UDK 004.7
https://doi.org/10.2298/FID2202326U
Original Scientific Article
Received 27.04.2022. Accepted 15.05.2022.

PHILOSOPHY AND SOCIETY
VOL. 33, NO. 2, 279–512

To cite text:
Uspenski, Ivana; Guga, Jelena (2022), "Embodying Metaverse as Artificial Life: At the Intersection of Media and 4E Cognition Theories", *Philosophy and Society* 33 (2): 326–345.

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EMBODYING METAVERSE AS ARTIFICIAL LIFE: AT THE INTERSECTION OF MEDIA AND 4E COGNITION THEORIES[1]

ABSTRACT
In the last decades of the 20th century we have seen media theories and cognitive sciences grow, mature and reach their pinnacles by analysing, each from their own disciplinary perspective, two of the same core phenomena: that of media as the environment, transmitter and creator of stimuli, and that of embodied human mind as the stimuli receiver, interpreter, experiencer, and also how both are affected by each other. Even though treating a range of very similar problems and coming to similar conclusions, this still has not brought these two disciplines closer together or resulted in their interdisciplinary approach. They did coalesce in regards to traditional media such as film, but more points of connection are needed for untangling interactive and immersive media environments and their effects on human cognition, action, and perception. With the rise of VR and VR-like systems, especially as they start to evolve into the Metaverse as their main platform of interconnectivity, the tissue of the body becomes almost physically intertwined with that of the virtual surrounding it inhabits through immersion. Simultaneously, the interest in these disciplines arises anew, and especially the need to use their concepts in an interdisciplinary way. This paper's main interest is to bring these disciplines together in problematising the position of a physical body and its sensory-motor capabilities and their development within synthetic surroundings as Metaverse and anticipate potential downsides of Metaverse's uncontrolled growth. We will do so also by looking into Metaverse as an artificial-life-like phenomenon, following artificial-life rules and evolving a completely new 'corporeality', a body which is completely adapted to virtual spaces. We call this body the Dry Body, an entity sharing cognitive resources with the physical body it is not a physical part of, but has to extend to.

KEYWORDS
4E cognition, immersive VR, Metaverse, ALife, Dry Bodies (DBs), evolutionary algorithms.

1 This article was realized with the support of the Ministry of Education, Science and Technological Development of the Republic of Serbia, according to the Agreement on the realization and financing of scientific research.

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Introduction: 4E cognition and Immersive VR

In the late 80s and early 90s, as digital computing gained cultural and economic momentum, cognitivist, computationalist theories began to implode. More specifically, the idea that cognition and intelligence are bound to the brain and its logical manipulation of symbolic representations could no longer withstand, giving way to the newly emerging postcognitivist paradigm in cognitive sciences (Penny 2017; Shapiro 2019; Varela, Thompson, Rosch 2016). Currently known as 4E cognitive theories, i.e. embodied, embedded, enactive, and extended cognition, these theories take an interdisciplinary approach to cognition and incorporate phenomenology, pragmatism, biology, anthropology, psychology, sociology, neuroscience, philosophy of mind, robotics, computer science, and, as of recently media studies, image science, and aesthetics. Although the 4Es have their conceptual differences, we will not deal with their individual specificities in this paper but will rather draw from and build upon their common ground, which is that intelligence, thinking, perception and cognition arise through dynamic interaction of the brain, body, and the world. It is the active, embodied engagement with the world that constitutes thinking.

Penny writes that "our understanding of the world is not separate from our exploration of the world" (Penny 2017: 199), following Maurice Merleau-Ponty's thought where he states that "[t]he body is our general medium for having a world" (Merleau-Ponty 2002: 169). According to enactivism, the world is not a pregiven backdrop of agent's actions but is structurally coupled with the agent and occupies a co-constitutive role in sense-making as the central cognitive activity (Fingerhut 2021: 5). Structural coupling, adopted from autopoietic biology, was brought into cognitive discourse by Humberto Maturana and Francisco Varela (Maturana 1975; Maturana, Varela 1980). It refers not only to congruent structural changes between two or more interacting systems, i.e., organism and the environment, but also between organism and physical, social, and cultural artifacts that co-constitute world-making through artifactual or media habits. We will further analyse selected 4E concepts in the context of immersive VR and ALife, starting with the questions: How does 4E translate into the immersive VR environments, namely, the Metaverse? How are cognitive capacities transformed and affected by structural coupling with interactive computer-generated media ecologies and artifacts?

VR technology has been around for at least three decades and is not new in that sense. It has been the subject of research in media studies, art theory, cognitive sciences, neuroscience, and philosophy among other fields. Through a vast number of experiments with VR, neuroscientific research involving immersive VR has demonstrated different applications as well as effects VR has on human experience, perception, cognition, and behavior. With the rise of Metaverse, the literature in philosophy, art theory, or (new) media studies on VR is again in the spotlight. What is new, however, is the fact that VR has become social VR, a ubiquitous socio-cultural phenomenon that is at this point already problematic and unpredictable, making it difficult to foresee its effects and out-turns.

In the past, cognitive sciences have often overlooked image science and media studies. Even though they offered different perspectives on the same issues of transformative effects media have on human perceptual and cognitive capacities, there was barely any communication between these scientific fields. Most of the interdisciplinary research was done in the field of film studies, which cannot fully apply to immersive, interactive, and participatory media such as VR. This kind of media calls for introduction of new vocabulary, methods, and concepts such as *ecomedia* (Parisi 2021: 244), *aesthetics of behaviour* (Penny 2017: 315) or *neuromediality* and *new cognitive media theory* (Fingerhut 2021: 8). In this paper, we set out to find a common ground across different scientific fields to map and better understand the challenges of evolutionary processes of interactions in and with the immersive VR socio-cultural ecologies. In doing so, we will focus on the implications and transformative power posed by Metaverse as ALife on the human embodied mind.

Metaverse Defined

There is no one fixed definition of Metaverse. The term has relatively recently been pushed into scholar focus by the intensified efforts of predominantly social media corporations and the industry of advertising to commercialise it. With its boundaries still not clearly defined and often used interchangeably with other terms covering similar territory like virtual reality, extended and augmented reality, social VR, or cyberspace, we think it rather important to dedicate some time to scope the term and anchor it more precisely for further theoretical and practical application. In this paper, consequently, a clear distinction of the term will be made, in order to explore, structure, and differentiate Metaverse's bespoke mechanisms and modalities of impact, especially in regard to the human embodied affective and cognitive apparatus and how it is exploited as a function of ALife (artificial life).

The term Metaverse (similarly like the term Cyberspace before it) has its origin in the work of science fiction, being first employed by Neal Stephenson in his 1992 novel *Snow Crash*. He defines it as "a computer-generated universe that [his] computer is drawing onto [his] goggles and pumping into [his] earphones." (Stephenson 2011: 22) Morphologically, the term can be tracked even further back to Ted Nelson and his notion of *Docuverse* (Nelson 1987), the overarching universe of all digitized documents mutually electronically interconnected and linked in such a way that their inherent references can be called out instantaneously and in parallel with the document explored, irrespective of the author, time or place or language of its creation. In a way, the World Wide Web represents the realisation of Nelson's idea of the *Docuverse,* with hypertext being its bespoke interface, structuring and facilitating the access to this otherwise impenetrable vastness of documented information. Thus, one important characteristic of *Docuverse*, though in Nelson's work still only rudimental, is its attribute of openness to interaction and manipulation, both of which are the cornerstones of *Metaverse*, too.

Here, we would like to go even deeper and explore the etymology of the term 'metaverse', as it also can help us understand some of its underlying principles. The word itself is coined from two words of Greek and Latin origin: prefix 'meta-(μετα-)', its closest translation in English being 'beyond', 'adjacent to self'. In epistemology it has evolved to mean something beyond but encompassing things of its own kind. A meta-theory, therefore, would be a theory about theories and a meta-art would be art about art. In the case of 'metaverse', it consequently denotes that what is beyond and encompassing all universes, as the second part of the word metaverse, is the root of the Latin word 'universum', meaning 'all things', 'all in one', 'the whole world'. In that sense, Metaverse is a world encompassing all the worlds of its kind. This is how far the etymology takes us, but what is meant by the 'worlds of its kind' is yet now on us to clarify further.

What most authors agree on is that Metaverse relates to and encompasses sets of virtual, computer- generated spaces/environments we as humans can access and interact with. In line with this is the most common referral to Metaverse as social VR, an interconnected network of virtual realities and virtual reality experiences, spaces for people to connect and interact with each other, with the virtual space around them and with the objects there found. Heidicker, Langbehn, and Steinicke say that "Social virtual reality (VR) has enormous potential to allow several physically separated users to collaborate in an immersive virtual environment" (Heidicker et al., internet). This remark is important because it brings up the notion of immersion, which is one of the key terms in defining Metaverse. The actual scope and breadth of access, interaction, and computer-generation in relation to Metaverse is understood differently by different authors and practitioners.

In this paper, building on Nelson's etymological definition of *Docuverse,* we will use the definition of Metaverse as an open and shared sum of all virtual reality spaces (worlds), which are computer-generated, inter-connected, immersive, and participatory. As such, these spaces do not fall under the concept of screen-framed space of traditional or digital media. Metaverse relies on technical immersive devices that control and streamline sensory stimuli (predominantly visual and auditory but amplified by all other sensory affectations as much as technology allows it) and allow for the dichotomy of real vs. virtual world to be felt, established, and then transcended by embodied human consciousness. It is built and draws support from different technologies like virtual reality, augmented reality, different means of connectivity and is modular, dynamic, and open to new technologies existing and evolving in parallel with the real world of physical objects, with or without our presence in it.

This definition is descriptive, rather than denominative and is expected to evolve together with the evolution of technology, interfaces, and formats of virtual spaces and, in that sense, it has many limitations. Still, it underlines several elements important for the purpose of this paper which address a range of related problems identified from the point of view of cognitive theories and theories of media, trying to connect the dots between these two disciplines,

and re-apply the learnings to the discussions around a fast-growing phenomenon of ALife.

Metaverse is not one specific virtual environment or platform. It should be clearly differentiated from the commercial platform 'metaverse' launched by the company Meta (former Facebook) as only one of its manifestations, but also from any individual VR project or spaces on their own such as VR Chat, Decentraland, Spatial, or Sansar. Metaverse is a sum of all those places and platforms, which essentially run on the VR principles.

Framing Cognitive Experiences in Metaverse

Immersion, Presence, Participation

The first important term we would like to address here is 'immersion'. The notion of virtual spaces is relatively old and can be traced back to the Renaissance and the invention of perspective in painting in the 15th century. The visual technique of perspective has allowed for objective representation of "virtual" worlds, reducing the process of perception to mathematical form. Like virtual reality today, perspective turned a picture into "a window that opens onto another, different reality" (Grau 2003: 37). Immersion has further developed in meaning and scope, most evidently with the advent of electronic media, and especially computers, where not only could the reality visually be simulated, but also interacted with, making it even closer in quality to the real world it simulates. We can say that with the advent of VR technologies (HMD, Cave) the way we can approach virtual worlds has evolved from mere inspection (paintings in perspective), through interaction (CGI, partly cinema), to full immersion and participation (VR, Metaverse). Immersive spaces should be considered those where devices allow, primarily visually, the real world to be completely blocked out and replaced with that of synthetic, computer-generated environments, thus creating a new sense of the real and of the actual space inhabited. Thus, we argue, our definition of Metaverse does not fully exclude, but rather pushes to the periphery of focus, any hybrid and 'framed' computer-generated environment such as CGI video games, video-conferencing platforms, or social media chat rooms, where the sense and the perception of the real-world is still acutely present, as well as the awareness of our bodies and minds acting upon the virtual spaces from the point of reference of the real world. In short, where the sense of 'presence' has not been fully achieved.

Immersion and presence are two closely related terms, easily distinguishable by their respective points of reference. Immersion is more a technical term, related to the capabilities of a piece of technology in question used to emulate and access virtual reality environments. In that sense: "By an immersive VR system, we mean one that delivers the ability to perceive through natural sensorimotor contingencies." (Slater, Sanchez-Vives 2016: 5) The VR system in this regard can be more or less advanced and immersion seen as the ability to build the illusion of actually being in a real, rather than simulated world. For

instance, the difference between HMD and Cave immersion is that in Cave there cannot be a virtual representation of the participant's body as, when looking down, one sees their own body. In HMD, the body is substituted by a virtual body, which makes this system more immersive. Michael Heim also identifies the difference between HMD and Cave immersion by referring to HMD as tunnel VR or perception-oriented immersion and to Cave as spiral VR or apperceptive immersion. In HMD, the primary body gives way to the cyberbody and "[t]he user undergoes a high-powered interiorization of a virtual environment" (Heim 1995: 72) and identifies with virtual images. Cave, specific for freedom of bodily movement unrestricted by bulky equipment, "permits us to remain aware of ourselves alongside computer-generated entities." (ibid.: 73) Unlike immersion into novels or films, VR is a highly engaging sensory immersion, which "extends us to the maximum because it transports our nervous system into the electronic environment." (ibid.: 75)

Presence, on the other hand, stands for a subjective feeling of immersion. "Presence is the feeling of being transported to another place." (Slater, Sanchez-Vives 2016: 37) Interestingly enough, we are not constantly aware of a sense of presence in the real world (in the narrowest meaning of the word). In the real world, we just are because the feeling of presence is taken for granted. It arises only in situations where perception is in a certain way disturbed and does not function nominally, such are the states where the mind is under the influence of, for example, hallucinogenic substances or in a state of illness (certain neurological or psychological diseases). Similarly, this feeling of presence in virtual environments arises due to imperfection of the immersion technologies. Slater and Sanchez identify place illusion as the illusion of "being there" in the virtual environment and "Plausibility" as the events are really happening. "This fundamental aspect of VR to deliver experience that gives rise to illusory sense of place and an illusory sense of reality is what distinguishes it fundamentally from all other types of media." (Slater, Sanchez-Vives 2016: 5) Similarly, Thomas Metzinger identifies three major dimensions of presence as a complex phenomenal quality, those being *identification* (being present as a *self*), *self-location in a temporal frame of reference*, and *self-location in space,* defining presence as "a phenomenal quality normally going along with a minimal sense of selfhood, and it results from the simulation of a self-centered world – in VR setting as well as in everyday life" (Metzinger 2018: 3).

Apart from Metaverse being immersive, meaning that, through advanced technology it achieves radical saturation of our cognitive capacities by eliciting the sense of presence, it also goes beyond it, allowing us to act on the objects of our cognition: it is participatory. This is the function it inherits from the VR-worlds it encompasses. "VR is different from other forms of human-computer interface since the human participates in the virtual world rather than uses it." (Slater, Sanchez-Vives 2016: 3) This is why regular CGI games, even interconnected or played over social media, do not belong natively to Metaverse. They are not immersive, as they do not elicit the sense of presence and the players use the computer-generated worlds only as platforms on which to pursue

and achieve game goals. This, though, is considered a border-line case, as in multi-player games it can be argued that the computer-game worlds are inter-connected participatory platforms. There are two additional arguments that decide against CGI games being attributed to Metaverse. One is that, in its essence, participation, even when goal-oriented, accounts for many more peripheral actions that are not revolving around a pre-defined goal only, but rather around the actual virtual space inhabited and others inhabiting it, such as conversations with other participants, unmotivated space exploration, artefacts interaction. These are all only partially included in standard multi-player CGI games. More importantly, though, participation means bypassing the sense of 'otherness' or 'otherworldliness' imposed by the visible frame surrounding a virtual space. The absence of the frame puts us in the same spatial point of reference with the virtual world, which becomes the one we are present in, rather than the one we look at and act upon from outside.

Transcending the Real through 4E Experiences

Related, and further explanatory for the above is the notion of transcendence. Even though with presence and participation we by-pass the frame of 'otherworldliness', we still recognize the simultaneous superposition of both spaces (real and virtual) when we make the conscious decision to step into the latter, accepting its rules governing both our cognitive and bodily processes as dominant and acting in accordance with them, "in spite of the fact that you know for sure that you are not actually there." (Slater, Sanchez-Vives 2016: 5) We make decisions based on the virtual world's rules even in cases when they do not go in line, or even directly oppose those of the actual physical space our body physically still inhabits. We will see later that this problematises the implications of Metaverse experience on evolutionary reconfiguration of our body, jeopardizing its ability to perform its core functions dictated by a biological eco-system it had been *a priori* borne into, and still is a part of and have a significant impact on. We will especially deal with the concept of 'returning', or 'repatriate' bodies, struggling to adapt to the challenges of the real world, to which they existentially and necessarily eventually always come back to and are a part of. This issue arises on the back of the efforts society and capitalism invest in pushing for a creation of new, 'technology-designed' bodies, able to not only inhabit new, in this case virtual and computer-generated territories, but even more to evolve the abilities to, there, efficiently create value and produce more wealth for the corporations in control of those new, rapidly evolving virtual territories. Unfortunately, now this is being done disregarding the arising question of how able these new Metaverse-evolved bodies are to repatriate the real world and continue their biological survival.

If we now look at the elements of the definition of Metaverse we have thus deconstructed, we will be able to draw a clear parallel with cognitive theories and see that Metaverse experiences draw from all 4 corners of the 4E cognition. They are embodied, meaning that they cannot be perceived without the

presence of a body, both a virtual one, which enables us to take active participation in the computer-generated world, and a biological one, whose sensorimotor apparatus it depends on. They are embedded, with a sense of full presence in the world mentioned, exposed to all its respective stimuli, artifacts, other inhabitants, as well as architecture, infrastructure, and rules. They are equally enactive, empowering us to impactfully interact with the virtual world in question, with all the rules of the responsive feedback applied (our action in the virtual world will drive respective reaction/change). "Enactivism argues that we bring forth experiences by engaging with the world and others." (Fingerhut 2021: 6) Fingerhut introduces another useful term to describe enactivism, and that is that of environmental affordances for action (Fingerhut 2021: 8), which extends some of the responsibility for cognition to the actual environment, which can or cannot afford certain actions. Therefore, the opportunities for us to act in any human-environment system are limited by the contingencies of that system. Here we have already mentioned the 4th type of cognitive experience, that which is extended. We will dedicate a separate part to it, passing it through the theoretical framework of media theories and media studies.

Metaverse as Media: Cognitive Bodies Extended

In his seminal work *Understanding Media: the Extensions of Man* from 1969, Marshall McLuhan defines media as man's cognitive extensions, meaning that media "works as 'extensions' of our senses, allowing a reconfiguration of our perceptual and cognitive possibilities" (Parisi 2021: 242). McLuhan understands that the speed of overarching development of industrial revolution, accelerated even further by the invention of electricity, has brought about changes a human, as a cognitive entity, will have difficulties keeping up with. He warns that, even though the media allow us to extend our cognitive capacities into worlds which, without the agency of media, would remain unattainable for us, we are "leasing our eyes and ears and nerves to commercial interests, [and this] is like handing over the common speech to a private corporation, or like giving the earth's atmosphere to a company as a monopoly" (McLuhan 1994: 68). Reading McLuhan's work now, more than 50 years after its publishing, it is clear that some of his concepts, especially anticipating the advent of an overall electrical networked society he saw that the introduction of electrically powered media would certainly bring about, resonates even more and gains completely new relevance.

Parisi further builds on McLuhan stating that we should differentiate between the act of extension and that of externalisation, where "the first indicates an 'enhancement' of the agent's particular activity, and the second indicates the 'transfer' of an ability onto different physical support" (Parisi 2021: 242). Extension, even as a phenomenon from physics, is heavily dependent on a material's plasticity and elasticity, its possibility to adapt to the strain imposed to it by an external force trying to make it reach the states broader than its resting state. The plasticity and elasticity are not unlimited adaptive

means, and when their limits are reached, the internal material consistency breaks and the connection becomes externalised: not of one entity being extended to encapsulate different distant states, but of now two broken entities of a same origin reaching out to each other in order to complement their respective missing states. What is being lost here is the unity, the continuity, where both parts now proceed with their development as separate entities. In the case of Metaverse, as we will see later in the paper, our cognition, after being extended, stretched too thinly from its physical body into virtual spaces, is in grave danger of breaking this inherent biological connection and becoming an externalised resource for two radically different embodiments: the physical one and the one of bodily representation in Metaverse.

The question arises if Metaverse per se can be considered a media? If we were to go back to the very origin of the term in communication theories, as it was established by Claude Shennon in "Mathematical Theory of Communication" (Shannon 1948), a media is nothing more but a vessel for transmitting information and its key role is to achieve reliable transmission, meaning that the message received (decoded), comes as close in its content and character to the message sent (encoded). "The fundamental problem of communication is that of reproducing at one point either exactly or approximately a message selected at another point." (Shannon 1948: 379) In order for the efficiency and effectiveness of information transfer to happen, the media can employ their own language, meaning code the message to better suit the characteristics of the media as a channel and make the transmission faster and more secure. The biggest problem for Shannon was, that precisely in this process of coding and transmission, various types of noise can pollute the content and the character of the message transmitted, making the end result, the received message not equal to the one sent, often losing important parts of its essence.

McLuhan already sees that media are much more than just mere channels for messages transmission. It is his famous statement saying that 'medium is the message', "it is the medium that shapes and controls the scale and form of human association and action" (McLuhan 1994: 9). Unlike radio or TV, Metaverse is not a channel in a traditional sense. Its main purpose is not transparent transfer of a message and its respective meaning, it is a platform for human association and action. "Concern with 'effect' rather than with 'meaning' is a basic change of our electric time, for effect involves the total situation, and not a single level of information movement." (McLuhan 1994: 26) Metaverse is the platform for broadcasting effects, in the sense of delivering experiences, rather than information, or to be more precise, delivering experiences as information. In the overall circulation of value and wealth, information is the key commodity. With all possibilities digital media offer for tracking and data-storage, even experiences in Metaverse are quantifiable, thus making them a form of information, too.

Therefore, we can conclude that Metaverse is a media, inasmuch that it extends human cognitive capacity, delivers associative and actionable experiences and additionally it does so by the means of media already known to

man. This is yet another characteristic of modern media, that it always starts by borrowing its language from the already existing media before it finds and develops its own. "The content of any medium is always another medium." (McLuhan 1994: 8) We have seen that newspapers have profited from the media of book and photography, computer games from all other temporal media like film, music, literature, whereas the Internet has become the most radical hypermedia combining all of these in its platform. In that sense, Metaverse is like the Internet, the media encapsulating all other media, with the difference that it evolves the human action to presence and participation. It is an ultimate metamedia, as defined by Manovich: "We are witnessing the emergence of a new cultural metalangue, something that will be at least as significant as the printed word and cinema before it." (Manovich 2002: 93)

Apart from sitting highest in the hierarchy of media, Metaverse also can be seen as the hottest media. McLuhan argues that hot media are those which oversaturate one single sense, stimulate it in 'high definition'. High definition itself is defined as "the state of being well filled with data" (McLuhan 1994: 22). The more data is given and information served 'as is', the hotter the medium. The more one has to complement the received media signal with additional data in order to have its full understanding, the colder the media. It is possible that McLuhan could not have anticipated Metaverse and the extension of the technical development of media, when he stated that hot media always saturate only one sense. This is still true even for Metaverse, as vision is the sense which gets overwhelmed the most, but others like hearing and touch especially, are catching up. In that sense, we can call Metaverse an overheated media, as it overflows many senses with data simultaneously. The only solution McLuhan sees for this problem is in cooling media through consumption diet. He sees it only in terms of quantity, what we already see parents do with children, i.e., limiting their screen time. We argue, though, that in Metaverse, it is not only quantity, but also quality of cooling that will need to be implemented. This means that it is not only the amount of time spent in Metaverse that will need to be moderated, but also what we do with that time, how we interact, consume, spend, and produce, but also how morality, legality, acceptable behaviors, and actions are defined and executed. This is a whole new regulatory territory which is beyond the scope of this paper, although we recognize the need for its further exploration.

Metaverse as Artificial Life: Evolving Dry ALife-Bodies and the Problem of Repatriating Reality

Perceptive bodies: Building the Image of the Real with Predictive Coding

A lion share of our cognitive processing, especially that which we relate to the notion of consciousness, is dedicated to ensuring our bodies remain well-orientated within the space they inhabit, so that when need arises they can perform

a necessary action: run, turn-around, scratch nose, sit or similar. This cognitive processing is of course dependent on the data-input our neurological, sensorimotor system receives. We need to bear in mind, though, that this data does not come only from the current environment (bottom-up processing), but also includes all the information stored from previous experiences, including beliefs and expectations (top-down processing). Our body with its consciousness and sensorimotor apparatus is well trained and evolved to, based on relatively limited data-input, reconstruct and predict a full model of the environment it inhabits, all with its respective potential benefits, dangers, and potentials for action. "Perception depends very largely on knowledge (specific 'top-down' and general 'sideways' rules), derived from the past experience of the individual and from ancestral, sometimes even prehuman experience." (Gregory 1997: 1126) Even in the case of vision, only a fraction of the generated visual perception comes from the data captured by the sense, the rest is our brain's best approximation of what the full picture of the environment is, based on previous experiences, predictions and 'filling in the gaps'. This is the core idea of Predictive Coding (PC). "In terms of perception, cognition and action, the computational contribution of the brain involves providing multi-layered system that produces predictions or hypotheses about the world." (Fingerhut 2021: 9)

The importance of this remark cannot be overestimated. We argue that what essentially will happen in VR systems, and consequently in Metaverse as a whole, is that our bodies, by being faced with qualitatively different and novel environmental data-input (bottom-up processing), and still relying on the existing experience data they use to complement it (top-down processing), will form a Metaverse-bespoke response, a form of hybrid virtual-real bodily affectation. When repeated enough times in similar environments and circumstances, it is expected that this response will inform the reconfiguration and evolution of top-down processing mechanisms in accordance with the Metaverse rules. This represents a danger for the repatriate body, as when it comes back to the real world, where its direct survival success is dependent on biological processes, rather than on representation and electrical computation, it becomes inadequate to act efficiently and is thus endangered. "VR not just as a reality simulator, but as an unreality simulator can paradoxically give rise to realistic behavior." (Slater, Sanchez-Vives 2016: 6) In VR, vision stands in for proprioception and other faculties – even when the user is physically inactive, neurons in these brain centers fire up in VR through vision. These new realistic, but unreal behaviours define the scope of new affordances, especially in relation to the role these affordances play in evolving artificial life.

ALife: Soft, Hard, and Wet Artificial Life

For the purposes of this paper, ALife is the term which will be used to denote the study of artificial life, whereas 'artificial life' will be used as the term describing the phenomenon of life-like behavior in non-living things. As Awodele et al. summarise: "Artifical Life (ALife) is the study of man-made (synthetic

systems) that exhibit behaviour characteristics of natural living systems. The primary goal of this field is to create and study artificial organisms that mimic natural organisms. ALife complements the traditional biological sciences concerned with analysis of living organisms by attempting to create life-like behaviours within computers and other artificial media." (Awodele et al. 2015: 5)

ALife is a relatively new field of study. We will not discuss it in depth in this paper but will use only some of its terms to help outline their possible application to Metaverse, how this reconfigures the role of human body, and to open the field for further research and discussion. The term dates back to 1989 and was coined by Christopher Langton, using it to describe "Life made by Man rather than by Nature" (Langton, internet). The term has evolved significantly since, now encapsulating the study of all non-biological life-like behavior, addressed by interdisciplinary research raging across biology, physics, engineering, philosophy, mathematics, arts, and other disciplines. Even though both refer to the biological processes that are trying to be simulated or re-created in synthetic systems/environments, artificial intelligence and artificial life come from different backgrounds and have different goals and are evolving quite separately. AI (artificial intelligence) is concerned with eliciting intelligent behaviour and decision making in computer systems. As Hiesinger rightly puts it, AI is "trying to avoid unnecessary biological detail in trying to create something that so far exists only in biology" (Hiesinger 2021: 3). ALife, on the other hand, is concerned only with eliciting life-like behaviors in non-living systems, which on their own do not necessarily need to be intelligent.

Mark Bedau defines three different types of artificial life (Bedau 2007: 595). *Soft*, which would completely be executed by computer software. In most cases those are digital simulations and constructs which exhibit life-like behaviour. *Hard* artificial life is the one where life-like systems are implemented within corresponding hardware, most common forms being all sorts of robots. The third type of artificial life is *Wet* artificial life, which refers to creating and inducing life-like behaviors in non-living biochemical materials. In this paper, for the purposes of inspecting Metaverse and its corresponding mechanisms, we will deal mainly with the first kind, Soft, fully software-generated and simulated artificial life, but some of the terminology from the remaining two kinds will be used to explain other arising, important phenomena.

Core Principles of (Artificial) Life: Self-Organisation, Growth, and Unpredictability

The foundational attribute of all artificial life behaviors is self-organisation. It is a complex term, which Gershenson et al. define as "local interactions between independent elements [which] lead to global behaviors and patterns" (Gershenson, internet). Additional important remark is that an external observer can spot this pattern as part of the system of many components, but the pattern itself is a product of the collective, and yet individualised behaviour of the system elements themselves. Hiesinger introduces two additional critical

attributes, those of information unfolding (reducing of entropy) and investment, in this case of time and energy (Hiesinger 2021: 326). He further writes that self-organisation is also based on spontaneous interaction of the system components that leads to a more ordered and more complex state of the system than the state prior to the process of information unfolding and the sum of its individual components. Self-organisation is a direct result of life's process of growth, whereas growth itself requires the existence of initial genetic information, which is set in motion of transformation through investment of time and energy.

An example of a self-organised system in biological life is the brain. Biology and neurology have been long trying to explain how the brain evolves, especially how individual cells know how to evolve into such a complex system that is the brain. For a long time, it was thought that genes carry a sort of a blue-print of 'brainness', a map of all the individual cells and the states they grow toward achieving in order to create it. This stance, that it is genetically encoded information that drives, dictates, and fully controls this process is true only partially. "The genetic code contains algorithmic information to develop the brain, not the information that describes the brain." (Hiesinger 2021: 7) This finding was of crucial importance, as it revealed that the information captured within genes, as elementary unit of life's self-organisation, is not full instructions to create the brain, but only the indivisible/discrete elements of growth and a growth algorithm, whereas the actual end (purpose) of growth arises gradually, driven by the principles of locality and randomness and fueled by time and energy. In the case of brain neurons this means that every individual neuron has its local growth autonomy, not having its end-state programmed into it *a-priori* in any way, creating meaningful neural connections and thus forming the brain only by randomly acting upon other equally growing neighbouring neurons, its surroundings and even upon itself. Through endless such repeated processes and trials and errors of connections being made and dying-off, eventually a system as complex as the brain comes to be. This means that a life-like self-organised system starts with a very simple unit of information, which, triggered by a growth algorithm, and through acts of randomly connecting and disconnecting with its neighbouring units, consuming energy over time grows to become an infinitely complex system, patterned and ordered. This system "would require more information to describe, than was needed to start its growth" (Hiesinger 2021: 2). This is what makes life-like behaviors impossible to predict and simulate from knowing their initial information-states. They can be only simulated in real-time, meaning, in order to understand their end-point evolution, we need to run it in an equal amount of time from beginning to end. This also means that any kind of developmental growth of life-like systems and their evolution can only be analysed in retrospect, not predicted or anticipated. This phenomenon is anchored in the rule that "there may be no other way to read the genetic information than to run the program. The information is in the genes, but it cannot be read like a blueprint. It really is a different kind of information that requires time and energy to unfold" (Hiesinger

2021: 4). This information unfolding, no matter how simple the unit of information or the algorithm containing rules for growth to begin with is, cannot be mathematically calculated or predicted before simulating or letting it grow in its entirety. This unpredictability of growth, and moreover of evolution of life-like systems is what should be the cause of concern when talking about the Metaverse and the role the human body takes in it.

One of the most famous examples of an artificial life simulation is "The Game of Life", created in 1970 by British mathematician John Horton Conway. It is a computer program running on an infinite, two-dimensional orthogonal grid of square cells, in which each of the cells can be in either of the two states: dead (unpopulated) or alive (populated). The artificial life simulation starts with the very simple initial (gene) state, with the small number of cells/squares (most often 4-12) in a predefined discrete state (dead/alive) being exposed to a very short growth algorithm, which is based on three simple rules:

1. Any live cell with two or three live neighbours (surrounding cells) survives
2. Any dead cell with three live neighbours becomes a live cell
3. All other live cells die in the next generation. All other dead cells stay dead.

This is considered the 'seed' of the system. After setting the system in motion, in a very short period of time, we can see how the system grows to become increasingly complex, creating patterns of life-like behaviors like grouping, swarming, distancing, piling, gridding, etc., quickly becoming a vast, dynamic, pulsing entity. None of the exposed behaviors is possible to be anticipated upfront or be pre-programmed.

"The Game of Life" is an utterly simplified example of a Soft artificial life, a life-like behaving system, computer simulated and living only as a software. The elementary unit of a Soft artificial life, the one that contains the software-equivalent of genetic information is called Cellular Automaton (CA), a term proposed by Andrew Ilachinski in 2001 (Ilachinski 2001). As Gershenson et al. explain, "A CA consists of many units (cells), each can be in any number of discrete states, and each of which repeatedly determines its next state in a fully distributed manner, based on its current state and those of its neighbours. With no central controller involved, CAs can spontaneously organise their state configurations to demonstrate various forms of self-organisation" (Gershenson et al., internet).

Metaverse as Soft Artificial Life: Evolving Dry Bodies

If we take all the above into account, we will propose yet another definition of Metaverse, this time from within the framework of Alife. Metaverse is a Soft artificial life system, in the early stage of its growth, with its Cellular Automaton, the elementary unit of its organisation, being a participatory human agent, self-organised in accordance with its respective local rules and interacting with

other such agents within a distributed system, creating a more complex, patterned system, driven by both growth and evolutionary algorithms and propelled by energy and time. Here we introduce a new term of *Dry Body* to refer to the human agent as Metaverse's Cellular Automaton.

Dry Body (DB) is a software representation of a human body in virtual environments, taken as a genome of Metaverse as Soft artificial life. The term is developed as an opposition to a physical, biological body, which is 'wet' and whose main constituent is water. Whereas for physical bodies as units of life the main propeller of growth is energy in the form of water, DBs as units of artificial life are equally propelled by energy, but this energy is dry, with its main constituent being electricity. Additional accelerants of growth of artificial life are algorithms, cognitive work, and capital. Whereas 'wet' bodies equally evolve with the help of growth and evolutionary algorithms, cognitive work and capital are reserved for DBs, defining how they get involved in producing additional value for their respective artificial life systems.

A DB should not be mixed-up with any of the concepts of individual human body representations in VR (i.e avatars or virtual agents). A DB, like our biological body, is understood as a vessel encapsulating a germ of life; a local unit, which is an indivisible part of a more complex artificial life system, and is its constitutional, evolutionary element. When defining artificial life-like behaviors above, we have stated that they are based on having an initial state of already existing genetic information upon which a growth algorithm is set in motion. In Metaverse, DBs are these Cellular Automata which already carry the seed of information Metaverse as artificial life needs in order to develop and grow. To sum it up, whereas an avatar is a carrier of personal information of identity, a DB is a carrier of information of a species of artificial life.

But where does this information come from? Here we return to the media theory terms of extension and externalisation. A software generated body is considered a DB only when impregnated with information it can use to contribute to artificial life's growth. It is just a software construct and what makes it potent is the information borrowed from human consciousness shaped by many dynamic embodied acts of cognition. We see here how Metaverse radically changes the essential quality and dynamics of medial extension. Whereas in traditional electronic media and CGI, media become our extensions as facilitators, empowerers, allowing us to amplify our consciousness through its extended simulation into the virtual (McLuhan calls this "technological simulation of consciousness" (McLuhan 1994: 3)), but our physical, embodied mind remains the anchor, the main agent of control. In Metaverse, on the other side, a DB reaches back out into the real for information, extending to and powering itself with that same embodied mind, which is now completely amputated from the real, physical space it inhabits. The biological body becomes only a dismorfed, feeding tube to a mind which a DB extends to for information. We see now that the human mind suddenly becomes a shared resource between two qualitatively different bodies, which are differently evolutionary motivated.

We have already mentioned evolution several times, but to fully understand the problems we discuss in regard to Metaverse, a clarification of how we use the term 'evolution' and what the difference is between a growth and an evolutionary algorithm is needed. A growth algorithm is asynchronous and linear. It is a developmental, linear process which consumes energy and time. It is a set of simple, repetitive instructions which we can call vertical, as they push Cellular Automata in question only in one direction, which is that of 'up', of being bigger and more and better organised. An evolutionary algorithm, on the other hand, is synchronous and horizontal. Heisinger defines that it is based on "the concept that a meaningful and heritable change to a biological neural network can only be achieved through random mutations in the genome and subsequent selection at the level of phenotypic output after the entire developmental process is concluded. The concept is based on the hypothesis that the effect of a mutation is fundamentally unpredictable in the absence of any knowledge of previous outcomes due to the nature of algorithmic growth" (Hiesinger 2021: 320). In essence, an evolutionary algorithm chooses horizontally between the mutations which have occurred during growth, and picks out those which have contributed to the amplification of evolutionary most desirable traits and feeds them back into the growth algorithm. This means that in Metaverse only those mutations will be chosen and fed into the growth algorithm that give rise to behaviors Metaverse sees most effective and efficient for achieving its evolutionary goals. What makes this problematic is that, like with any life or life-like system, we cannot know what their ultimate evolutionary goal is before the system achieves its end-state, so it is impossible to predict how DB will use or in which direction it will evolve our cognitive apparatus, for us to be able to react to this and compose and implement preventively a set of respective measures aimed at protecting the sensory-motor and cognitive abilities of our biological bodies.

Metaverse- Exploring the Unpredictability of Connections. From Realistic to Un-Real Behaviors

By visiting Metaverse, through entering and inhabiting one of its existing VR worlds, or expanding it by building a new one, people in a random, but motivated fashion (just like neurons in a brain) act individually by extending their attention and communicating with their neighbours, exchanging information, exploring their surroundings, and eventually creating connections. Those can be connections with other people inhabiting the same virtual space, with the space itself or with cultural artifacts found in that space, thus giving rise to and expressing novel patterns of behavior. As Parisi puts it, "what a sensorimotor body becomes is the result of coupling with the world in the sense that the world guides and limits the development of the organism through normative regulations, resulting from the relation itself" (Parisi 2021: 250).

For example, people will keep on returning to a retro-designed un-real virtual space, which contains many of the long-gone artifacts from their childhood,

because it evokes in them a sense of nostalgia, a feeling of safety and carelessness. They will also return to the virtual spaces their long-distance friend visits most often, because this is the closest they can get to seeing them in person. They will also exchangeably go from one place to the next, probing new places as participants and in that way creating even more connections. Some of these connections will be amplified by their behavior because of the sense of gratification they bring, some connections will die-off because they either do not elicit the same gratification anymore or have simply lost their motivational relevance. As the new virtual worlds and environments join Metaverse, accelerated by the fuel of capital and improved technology, so will Metaverse grow, allowing for more connections and more behavioral patterns to be made, which in turn will make it grow even further exponentially. The issue is that un-real virtual places can still give rise to realistic behaviors our bodies naturally perform or can be deceived into performing. For example, people in Metaverse still apologise or move aside when with their avatar they bump into another avatar, even though, unlike in the real world, this does not cause any kind of tactile affectation. It can be presumed that by repeatedly experiencing this behavior, our physical bodies will become partially or fully numb to the actual tactile stimuli when faced with a similar situation in real life.

As McLuhan wrote: "Nobody wants a motorcar till there are motorcars, and nobody is interested in TV until there are TV programs. The power of technology to create its own world of demand is not independent of technology being first an extension of our own bodies and senses." (McLuhan 1994: 69) Just because we have designed a VR space in a certain way, or we have ensured that only a certain profile of people is allowed to enter it, does not mean that we can dictate or even fully anticipate the kinds of behaviors these spaces will give rise to. As mentioned earlier in the paper, we can spot the patterns forming in the system, but we cannot control it. Another example is that, even in Metaverse, when we in the distance see an avatar of someone we know and want to interact with, we will use our avatar to wave to them, because it is a top-down learned behavior we have inherited from the real world to draw their attention, but this behavior does not coincide with the logic of the VR spaces. It is impossible to tell how this gesture will evolve. Maybe instead of waving a hand in the future a common practice will be making a triple salto in their direction, or holding a virtual balloon with their name printed on it, or most probably something at this moment completely unimaginable, un-real, and not possible to execute in real life. Even if we do not feel it, we are already in the process of learning new behaviors and acquiring new top-down perception processes, being shaped by Metaverse the moment we step through its doors.

Our minds do have plasticity and almost endless possibility to adapt to new situations, but they have never been put in front of such a challenging task, where two qualitatively different sorts of bodies fight for the same cognitive resource and require them to evolve different responses to the same or relatively similar sensorial stimuli. DBs evolved in Metaverse are not required to have any plasticity or adaptive behaviors typical for wet bodies. In the world

of biological life, this makes DBs brittle, fragile, inflexible, and easy to break. The artificial life we have already unstoppably set in motion with Metaverse will evolutionarily prioritise DB as it starts to employ an ever-higher share of our cognitive capacities. If we know that smaller interactive technological systems and media like video games or especially the Internet have already reconfigured our bodies in ways which could not have been anticipated to suit their needs, the conversations about managing the impact of and cooling the media of Metaverse cannot start too early. Biological life is, after all, still a meta-life to Metaverse.

Let us close this paper with the visionary words of McLuhan: "In operating on society with a new technology, it is not the incised area that is most affected. The area of impact and incision is numb. It is the entire system that is changed…No society has ever known enough about its actions to have developed immunity to its new extensions or technologies." (McLuhan 1994: 64)

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Ivana Uspenski i Jelena Guga

Utelovljenje Metaverzuma kao arificijelnog života: na preseku medijskih i 4E kognitivnih teorija

Apstrakt

U poslednjim decenijama 20. veka videli smo kako medijske teorije i kognitivne nauke rastu, sazrevaju i dostižu svoje vrhunce analizirajući, svaki iz svoje disciplinske perspektive, dva srodna osnovna fenomena: medije kao okruženje, prenosioce i kreatore stimulusa i otelovljeni ljudski um u dinamičnoj interakciji sa okruženjem, kao i načine na koje mediji i um utiču na i transformišu jedno drugo. Iako tretiraju čitav niz veoma sličnih problema i dolaze do sličnih zaključaka, to ipak nije dovoljno približilo ove dve discipline niti je rezultiralo njihovim interdisciplinarnim pristupom rešavanju ovih pitanja. Pomak je napravljen kroz kognitivne teorije medija u kojima je fokus uglavnom na tradicionalnim medijskim formama poput filma. Ipak, potrebno je uspostavljanje više tačaka povezivanja za rasplet interaktivnih i imerzivnih medijskih okruženja i njihovih efekata na ljudsku kogniciju, akciju i percepciju. Sa usponom sistema virtuelne realnosti (VR), posebno u trenutku kada počinju da evoluiraju u Metaverzum kao svoju glavnu platformu povezivanja, tkivo tela postaje gotovo fizički isprepleteno sa tkivom virtuelnog okruženja u kom egzistira kroz uranjanje. Istovremeno sa Metaverzumom, iznova se javlja interesovanje za ove dve discipline, a posebno potreba da se njihovi koncepti koriste na interdisciplinaran način. Cilj ovog rada je da spoji ove discipline u problematizaciji položaja fizičkog tela i njegovih senzorno-motoričkih sposobnosti i njihovog razvoja u sintetičkom okruženju kao što je Metaverzum, kao i da predvidi potencijalne negativne strane nekontrolisanog rasta Metaverzuma. Metaverzum ćemo posmatrati kao fenomen veštačkog života, prateći pravila veštačkog života i razvijajući potpuno novu

„telesnost“, odnosno telo koje je potpuno prilagođeno virtuelnim prostorima. Ovo telo nazivamo Suvim telom. Ono je entitet koji deli kognitivne resurse sa fizičkim telom čiji nije fizički deo, već se na njega proširuje. Polazimo od premise da svaka nova, inovativna tehnologija u svom razvoju sledi pravila algoritama rasta, što znači da se njeno konačno ‘krajnje stanje’ nikada ne može znati ili predvideti unapred, kao ni promene koje ona donosi u postojeći svet i njegov ekosistem. Što je veća inovacija, to je veći uticaj i promena na stvarni stvarni svet i naša biološka tela u njemu. Metaverzum, kao krajnja tehnička inovacija u oblasti virtuelnosti i manifestacija veštačkog života koji evolutivno prioritizuje „suva tela“, nosi sa sobom značajne i nepredvidive načine na koje se naša biološka tela dalje koriste i razvijaju. Konačno, naglašavamo važnost kontrolisanog, praćenog i doziranog kognitivnog učešća u Metaverse-u, kako bi se uspostavio i sačuvao kognitivni balans između suvih tela i bioloških tela.

Ključne reči: 4E kognicija, imerzivna VR, Metaverzum, artificijelni život (ALife), suva tela (DB), evolucioni algoritmi.