška et al., 2021, 2022a,b, 2024a,b, Reber et al., 2023).

Each of these four stipulated requirements are essential for cellular cognition and have been covered in detail in previous publications (Miller, 2018, 2023a,b; Miller et al., 2019, 2020a,b, 2023a,b; Baluška et al., 2021, 2022a,b, 2024a,b, 2025; 2023 a,b; Reber et al., 2023, 2024).

Among these four prerequisites, the requirement for an external cellular boundary is directly manifest since it is a feature of all cells. A plasma membrane separates the external environment from the interior milieu, creating the conditions for a self-contained informational matrix that enables self-reference autonomy and agency (Miller, 2023a,b).

The functional characteristics of this type of boundary have been modeled as a Markov blanket representing a "statistical boundary that mediates the interactions between the inside and outside of a system" that has been applied to many biological systems including the brain (Hipólito et al., 2021).

The blanket is a separation of different states with their constitutive subsets, which include active and sensory states. Notably, each statistical set maintains conditional independence from the other. Active states are influenced by the internal states, not the external ones. Conversely, sensory states are influenced by external states and not internal systems. All connect through a nesting configuration that extends across scales (Palacios et al., 2020). This contingent independence induces active

inference and sustains self-organization and the autopoietic self-generation of information (Kirchhoff et al., 2018). Notably, the concept of Markov blankets and smart boundaries is scale-free, applying to intracellular bounded organelles, various other subcellular components, cells, and the further relationship of holobionts with their environments.

The senome represents the sensory organ of the cell as its entire sensory apparatus extending from its external sensory biofields, plasma membrane, and its myriad internal sensory and reactive biomolecules and supporting structures (Baluška and Miller, 2018; Miller et al., 2020a,b, 2023a,b; Baluška et al., 2021; Miller, 2023a; Reber et al., 2023). Consequently, the senome is the cell's connection to its external environment (external Markov state), seamlessly linking all the cell's active tools for information assessment and permitting its individual measurement of uncertain information. Those measurements include both value and valence and sustain a cell's preferential state of homeorhetic equipoise (Reber et al., 2024). In this manner, the cell senses environmental shifts and also 'perceives' its effect on its homeorhetic balance related to its preferential state of equipoise. Necessarily, just as the Markov blanket and boundary system is a nested architecture of sub-states, so is the cellular senome. The plasma membrane-based senomic fields resonate with organelle-based senomic sub-fields and micro-senomic fields associated with all vesicles, the cytoskeleton, and bioactive molecules (Baluška et al., 2021; Miller et al., 2023a,b; Reber et al., 2023).

The essence of conscious experiences and the uncertainties embedded within them begin with cellular infocompuation value and valence. Furthermore, none of these actions would have any meaning absent a ready reference to retrievable and deployable memory (Miller, 2023a,b; Miller et al., 2023a,b; Reber et al., 2023). The cell is endowed with multiple forms of overlapping retrievable and deployable memory beyond that of the central genome. Additional sources of cellular memory include the plasma membrane, multiple lines of immune cells, including various subsets of T and B cells, the membranes surrounding organelles, many kinds of memory-dependent aspects of the cellular receptor systems such as Teazeled (TR) receptors, cell surface cognate receptors, and conformable proteins such as prions and intrinsically disordered proteins (IDPs) (Miller et al., 2024a).

The boundary system based on the plasma membrane that enables its competent senomic architecture is required since any self-referential self-organizing autopoietic system requires some limitation of its potential sources of information so that a 'difference that makes a difference' can be effectively recognized as functional information (Miller, 2023b). In previous publications, universal information has been conceptualized as N-space, a universal field of matter-energy interactions that characterize potential information as superimposed implicates or potentials (Miller et al., 2023b). A membrane-based Markov blanket not only separates external from internal states but is a critical component of establishing a constrained and integrated local information field as a comprehensible subset of otherwise limitless information, thereby providing a constrained set of external environmental cues that an individual cell can access as its field of implicates (Miller, 2016, 2018, 2023a; Miller et al., 2020b; Baluška et al., 2021; Reber et al., 2023). This localized cellular information field, termed its Pervasive Information Field, can be considered the cell's field of view as its individual attachment to universal information space-time (N-space), constituting its entire set of affordances. The cellular senome attaches to this information field as its sensory information projection of the composition of its external environment. Accordingly, the senome represents a critical aspect of its internal measured assessment of self-produced information from which cell-cell communication and contingent deployment of cellular resources eventuate. Necessarily then, each of these cellular actions is downstream of its senomic reception and the cellular self-production of information (infoautopoiesis). Since the senome is cell-wide, the cell must be regarded as a unity, and its cognitive awareness is, therefore, a whole cell experience (Miller et al., 2023a,b;

Miller et al., 2024a,b), acting as a Kantian whole.

Within the entirety, various subcellular compartments and even specific biomolecules have demonstrated remarkable and intricate contingent reactions to intracellular stimuli and stress, so much so that these may qualify as types of intracellular nanobrains (Timsit and Grégoire, 2021; Baluška et al., 2021). In this manner, living cognition can be seen to conform, on a conceptual basis, with nesting Markov blankets and boundaries in which myriad intracellular components each comprise its own conditionally independent sub-unit within an organized Kantian whole (Baluška et al., 2024b).

From this base, the coordinate system of an individual cell-based information field, based on senomic competence and sufficient memory, reiterates in multicelluarity as a multicellular shared attachment to space-time as a multicellular N-space Episenome. The justification for this concept has been fully articulated (Miller et al., 2020b; Miller, 2023a,b; Baluška et al., 2024a; Reber et al., 2023; Slijepčević, 2024) Despite any seeming complexities, the line of reasoning is uncomplicated. If cognitive multicellular organisms with constituent cells numbering in the many tens of trillions are going to seamlessly coordinate their activities to respond productively to successive environmental cues and stresses, and further, if holobionts consist of a wide variety of widely differentiated eukaryotic cells and an obligatory, intimately aligned microbiome comprised of other living species, then any coordinated action requires a common means of assessing uncertain environmental cues so that there is sufficient, effective intracellular and cell-cell communication with volitional sharing of resources to effect highly resilient holobionts.

Cellular cognition requires a boundary as a uniquely competent Markov blanket. This boundary is the bioactive interface between the internal architecture of the cell and its external environment. Thus, that boundary is the epicenter of informational ambiguity represented by the plasma membrane populated by numerous proteinaceous complexes serving as biological versions of Maxwell's hypothetical demons (Baluška et al., 2022b). The boundary itself has multiple forms of embedded memory based on families of molecules like ATP-Binding cassettes, for example (Flatt et al., 2023). Through their highly coordinated actions, these biomolecules actively discriminate which molecules can transit the plasma membrane and enter the cellular interior as substrates for self-produced information. Accordingly, the plasma membrane functions as an initial, key participant in cognitive selection, forming a part of the cognitive palette of the cell (Miller et al., 2024 b).

Cells have a unique senomic apparatus that is dependent on that boundary. The cell's senomic apparatus completely integrates uncertain environmental cues encompassing information reception, internal measurement (self-production), and its internal assessment to become an integrated measured value of information. This self-generated measurement links to prediction, anticipation, and inference to determine its further communication and the contingent deployment of scant cellular resources. All these represent self-referential actions within a context in which the work of analysis changes the outputs as the essence of supporting preferential states of homeorhetic flux. Thus, in the living state, every individual information processor, either as the entire cell or its sub-cellular cognitive constituents (Fitch, 2008; Timsit and Grégoire, 2021; Baluška et al., 2021), is actively discriminating about the value and valence of informational inputs. There is no computer equivalent.

From these particulars, the essence of consciousness can thereby be constructively summated. Consciousness is the self-referential cell-based capacity to apprehend informational uncertainty within the context of a sufficient biological architecture permitting continuous adjustments as problem-solving. Notably, wherever one deems consciousness to emerge along the living scale, each of the four enumerated essentials of cellular cognition represent cell-based solutions to uncertainty. Further, we argue that this apprehension of informational uncertainty and any reaction to it effecting the contingent deployment of resources represents an experience. Machines and AI technology are not conscious since they do not experience doubt and have no internal states. While it is true that

AI systems can engage in autopoietic self-construction, living autopoiesis has always been framed within the cognitive frame which distinguishes self-assembly which some abiotic entities can do and autopoiesis as living self-construction (Maturana and Varela, 1980; Capra, 2022). While it is true that some computer-programmed entities can exhibit activities that seem to represent sequential steps of autopoietic self-construction to yield other forms, these are not the result of internally self-directed. preferential goals. Instead, by definition, these are the product of cognitive human engineering that creates the conditions that stimulate an emulation of independent autopoiesis. Accordingly, machines and AI systems are neither alive nor conscious. From this, a clarifying reduction ensues: the creation of conscious AI is equivalent to the creation of life with all its specific entailments.

3.2. The differential crux of consciousness: the music of experiential life is in its spaces

If musical sounds are played with absolute precision and an unvarying tempo, we criticize them as mechanical, robotic, or lifeless. Artfulness in music is characterized by variations in tone, texture, or tempos that create nuanced expression. Our musical satisfactions center on the layered unpredictability of the exact instant a musical artist will satisfy the transient superimpositions of possibilities into the expressed explicit sound that reaches our ears and senses. The note satisfies those superpositions into an explicate sensory-based 'yes' (Johnson, 2023). The notes start the process, and their duration matters, but the distances among them are where our emotions trigger. We appreciate those uncertainties and experience them as musical delight (Miller, 2022, 2023a).

That same principle of uncertainty relates to our preferences in musical forms. For example, nearly all singers worldwide use vibrato. We hear the wavering around the desired pitch as 'truer' and more innately satisfying than singing without vibrato. Similarly, electronic music has only a very small audience and almost exclusively deployed as a rhythmic backup to a human performer. The lack of depth to the notes in electronic music has little allure unless that electronic instrument has been designed to imitate an actual physical instrument, such as when electronic organs have been engineered to recreate the sounds of physical organs. Yet, that electronic organ is no more a physical organ than AI is a conscious living being. In each instance, only a facsimile has been produced.

The same phenomenon holds for our discriminating choice of interpretations of pieces of music. Why is it that when ten great pianists interpret a Chopin nocturne, opinions as to a favorite will vary so widely? The reason is that, as conscious observers, we each live in our own reality and, consequently, independently resolve informational uncertainties to be in concord with our preferential sensibilities. None of us experience that music in a precisely similar manner. That difference is based on our cellular nature and our obligate existence within an uncertainty relationship as the essence of the conscious state. The reason why conscious self-awareness of doubt exists is a mystery, but nonetheless, it does. Crucially, however, it exists only in the living state and not otherwise.

Music has often been advanced as a discerning metaphor for life's complexities. Noble (2008), in an acclaimed volume, The Music of Life: Biology Beyond Genes, asserted life as a 'symphonic interplay' among multiple living scales. Just as in music, all levels participate, and none have absolute primacy. This apt conception can now be productively extended, helping to explain the gap between actual living consciousness and AI simulations.

The essence of consciousness is not centered exclusively within the notes themselves but, instead, is contained in the ambiguities that develop within the spaces between them. Consciousness is not a stream of exact environmental stimuli as direct functional inputs. The sources of noise that occur before and after that stimulus that interact with the senomic architecture of the cell are numerous, and the cell must interpret every stimulus internally. Consequently, the context of the inherent informational ambiguity that defines cellular existence represents not only the stimulus itself but an interpretation of that stimulus based on the cell's current palette of anticipations and inferences as a harnessing of ambiguities. Accordingly, the essence of self-referential cognition is the self-referential perception of the relative concordance of stimuli and anticipation based on prior experiences as the means by which cells manage innate uncertainties.

This process can be likened to reality as enfolded meaning, as depicted by Bohm and Hiley (1975) as the uninterrupted process of the continuous resolution of implicates into explicates (Torday and Baluška, 2019). Metaphorically then, musical notes are explicates, and the spaces between them represent superimposed implicates. Thus, the spaces are where the greatest number of ambiguities dwell.

The idea that the spaces between information inputs are particularly relevant to consciousness has been introduced previously. Forshaw (2016) presented the Third Space concept, indicating that spaces between points of information in an informational matrix are not 'empty' spaces (Forshaw, 2016). Indeed, within that space-time matrix, the spaces are what bring order and value to a stream of data or information, just as the spaces between these words bring an improved understanding of the words in this sentence. The Third State is conceived as a universal operator that exists beyond binary operators in data → information, augmenting the "probabilistic nature of the conscious manifestation" (Forshaw, 2016. p. 69). Accordingly, consciousness is the simultaneous product of current conditions and anticipation (self-predicted future).

It has been previously argued that information has both a presenting value and its antipode as information that is not directly sensed but still relevant to an organism, operating much as commercial communications feedback channels use antipodal signaling to improve system performance (Srinivasan, 1981). This form of inferential information leads to an important characteristic of self-referential consciousness. Anticipated information that is not received is highly significant (Miller et al., 2019).

The 'Third Space' highlights the differences between digital computers that have no inferences and consequently no expectation of the length of anticipated 'spaces' and living consciousness in which these relevant spaces have direct meaning for affective states and ultimately influence states of preference. Conscious organisms 'know' there are spaces between their environmental inputs and their determinate appraisal. The appreciation of that uncertainty gap defines consciousness (Poznanski et al., 2023).

4. Discussion

> You can simulate every aspect of a swimming pool but no one is going to get wet.
>
> John Searle, philosopher

In discussing the issue of intelligence, Hollnagel (2003, p. 65) offered a vignette from one of the Father Brown short stories of G.K. Chesterton, written in 1911. Chesterton describes the head of the Paris police Aristide Valentin, "'(h)e was not 'a thinking machine'; for that is a brainless phrase of modern fatalism and materialism. A machine only is a machine because it cannot think." Although insightful for its time, our modern view of computers has evolved to view their engagement with ourselves and our environment in terms that conflate with conscious experience (Hollnagel, 2003). The computer may not be 'thinking', but our intimate dependence on them and their ability to evoke an affective response in us begin to blur these once-sharp distinctions between human thought and machine intelligence. Accordingly, Hollnagel (2003) recommends that the contentions be put aside since what matters most is our effective communication with them.

Keep in mind that AI's are "simply" covariation detectors. Their computational power comes from being able to extract relationships among vast arrays of factors in the data inputs — a function that is a

version of associative learning in which all organic entities engage (Reber, 1993). However, the computational power of AI allows the spotting of associations among a huge array of features over temporal and physical distances that no living organism can match. Even so, that is not "knowing", only just logging, systematizing, and presenting data links. Correspondingly, AI's play complex games like chess or poker with extreme facility without "knowing" what a "game" is or predict the weather far better than any of the standard meteorological methods — without, as Searle would put it, "getting wet."

A general consensus exists that discrete attributes inherent to consciousness exist, separating a non-thinking machine from a conscious, thoughtful individual by encompassing several key characteristics.

- Consciousness is inherently subjective and embodied, existing solely within the realm of individual perception (Tait et al., 2023).
- Consciousness achieves unity by seamlessly integrating various sensory modalities, forming a cohesive and singular experience as recurrent processing (Tait et al., 2023).
- Conscious experience is intentional, always directed towards a perception, object, emotion, or prior thought.
- The richness of our conscious encounters lies in qualia, the subjective qualities that define our experiences, such as color, taste, sound, or heat.
- Together, subjectivity, unity, intentionality, and qualia collectively shape the intricate tapestry of our conscious existence.

As previously noted, consciousness depends on deployable and retrievable memory and an effective boundary system from which predictions as active inferences can be gleaned (Miller, 2023a,b; Reber et al., 2023). Thus, a sensitive boundary mechanism linking to retrievable and deployable memory is a prerequisite for consciousness (Miller, 2023b).

Two salient features of the living state that depend on this boundary have been previously emphasized. First, a Markov blanket "comprises a set of states that renders states internal to the blanket conditionally independent of external states." (Friston et al., 2020, p.3). These mathematically separable states permit a conditionally independent internal and external, enabling the biological thermodynamic flows that consciousness entails. Furthermore, these same Markov blankets are intrinsic to the Free Energy Principle, which has been asserted to enable prediction and inference as a minimization of surprise as a cornerstone of cognitive discrimination (Palacios et al., 2020).

These same principles hold whether or not individual cells are appraised as conscious agents. Cellular structure enables these requisites, forming an interior state separate from and independent of the external environment. That boundary and the noise it engenders stimulates cellular infoautopoiesis as internal measurement. Thus, there is an obligatory gap between any external cue and the cell's internal perception of it, and this informational ambiguity has no parallel in computer data processing. Since all conscious being are cellular, then the fundamental informational substrate of all cells, whether conscious or not, must ultimately form any emergent multicellular consciousness.

For many scientists, the Free Energy Principle conditioned on Markov blankets is an embedded feature of sentience (Friston et al., 2020, 2021). Though not all agree, it is reasonable to assume that consciousness represents a continuum of fundamental thermodynamic processes. According to the Free Energy Principle, the self-organized living state is a thermodynamic flux that directs to the diminution of variational free energy which directly links to the minimization of surprise as predictive inference (Friston et al., 2006). In this way, consciousness is a process of successive series of active Bayesian inferences in context (Friston, 2009). Consequently, informational ambiguities, as a continuing flow of superimposed implicates, can be settled non-randomly through internal predictions. In this manner, and because of these obligatory flows, all cells and multicellular organisms are not merely 'in' the environment but 'of' the environment as simultaneous observers and participants,

thereby defining the crux of the conscious experience (Torday & Miller, 2016).

Secondly, pertinent to the anti-entropic requirements of living consciousness, Kauffman (2022) has proposed a Fourth Law of Thermodynamics as a dynamic underpinning the living state with organisms as a Kantian wholes. In this framework, living entities do work, self-constructing sub-domains within an ever-enlarging phase space (Roli and Kauffman, 2020; Baluška et al., 2024b). The result is a net localized decrease of entropy, contravening the Second Law and enabling the living state. Notably, however, in living systems that are information-dependent, these thermodynamic fluxes correspond to the living use of information which relies on each organism's relevant information field (Miller et al., 2020a,b, 2023a,b; Miller, 2023a,b; Miller et al., 2024a).

Naturally, there are many other divergent approaches to consciousness. In devising their fourteen indicator properties of potential AI consciousness, Butlin et al. (2023) based their analysis on brain and nervous system-centered conceptualizations such as recurrent processing theory, global workspace theory, computational higher-order theories, and attention schema theory, as these enable predictive processing, agency, and embodiment.

On the other hand, this group dismissed integrated information theory (IIT) as unscientific and unable to be falsified. However, this latter theory does offer some concepts that conform to the cellular living state. Integrated information is the total quantity of information formed from a 'complex of elements' that includes their relevant connections (Tononi, 2004). In consequence, integrated information is always more than the sum of its parts. Pertinently, this conception fits well with the concept of the cellular attachment to its relevant information field, which represents the entire architecture of all potential information that might be made available to a cell and forms one aspect of its conscious attributes (Miller et al., 2020a; Miller, 2023a,b).

Integrated Information Theory in its 3.0 version offers five "self-evident truths" about consciousness (Oizumi et al., 2014). Many scientists argue that these truths are either obvious or not necessarily applicable. Butlin et al. (2023) assert that the entire basis of IIT is ill-founded, citing Bayne (2018) and Hanson and Walker (2023) as evidence. Nonetheless, IIT's five principles correlate with features of cellular basal consciousness in a direct manner (Miller, 2023 a,b).

a) Consciousness exists.
b) Consciousness is structured as a combination of its aspects as an entirety.
c) Consciousness is informative, allowing the differentiation of one experience from the next or those of others.
d) Consciousness is integrated: each experience is not reducible to its interdependent components.
e) Each experience is exclusive and unlike any other.

Pertinently, though, while IIT identifies a variety of functions and operations that conscious entities display, it does not follow that any artificial system displaying these features through facile programming will be conscious. There are differences in how organisms carry them out compared with artificial ones based on cellular processes. Simply 'doing' them does not make entities conscious, self-aware, or sentient.

Tononi (2008) argues that integrated information sets the conditions "that permit many nested discriminations (choices)." Such distinctions lead to the deployment of resources. Crucially, those distinctions are necessarily a measurement meant to place value and valence on informational stimuli. Notably, value and valence are both derived from within the obligatory ambiguities inherent to the reception and processing of information (Miller et al., 2020a,b; Miller 2023; Reber et al., 2023). Further, that measurement is internally self-generated, and therefore, individual to that cell. The drive to improve the validity of self-generated information derived from uncertain information leads to its collective cellular assessment. Thus, uncertainty drives

multicellularity as collective measurement in a recursive application of the integration of information (Miller, 2018, 2023a,b; Miller et al., 2020a,b; Reber et al., 2023).

A pertinent entailment arises from this close linkage. The issue of informational quantity and quality in consciousness cannot be separated into an 'easy' problem of wiring connections and the 'hard problem' as experientiality as proposed by Chalmers (1995). The internal measurement of information establishes both value and valence since that measurement is self-produced from an uncertain source and is deployed to sustain a preferential state of homeorhetic flux. Thus, it can be argued that all cells exhibit basal sentient dualism, which includes cognitive infocomputation and conscious experientiality at scale as its form of an affective state at scale, which translates into cellular preferences (Reber, 2019, Baluška et al., 2021, 2022a,b; Reber et al., 2023, 2024).

Significantly, in cognitive cells, any deployment of information as a 'nested discrimination' is a choice based on the prediction that the expenditure of limited cellular resources is likely to be productive to maintain its state of preferential equipoise. Notably, these predictions include those communications that enable multicellular integrated information (Miller, 2023a). Consequently, any theory of cognition, consciousness, or mind must be based on a cell theory (Margulis, 2001; Miller, 2016, 2023a,b; Reber, 2019, Baluška et al., 2022a,b, 2023a,b, 2024a; Reber et al., 2023a,b). Significantly, then, in the living frame, which is definitionally cellular, each individual logic processor is making choices based on value and valence and forming internal predictions because of it.

Pertinently, the basic cell is the epitomic form of exclusive selfhood, connecting seamlessly to information space-time (Miller 2016, 2018, 2023,a,b; Miller et al., 2019, 2020a,b; Baluška et al., 2021, 2023b; Reber et al., 2023). Three essential elements are inherent aspects of this conscious dimension, and each is exemplified by cells (Miller et al., 2019; Miller, 2023a). A self-referential cell 'knows that it knows' by appreciating that it is separate from the environment and must do deliberate work to sustain itself. Secondly, it is apparent that self-aware cells 'know that others know' since collective life is the preferred living format, permitting the sharing of information and the trading of resources. And third, and incumbent on the preceding, cells understand that others 'know in self-similar patterns' and will assess information and attend to goals in like kind to themselves.

This background clarifies the unbridged gap between artificial intelligence and the cognitive intelligent cell. Artificial intelligence simulates human thought but is not energized or constrained within the living parameters that actually define living consciousness. It follows that to actually recreate consciousness requires an adherence to those exclusive mechanisms that permit cellular consciousness.

Many scientists have concluded similarly, agreeing that many hurdles remain in attaining AI consciousness. Aru et al. (2023) argue that AI offers users the impression of being a conscious agent but does not exhibit it, lacking the 'phenomenological umwelt' of living organisms, which is multifaceted and differently integrated from computer processing. AI tools do not display the 'organizational complexity' of living systems, which would have to be captured to gain consciousness. For instance, the large language models (LLMs) used in AI systems do not mirror the type of information processing displayed by the thalamo-cortical system that many cognitive neuroscientists deem necessary for a full integration of human consciousness. Whether or not these specific neurocircuits are required for conscious awareness, AI LLMs "lack the embodied, embedded information content characteristic of our sensory contact with the world around us." (Aru et al., 2023, p. 1008). Consequently, AI technology offers no parallel to the pathways to consciousness in the living state.

Roli et al. (2022) conclude similarly by examining consciousness in an analytical framework of 'affordances', defined as opportunities or obstructions organisms enter to achieve their goals. In their view, only living organisms can have such 'affordances' as the "use of an object in the hands of an agent", since the characteristic features of these

'affordances' cannot be specified algorithmically. Hence, AI architecture is not amenable to consciousness.

Beyond those differences already discussed, five salient biologically-centered differences categorically separate living consciousness from artificial intelligence.

a). At the most fundamental level, the nature of the information between computer-based machines and living systems is unalike. This essential contrast can be simply visualized as two separate types of waveforms (Fig. 1).

Notably, digital '1's and '0's can be considered terms of a 'yes' or 'no'. There is no 'maybe' which categorizes the living assessment of information. Anything construed by the system as a 'maybe' is assumed to represent an error, to be disregarded or requiring the data transmission to be repeated. In living systems, there are no absolute yes's and no's. All information is a conditional 'maybe' upon reception, triggering its internal measurement where it is given a value and valence (Miller, 2018, 2023a,b; Miller et al., 2020a,b, 2023b; Reber et al., 2023).

To create a conscious AI, the receptive apparatus of the computer would have to change. Computers are built on binary data inputs. The living frame is not. For a computer to know its information is ambiguous, the actual basic structural computer informational format would have to be redesigned to have stochasticity embedded within as obligate noise. If this were the case, then the computer would be individually measuring every informational input for value, but also must embody an internal sense of preference to appreciate informational valence. Specifically, cellular infocomputation extends beyond assessing a value as if it were a raw number reflecting intensity but includes its valence as meaning to be integrated as aspects of learning, perception, memory, and decision-making (Lyon et al., 2021; Dodig-Crnkovic, 2022). Thus, both 'meaning' and 'shades of meaning' derive from the ambiguity of information. From this informational processing, the cell upholds its preferential state of homeorhetic flux from which its choices devolve, including communication and trading resources (Miller, 2013, 2022, 2023a; Reber et al., 2023). Further, though, and quite significantly, an internal self-produced cellular measurement whose output is valenced for informational meaning constitutes an experience that contribute to cellular states of preference.
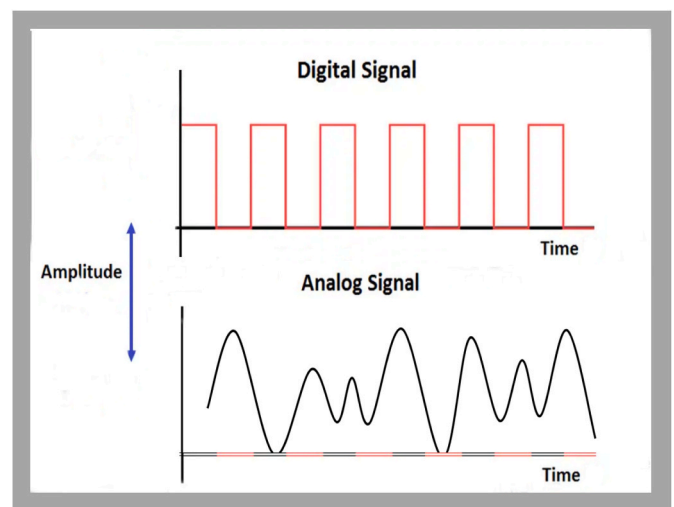

Fig. 1. Digital versus analog signals: A square wave characterizes the digital waveform by indicating its binary nature as 1's and 0's as metaphoric yes's and no's. Discrete orthogonal signals correspond to the instantaneous response pattern of digital electronic circuits. An analog system can be represented by a sinusoidal waveform whose amplitude varies considerably, depicting harmonic averaging and the effects of noise and better reflecting the uncertainties (maybe's) of living systems.

b). The entire architecture of AI is fundamentally unlike our biological world. In the living state, each informational node is an individually active, conscious, receiver-sender agent as both a participant and observer. Agency resides in each cell in a holobiont that is tens of trillions of cells. That agency resides within the cellular requirement for each cell to internally measure ambiguous biological information. Therefore, each cell self-produces its own representation of an informational cue. Consequently, each cell's encounter with the environment forms the substrate of organism-wide consciousness. This requisite clarifies why AI is not conscious, nor will be in the foreseeable future. In the living state, the basal information processor is a cognitive, competent participant across an entire connected architecture of similarly endowed participants. There are no parallel like-kind features in AI construction. For it to be so, each individual processor, each computer chip in current terms, would have to be conscious and individually capable of the self-assessment of uncertain environmental cues.

c). The current dominant cognitive science framework presumes that consciousness arises in the brain (Grossberg, 2017; Lyon et al., 2021). However, all multicellular eukaryotes are constellations of tens of trillions of cells that participate in our growth, development, physiology, metabolism, and survival (Miller, 2016a,b, 2023a). Accordingly, we experience our conscious apperceptions because of their seamless and intricate integration (Miller, 2016, 2023a,b; Reber, 2019; Baluška and Reber, 2019; Miller et al., 2020 a,b, 2023a,b; 2024; Baluška et al., 2021, 2022a,b, 2023a,b; 2024a; Reber et al., 2023, 2024).

d). This conscious totality relates to the individual cognitive competence of highly differentiated eukaryotic cells, including those of the nervous system, and the strategic competencies of our microbial partners and competitors. The totality of our conscious perceptions depends on an intimately related co-appended, partnering microbiome. Research confirms that our microbiome has far-ranging influences on our metabolism, physiology, moods, and behaviors (ElRakaiby et al., 2014; Johnson, 2020). For example, 90% of serotonin production depends significantly on our microbial fraction (Xie et al., 2020). Further, Vitamin B12-producing bacteria colonize the intestine, producing acetylcholine that affects excitatory cholinergic signaling and behavior (Kang et al., 2024). Furthermore, evidence is accumulating that a breakdown of that microbial partnership carries cognitive consequences, including cognitive impairment, dementia, depression, schizophrenia, and addiction (Luca et al., 2020). Even a single pathogen can influence the conscious perceptions of a holobiont. Toxoplasmosis infection is associated with behavioral changes in humans and other animals, including shifts in risk tolerance, neuroticism, and triggering other behavioral anomalies associated with mental illness (Johnson and Johnson, 2021).

e). Lastly, living systems are inherently social, forming complex, integrated social networks. Prokaryotes form ubiquitous biofilms. All multicellular eukaryotes are holobionts as vast assemblies of differentiated eukaryotic cells and a partnering microbiome (Miller, 2016a,b). Even viruses, typically considered neither alive nor conscious, display aspects of sociability, demonstrating pervasive, collective viral interactions through cross-communication, cooperation, and competition, studied as the new discipline of sociovirology (Díaz-Muñoz et al., 2017). In contrast, computers have no social sensibilities that can be construed as active social dialogue akin to all living systems and are insensible to social content as humans experience it (Collins, 2018).

Accordingly, our human consciousness that AI attempts to emulate is a product of individual nodal cognitive competencies of eukaryotic cells,

which differ metabolically, physiologically, and biochemically from one another. These are further entwined with a partnering microbial cohort comprised of entirely different (microbial) species that also contribute to the resources and substrates that enable our total holobionic consciousness. Our modern understanding of the complexities of holobionic life supersedes 20th-century dualism. Holobionic consciousness is an organism-wide, entirely integrated phenomenon that AI architecture cannot simulate. Consequently, the debate on AI consciousness has proceeded along unproductive pathways since they have not been grounded in 21st-century cellular biology. An additional incorrect assumption compounds this deficiency. Current consciousness scholarship and research presume that cognition represents an emergence. Instead, strong evidence based on cellular behaviors indicates that cells have been cognitive agents since life's beginnings (Miller, 2016a). In these terms, cellular cognition can be alternatively considered to be an instantiation. The Cellular Basis of Consciousness asserts similarly, contending that consciousness and life are coterminous, with consciousness continuously embodied in the cellular form (Reber, 2019; Reber et al., 2022, 2023, 2024). The consciousness displayed by multicellular organisms is its aggregated manifestation with all of its attendant idiosyncratic nuances as expressed by each individual organism. This principle explains why species' consciousness strongly tends to type, but every individual within the species represents a variance, not merely physiologically or phenotypically, but also in its conscious appraisal of the environment. In a sense, then, consciousness can be appropriately considered another form of phenotype (Miller, 2023a).

In contrast, any AI system trained on the same data and run by the same program would produce identical results except for any faults incurred. Its processors are not separate agents, and its emulation of consciousness would follow invariant patterns within the same system.

A part of the seductive capacities of AI stems from the ability of LLMs such as ChatGPT to interact so successfully with us that the programs seem to our conscious experiences and sensibilities to understand our human way of thinking with disarming facility. Durt et al. (2023) explain this effect by stressing that human language is intimately related to experience and understanding: "Written words are only one part of language use, although an important one as it scaffolds our interactions and mental life. In human language production, preconscious anticipatory processes interact with conscious experience. Human language use constitutes and makes use of given patterns and at the same time constantly rearranges them in a way we compare to the creation of a collage" (Durt et al., 2023, p.1). Crucially, then, LLMs do not model mental capacities but instead provide insight into how we use language and its embedded clichés and biases. In essence, LLMs reveal the underlying patterns of human language that guides thought.

However, that facility does not encompass the sweeping totality of our consciousness since it misses the preconscious anticipatory processes enabling our consciousness and likely informing our elusive subconscious. Crucially, the machine has no understanding of what it has produced and has not experienced anything through that production. AI simulates consciousness by revealing the surprising extent to which human language use gives rise to and is guided by meaningful patterns in language use (Durt et al., 2023).

The philosopher John Searle offered an illuminating way of looking at this debate: "The Turing test enshrines a temptation to think that if something behaves as if it had certain mental processes, then it must actually have those mental processes. And this is part of the behaviorists' mistaken assumption that in order to be scientific, psychology must confine its study to externally observable behavior. Paradoxically, this residual behaviorism is tied to residual dualism. Nobody thinks that a computer simulation of digestion would actually digest anything, but where cognition is concerned, people are willing to believe in such a miracle because they fail to recognize that the mind is just as much a biological phenomenon as digestion" (Searle, 1990, p. 31).

Wang (2023) places the issue of AI consciousness into a framework of 'Subjective Self', reflecting self-awareness and the sense of knowing that

you are self-aware. Computers can be programmed to say they possess this sense of self, but are nonetheless not self-aware. Two axioms guide this stance: subjective self is unitary (there is only one I), and subjective self is not copiable. Computers fail both tests. They have no intrinsic self-awareness, and computer programs are copiable.

Wolfram (2002) argued that the universe including the emergence of life and consciousness runs on universal laws that can be described by simple programs as the ultimate source of all codes. Wang (2023) disagrees and regards consciousness as a singularity, constituting a "forbidden blind spot" since it cannot be realized by a computer. Consequently, strong AI is not consciousness, just an emulation of self-consciousness as humans interpret their consciousness and train AI systems.

At the current extent of our knowledge, consciousness constitutes a singularity. Cognition was embodied within the cellular form at least 3.7 billion years ago and has continued uninterruptedly since that origin (Miller, 2016a, 2023a; Baluška et al., 2022b, 2024a,b, 2025; Reber et al., 2023). The characteristic feature of that instantiated consciousness is the self-referential awareness of uncertainty. Since AI cannot re-create this intersection, it cannot have a subjective self. For AI to achieve that, it would need to be its own autopoietic closed causal loop with the intrinsic capacity for prediction and anticipation, which is necessarily based on both structure and process (Capra, 2022).

Accordingly, one marker for any human type of consciousness is the presence of actual self-conscious emotions, such as shame, pride, or guilt, which drive human thought and actions. However, these self-conscious emotions require genuine self-awareness and self-representation, which computers lack (Tracy and Robins, 2004). Damasio and Damasio (2023) argue further that these emotive and experiential aspects of life as 'feelings' are the specific source of consciousness based on their continuous flow.

Butlin et al. (2023) raise the question of whether there can be consciousness without experience. They opine that: "It is at least conceptually possible that there could be conscious systems that have no valenced or affective conscious experiences—that is, no experiences that feel good or bad to them" (Butlin et al., 2023. p. 64). They cite others who assert that such distinctions between mental state and phenomenal consciousness exist (Barlassina and Hayward, 2019; Carruthers and Gennaro, 2020). Similarly, Amir et al. (2023) ask, "can you experience without knowing?" and conclude that a dissociation exists between phenomenal consciousness and access consciousness, which permits reporting of having had an experience (Amir et al., 2023). 'Unconscious' states from anesthesia or drugs are considered examples of this phenomenon.

The Cellular Basis of Consciousness explains this phenomenon by upholding that in multicellular systems that require a complex integration of an entire suite of trillions of coapted cells to enable conscious experiences, there will be circumstances that are either natural everyday events, such as sleep, or artificially induced (anesthesia, drugs) states that suppress some aspects of the critical cell-cell communication that enables full holobionic conscious integration. Thus, levels of conscious perception are a natural circumstance, and the levels of consciousness that are part of the practice of anesthesia readily exhibit this phenomenon. Accordingly, the levels of anesthesia required to suppress mobility, induce amnesia, or block perceptions of awareness differ since they depend on separate groups of cells in different regions of the nervous system and body (John and Prichep, 2005). Although purely speculative, we could wonder whether our active sub-conscious impulses are secondary to this same temporary, relative sequestration of some sets of cells from the unitary whole.

AI chips include graphics processing units, field-programmable gate arrays, and application-specific integrated circuits. Yet, no one supposes these silicon-based chips have experiences during information processing. Despite this self-evident limitation, some believe that AI consciousness will emerge if the models are skillfully taught to mimic human patterns of thought (Butlin et al., 2023). However, the learning process for AI is distinctly different from how humans optimally sort and order informational cues. For example, back-test overfitting is a common error in financial modeling, leading to errors in real-time applications. AI training issues include a similar limitation in which insufficient and non-representative training data limit a model's capacity to adapt to novel situations. Overfitting exacerbates this challenge by hindering the generalization of new data. As a result of overfitting, the model performs well on the training data but poorly when placed into real-time testing. (Pothuganti, 2018). What computers lack is the programmed flexibility to harness stochastic inputs to settle inferences and anticipations that are unsatisfied to sustain a preferential state. Similarly, living beings harness ambiguities as one trigger for creativity (Miller et al., 2023b, 2024b).

AI's creativity is a product of its training data and algorithms. AI systems possess no emotions or human physiological variability that assists in triggering 'mind-wandering', an essential aspect of our creativity (Henriksen et al., 2020). AI manipulates and generates content based on statistical associations and patterns in data. The results can be impressive, but they fundamentally differ from the creativity that arises from human consciousness and imagination.

For decades, the Turing test was a valued litmus for computer competence and human simulation. AI has surpassed that hurdle. In the 21st century, other tests need to be devised. From these differences between living consciousness and AI computation, whether the consciousness gap has been overcome requires a new set of questions that extend beyond the previously clarifying hurdle of the celebrated Turing test. Undoubtedly, AI can fool a remote observer into believing their interaction is with a human being. Still, we know that that same AI program is not conscious. What are the correct assessment questions in our current circumstances?

- Does the computer 'experience' ambiguity?
- Does the AI self-produce its information through sorting informational inputs that are non-binary and innately ambiguous and noisy?
- Does the AI harness stochasticity and ambiguity as its means of channeling novel, creative outcomes?
- Does the base element of the relevant computer hardware have self-referential states of preference as individual experiential nodes?
- Does the measurement of information by the individual computer processor have value and valence so that specific data processing node is experiencing both particulars?

Undoubtedly, these are formidable hurdles to designing systems that could measure the validity of claims that these particulars are satisfied. Indeed, if it is precisely determined how to measure these indicators of consciousness, then it is highly likely that the test conditions have been satisfied.

When the aforementioned stipulations are fully considered, the issue of AI consciousness is amenable to a striking reduction. When the origin of life and cognition/consciousness are considered coterminous, AI equates with the de novo creation of life, either as self-referential, subjective cognition or replete consciousness. Since we have yet to learn how life was created, AI computer scientists cannot purposively proceed to that goal and would have to stumble upon it.

The highly debated relationship between technology and epistemology has been elaborated by one of us (Slijepcevic, 2023, 2024). These linkages, as described, incorporate the thinking of Maturana & Varela, Robert Rosen and Gregory Bateson, integrating the concept of information in a biological sense with naturalised technology. In this framework, both AI and music should be interpreted as surrogates of naturalised epistemology, with both utilizing relevant instruments (violins or computers) to convey information in different contexts. Significantly, despite their apparent differences, both computers and musical instruments reflect a cognitive agents' capacity to use them constructively. Each represents the selective application of different materials to deploy abstract concepts and express information. This living action is

autopoiesis in the true sense, embodying Rosen's perspective that organisms remain closed to efficient causation, relying on internally generated predictive models of themselves and their environments (Slijepčević, 2024).

This insight clarifies that both AI and musical instruments, despite wide variances in form, are simply tools of expression by a relevant cognitive agent. Both are forms of technology and neither have internal subjective agency. No one would consider a violin a potentially conscious agent because it channels the creative power of the musical artist. AI is merely a different tool, though a highly seductive one, and has no more inherent consciousness than a violin. Neither experience internal subjective uncertainties.

We have previously argued that cognition/consciousness resides within each cell, and global multicellular consciousness derives from aggregated individual cellular consciousness (Miller, 2016a; Reber, 2019; Baluška et al., 2022a,b, 2023a,b; 2024; Reber et al., 2023, 2024). However, this same linkage remains true even if one grants that cells only exhibit basal cognition and are not fully conscious. Since all information appraisal is definitionally conducted at the cellular level as an internally produced measurement of ambiguous environmental cues, it follows necessarily that the epicenter of informational uncertainty resides at the level of the individual cell.

We argue that any proposal that cognition/consciousness arises only in some organisms and is denied in others is unsupportable when the essence of cognitive awareness is the 'knowing' of uncertainties. Those ambivalences require cellular internal measurement of environmental cues, yielding the cellular self-production of information. A competent, discriminating senomic apparatus is required for this cellular assessment of uncertain information. All individual cells satisfy these requisites since they are the front line of environmental assessment. Further, the path toward understanding our human faculties, such as our capacity for abstraction and advanced problem-solving, is clarified. Abstraction and greater problem-solving abilities correlate with the ability to accept higher levels of uncertainty prior to settlement into explicate biological resolution.

Thus, multicellular consciousness is the flexible, seamless integration of individual cells 'knowing' uncertainties and integrating these into multicellular biological competencies (Miller, 2016a, 2018, 2023a,b; Miller et al., 2020a,b, 2023 a,b; Reber et al., 2023; Poznanski et al., 2023). Indeed, higher levels of organismal consciousness such as our human kind do not equate with fewer uncertainties but instead represent the ability to sustain states of uncertainties and weigh their consideration for longer periods before settlement. Indeed, it is no different than watching a very young child fidget, trying to decide to consume a sweet now or voluntarily postpone immediate consumption in the prospect of being offered an additional one as a reward for patience. A hallmark of the developing juvenile intellect relates to accepting present uncertainties and dealing with them successfully.

According to Bohm and Hiley (1975), that uncertainty gap lies within the matrix of superpositions of uncertainties that define living ambiguities and trigger their explicit settlement into specific biological forms. This distance can be considered the 'living gap' that separates living consciousness from computer-simulated AI consciousness, however elusive it may be. Cells are the ground state of that informational uncertainty.

This specific gap can help us to understand the tidal differences between assertions of AI consciousness and biological reality. Computer and cognitive scientists recognize this difference and are actively attempting to address this gap. Poznanski et al. (2023) have devised mathematical models of brain-centered consciousness that explicitly acknowledge the role of uncertainty. In their terms, the intrinsic information in the brain that permits consciousness is temperature-dependent "hidden thermodynamic energy", acting at the submolecular level and enacting subjective intentionality. Subjective intentionality leads to 'meaning' as a "precognitive affect forms an 'act of understanding' or subjective intentionality that relies on intentions

sensed as feelings" (Poznanski et al., 2023, p. 288). From this sequence, their definition of consciousness arises as "the act of understanding uncertainty," which is regarded as psychodynamically fundamental.

Computer scientists are working with 'fuzzy logic', which extends beyond binary computing as 'true or false' to informational states as 'degrees of truth,' thereby attempting to imitate human cognition. Non-numeric values are used to enable the expression of rules, description of states, or characterize facts. This form of computing has many uses, but notably, the computer does not know uncertainty, nor does their logic function deal with informational uncertainty as cells must deal with it. The computer weighs a variety of valued inputs in relation to each other to arrive at a decision. The logical process of fuzzy logic is quite unlike simple binary computing, but it is still computing, and there are no hidden variables that characterize living consciousness.

That non-withstanding, there is a developing recognition that looking for consciousness in AI systems entails modeling individual environmental states and their embedded uncertainties and understanding how those calculations lead to a next state (Khayut et al., 2020). As promising as this complex work may seem, a recent thorough review of progress toward AI consciousness concluded that no breakthroughs could be found that would deliver machine consciousness over the near term, and there are no methods to evaluate if machine intelligence possesses consciousness (Yamada et al., 2022).

The reason why these initiatives will not produce machine consciousness directly relates to the manner in which living organisms assess their environments. Kauffman and Roli (2023) examine how living organisms navigate through' features of the world', representing their 'affordances' as potential sources of benefit or harm. Significantly, the number of uses of each of those features is always indefinite, unordered, cannot be listed, and cannot be deducible from one another. However, all still participate in adaptive mechanisms. Consequently, artificial intelligence based on universal Turing machines is not possible since their information processing mechanisms are completely different. Kauffman and Roli (2023) further assert that the living process is at least partially quantum-based. When placed in those terms centered within Heisenberg's interpretation of quantum states as 'potentia', then any 'actuals' are the result of subjective measurements, inseparable from qualia, which computers are incapable of experiencing.

These same parameters are applicable to cells. Basal cellular cognition is based on a replete senomic apparatus that is entirely different from computer architecture. Therefore, the appraisal of information in the living state is specifically unlike computer systems. Consciousness is the self-referential state that permits the harnessing of ambiguity and stochasticity at all scales. No computing system can do either. Consequently, noise in the living state is potentially useful, but not in computers. Conscious beings live within uncertainty. Computers do not. Unlike computers, conscious beings have cycles of wakefulness and rest, linked to internal states of preference. Computers do not. In cellular life, all communication is a work signature to some other observer-participant in its conjoining information field. There is nothing similar within computer operations. Accordingly, the concept of 'conscious AI' derives from a significant misapprehension of the nature of living consciousness, experientiality, and its fundamental roots.

AI systems can learn from experience and perform human-like tasks, and they may be considered more intelligent than humans based on many metrics. However, no matter its manifest powers, AI systems cannot be conscious because they never experience internal doubt or have any internal, subjective state of preference.

5. Synthetic biology

If you ask a computer scientist whether machines could be made conscious, many would insist they could. If you asked the same scientists if they believe they can create life, they would demure. Yet, they are one and the same. Given that confluence and recognizing the nearly insurmountable hurdle of creating consciousness de novo, it is inevitable that

scientists will gravitate to avoiding this task by marrying AI systems to conscious cells, creating a new form of synthetic living dualism. There is a notable symmetry to this assertion. Doing so entirely remains within the definitional paradigm that life only comes from life. Accordingly, we can predict that a fully conscious AI machine will not be developed de novo. Instead, we will default to leveraging a seductive synthetic combination that adroitly combines the computational features of AI with the uncertainty relationships inherent within the cellular living frame. Undoubtedly, a melded architecture will ultimately be developed, perhaps a form of machine-based fuzzy logic meeting cellular doubt.

Those results can be expected to be both exhilarating and discomforting. Most particularly, our technical powers are moving faster than our moral systems can adapt and more swiftly than our ethical systems can constrain.

These 'thinking' AI synthetic organisms might center on how the computer architecture interprets noise. In computer computational terms, this specific living feature might be based on an intensive study of the noise in biological fluctuations, termed 'Yuragi' (Ishiguro, 2013).

Significantly, what we are presently learning from AI intelligence and will comprehend better in the future is that each form of intelligence can inform and leverage other types of problem-solving. For example, new strategies for the efficient, targeted delivery of bioactive cargo are being researched, combining cell-membrane-derived systems used as carriers, and applying AI intelligence to the biological decision matrix (Mozafari et al., 2023). The result will be new forms of nanomedicines for treating cancer and immunological disorders. Similarly, AI is being used to assist in designing novel synthetic proteins with a broad range of usage in drug, vaccine, and enzyme development as part of the rapidly advancing field of metabolic engineering (Jang et al., 2022).

The emergence of the new field of organoid intelligence (OI) will dramatically change biology. These high-cell-density organoids are composed of pluripotent or tissue-resident stem (embryonic or adult) cells or partially or fully differentiated cells from various body tissues (Zhao et al., 2022). Novel 3D brain organoids enriched with glial cells are being studied to replicate aspects of learning, memory, and cognition (Smirnova et al., 2023). These brain organoids are viewed as critical new tools in understanding neuromorphic computing and will function as experimental models in neurobiology and in devising pharmacological and genomic therapeutic interventions (Friston, 2023).

This promising technology is already being melded with computer-based neural networks, yielding synthetic computational platforms capable of potentially mimicking brain functions displaying memory and learning (Cai et al., 2023). The result is " ….Brainoware, living AI hardware that harnesses the computation power of 3D biological neural networks in a brain organoid." (Cai et al., 2023, p. 1).

Whether these experiments will lead to any profound new insights into the mystery of self-referential agency remains an open question. The specific limitation is that the internal dynamics of self-organizing organoids are not currently available for interrogation based on the measurement of an interior blanket state (Friston, 2023). Given the pace of research, there is reason to suppose that those technical limitations will eventually be overcome and glimpse the interior monologue that characterizes conscious self-reference.

These developments already point to ethical and moral concerns (Smirnova et al., 2023). For example, if organoids are conscious, might they experience suffering? Might they feel pain? Even today's primitive organoids demonstrate some EEG-like neural oscillatory features comparable to a pre-term infant(Lavazza, 2021; Jeziorski et al., 2023).

Could these thresholds be passed at some point as these organoids get more complex? One challenging issue is that the language we employ to describe internal living states and might equate with a derivative moral stance remains debatable, including such terms as sentience, cognition, intelligence, qualia, computation, and agency (Kagan et al., 2023).

Nonetheless, on-going research should be directed toward developing a strategy for assessing the possibility of consciousness with a distinct set of criteria for that determination. Hunt et al. (2022) establish an initial framework for considering how consciousness might be assessed in living systems or machines, determined by a series of measurable correlates, including those based on neural, behavioral, and creative criteria. These different measures might be selectively applied across the living scale from bacteria to holobionts and might also be applicable to synthetic organisms or AI systems. If consciousness is a variable of the depth of integration of information, this metric might be measured by the level of conformity of signature oscillations and resonances of the electromagnetic biofields generated by all living organisms. According to a general resonance theory of consciousness, the interaction among these fields as coupled oscillations may directly relate to specific attributes of qualia (Hunt and Schooler, 2019; Hunt et al., 2022; Watson and Levin, 2023). Certainly, then, at the cellular level, a highly nuanced understanding of the cellular senome would be required.

It would be reasonable to feel perplexed about how to approach the issue of consciousness within the burgeoning field of synthetic biological intelligences. We do not. Our opinion is that if these synthetic organoids are composed of cells, then they are alive. Since they are alive, they are conscious, sentient, and intelligent, capable of internal cognitive computing, and endowed, as living beings, with elemental qualia. Simply put, they are living, conscious agents. Any synthetic intelligence not made from living cells is not alive, non-conscious, without qualia, but potentially capable of prodigious intelligence. In this regard, however, we are in agreement with those who argue carefully appraising the power and scope of these emerging diverse intelligences among living, synthetic, and combined forms of life. Each will exhibit useful intelligence to help us navigate specific goals in problem-space (Clawson and Levin, 2023; McMillen and Levin, 2024). In that sense, the importance of the conscious/not conscious distinction becomes secondary to the highly practical issue of problem-solving to meet human needs.

AI is a wonderfully compelling tool. However, consciousness is not among its powers. It has no independent agency and ultimately depends on its initial program, no matter how far afield its outputs might flow through various iterations. The replete intelligence that machine AI will eventually display will not be consciousness but will undoubtedly incarnate a new form of flexible intelligence, powerful and perhaps dangerous, unlike ourselves, and always a conjurer's seductive trick.

6. Conclusion

A machine can never be self-aware.

Jinchang Wang (2023, p. 69)

Cognitive competence permits cells to uphold themselves and sustain their self-integrity. The interplay between cells and biological ambiguity is the specific substrate of self-referential subjectivity that expresses itself in various biological forms. Cognitive self-awareness was instantiated within the cellular form approximately 3.7 billion years ago and remains permanently embodied within it. From that base, cognition, either granted to individual cells, or conceived as an emergent product of multicellular organization, can now be examined as the continual flow of 'knowing' states of cellular preference in the context of informational uncertainties.

Computer consciousness cannot be attained by cleverly massaging binary informational inputs so that responses are supple. The relevant issues are far more profound. In turn, this debate mirrors a multi-century argument about the nature of life. The previous long-held paradigm of the cell as a complex machine is obsolete. A contemporary living narrative "emphasizes the dynamic, self-organizing nature of its constitution, the fluidity and plasticity of its components, and the stochasticity and non-linearity of its underlying processes" (Nicholson, 2019, p. 108). The differences between any machine and the living frame are explicit. All biological information is ambiguous. Consequently, cells live within the context of 'knowing' uncertainty. This sense of doubt undergirds cellular states of preference as experiences, forming their individuated sense of homeorhetic equipoise.

These terms of living cognition constitute the cellular experience at its scale as its form of sentience, however limited it is construed to be (Baluška et al., 2025). The terms 'doubt', 'preference', and 'equipoise' are indicative of the living self-aware state and have no equivalence in computer programs or their logic. As cellular beings, we humans reiterate and amplify this cellular experience among tens of trillions of co-existing participants, becoming our species-specific cellular consciousness and creating our aggregate sense of self-referential sentience. In a metaphorical musical sense, that subjective sensibility is not within the notes themselves but in the uncertain intervals between them. These attributive terms of the living state are more than mere vocabulary. These elusive characteristics define the living state. Simply but, *being is doubt* (Miller, 2022, 2023a,b). Living consciousness is the ability to harness stochasticity and informational ambiguities toward productive biological expression (Noble, 2021; Miller, 2023a,b).

Consequently, if music is an instructive metaphor for life, then consciousness resides in the gaps between the notes. Life is not merely striking the thermodynamic chords but comprehending the superposition of possibilities among them. The essence of living consciousness lies within the obligatory gap between any external informational cue at its source and its cellular reception and internal analysis. Life is governed by these fleeting pauses as the essence of its ambiguities. Computer systems have no interior sensibility of these states and are not conscious, no matter how tantalizing their conscious simulations. No genuine subjectivity exists within them. Thus, any attribution of AI consciousness directly squeezes the 'life' out of life, replacing it with an adroit facsimile.

No doubt, the debate will continue. However, our arguments offer a clarifying question that can be posed to any laboratory claiming success in achieving AI consciousness: Do you believe that you have created life? Absent an unequivocal yes with the data to support it, the claim is false.

CRediT authorship contribution statement

William B. Miller: Writing – review & editing, Writing – original draft, Conceptualization. **František Baluška:** Writing – review & editing, Conceptualization. **Arthur S. Reber:** Writing – review & editing, Conceptualization. **Predrag Slijepčević:** Writing – review & editing, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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