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Umwelt in an umwelt: Co-developing within immersive virtual environments and the paradoxical nature of reality and hyperreality

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Abstract. This paper examines how to model immersive virtual environments using Kalevi Kull's ecosemiotic model of four degrees of nature. Using this theoretical model allows for an investigation into the paradoxical nature of reality and hyperreality, which is a novel approach to understanding how a user co-develops with both their physical and immersive virtual environments. Analysis for the four degrees of nature within the virtual space reveals that an immersive virtual environment emerges from an imaginative void, contains milieu that users can recognize and interact with, offers the action-potentiality (affordances) for altering and changing materials within the virtual space, and the reproductive nature which converges the boundaries of reality and hyperreality during the meaning-making process for users. Additionally, this paper elaborates how technological household goods in the past century have integrated texts into the cultural construct of a home. The paper identifies how immersive virtual environments alter an inhabitant's perception and interactions within the home and explains how to model immersion, which is important for future research of user behaviour in the digital age of new media.

Keywords: intentionality; paradoxical thinking; design; nature; hyperreality; immersion

This research elaborates on how semiotics can be used as a tool by designers during the creative process of immersive virtual environments experienced through the technology of virtual reality. Virtual reality as a technology provides the user with the potentiality to simulate real-life, ontological events that exist within the intrinsic environment, but the technology also offers the means to experience digital environments that originate, respectively, from an imaginative nature and the semiotic process of a designer to mark out (i.e. design) their imagination. A

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designer of an immersive virtual environment can range anywhere from a design team within a company to a user that has sufficient competence to construct user-generated content; no matter who the designer may in fact be, the agent that undertakes the role of a designer can utilize biosemiotic and ecosemiotic models as an apparatus during the design process to enhance the meaning-making events that are constructed by a prospective user. With this in mind, it is essential for designers to understand what the immersive virtual environment provides as a structural system of hyperreality for the user that will experience it within their real (physical and intrinsic) environment.

In the last three decades, branches within the discipline of semiotics, such as biosemiotics and ecosemiotics, have emphasized that an organism co-develops with the environment that contextually embeds the organism's perceptual lifeworld – otherwise known as the umwelt theory, developed by Jakob von Uexküll (1992[1934]) to model the species-specific biological processing of environmental stimuli, the subjective reality. The umwelt, as the embodied subjective world, is the means in which an organism perceives and behaves in the world and environment around them where meaning-making is constructed. From the Uexküllian sense, the use of an organism's perceptual and effectual cues allows for meaning to emerge into a subjective, phenomenological experience (Uexküll 1992[1934]), and as Kalevi Kull and Donald Favareau (2022: 2) propose, there must be an umwelt for an organism to afford associative learning and consciousness. The primary goal of this study is to shed light on how a user of immersive virtual environments not only co-develops with their physical surroundings, but also with the experienced immersive virtual environment. This research provides a novel approach to model how nature is represented within a digital reality that is an immersive virtual environment, which allows designers to understand effectively what milieu within the virtual environments can serve as a meaning-carrier for prospective users. For this research, it is essential to understand *what* the nature of the hyperreal immersive virtual environment provides as a transcendental process for semiosis – i.e. the continual and irreversible construction of meaning through the action of signs – and *how* the prospective user interacts with the designed objects in the virtual space to construct meaning-making within the virtual environment.

In recent years, there has been a development in the literature on semiotic research and the interactivity of new media, which covers a wide range of modelling sign systems that exist in relation to new media. As a taxonomy for the modelling development related to new media, there are four semiotic programmes that each give novel approaches to analysing the many technologies and meaning-making activities that fall within the umbrella term of new media. First on the list of notable programmes and new media is PUC-Brazil, established

by Clarisse de Souza and her development of semiotic engineering, which concerns the theoretical modelling of metacommunication regarding human-computer interaction and focuses on how designers and users communicate via systems interface (Souza 2005; Ferrari, Aquino 2016). Second, there is the Semiotics and Philosophy Department at the University of Turin: their research venture known as FACETS[2] (Face Aesthetics in Contemporary E-Technological Societies) regarding the human face as an object within the digital age sheds light on various facets of how identity and culture are being developed through the means of new media. Third on the list is New Bulgaria University and their New Media and Digital Culture programme; their leading researcher Kristian Bankov has extensively studied how a user interacts with a digital platform, thus forming a digital culture which Bankov terms as 'platfosphere' (Bankov 2020, 2022).

The notion of the platfosphere originates from Juri Lotman's (1990) theoretical model of the semiosphere which is where meaning emerges and resides for cultural systems. Lotman's theoretical development of cultural systems brings us to the fourth notable semiotic school for modelling new media, the University of Tartu's programme in semiotics, which has contributed to the branches of biosemiotics, ecosemiotics, cultural semiotics, and sociosemiotics. Aside from the semiotic fields described above, a rising number of Tartu early-career semiotics scholars – Milyakina (2020), Kozicki (2021), Fadeev (2022), and Davidson (2022) – are investigating the cultural structuring in relation to semiosis in the digital age. The reason for bringing these four programmes into the spotlight is to emphasize the wide range of applicability that semiotic research provides for technological development within the vague and exponentially growing notion of new media. The current research aims to investigate how a potential user interacts with digital milieu within a degree of nature for an immersive virtual environment, as well as to elaborate on what the nature of the hyperreal environment offers as a transcendental process for semiosis.

1. Overview and scope of immersive virtual environments

To begin this research, a brief historiographical overview is required to establish how immersive virtual environments developed over the past century, as well as to clarify what is meant when the term 'immersive virtual environment' is used in this research. Throughout the paper 'immersive virtual environments' will be abbreviated as IVE, and 'virtual reality' will be abbreviated as VR.

[2] See *Signs Systems Studies* 2021: 49(3/4) for a special issue on the Cultures of the Face (edited by Remo Gramigna and Massimo Leone), as well as the book *Il metavolto* (2022) written by FACETS researchers.

From a global perspective, we have collectively experienced a technological schism due to the COVID-19 pandemic that affected various meaning-making events related to how we work, play, learn, and ultimately grow as individuals. During the pandemic lockdown, the physical office and the physical classroom transformed into virtual environments on which we, as users, relied to perform certain tasks. This transition to virtual environments was mostly felt in the comfort of our own living spaces; a kitchen table could be transformed into a workspace, a bed could be transformed into a desk, and the mute and 'stop video' buttons became resources for concealing stimuli that exist in the physical (intrinsic) environment, so they did not appear in the virtual environments in which we found ourselves.

During this time in the pandemic of performing real tasks within a hyperreal environment, popular media and news outlets became ever so interested in the announcement of Facebook's branding transition into Meta and their future release of the metaverse platform. It is crucial to bring the metaverse into the discussion early in the article because it is highly relevant to IVEs and the integration of technological artefacts within the user's physical environment. As Pericles Rospigliosi (2022: 1) mentions in an article about the turn to VR for education, socialization, and work:

> 2021 may well turn out to be the inflection point when the use of virtual reality became widely recognised as the gateway to the metaverse. The rebranding of the world's largest online social network from Facebook to Meta is indicative of a shift that is well underway among the generation who are at schools and university now and is accelerating in those that will engage in learning in the future. It is a turn to the virtual that is likely to play an important role in what we consider to be interactive learning environments.

The term metaverse was first used by Neal Stephenson (1992) in the dystopic fictional novel *Snow Crash* to depict a cyberspace where people from across the world could connect online to escape the problems related to a post-global economic collapse in their physical environment. From an economic perspective, J. P. Morgan and Associates released a whitepaper[3] in 2021 that highlighted their services offered for their potential clients who are seeking market entry into the metaverse; their definition reads: "the metaverse is a seamless convergence of our physical and digital lives, creating a unified, virtual community where we can work, play, relax, transact and socialize". The metaverse from the perspective of this definition offers a look into the potential meaning-making acts that can

[3] J.P. Morgan metaverse technology whitepaper can be accessed at https://www.jpmorgan.com/content/dam/jpm/treasury-services/documents/opportunities-in-the-metaverse.pdf.

come into existence within the concept itself, but it is crucial to keep in mind that the metaverse is the integration of the physical world with the digital world; this can be achieved and performed by technological devices such as augmented reality (AR) and VR. Specifically for this research the focus is on modelling the *immersive-ness* of virtual environments using a closed visual perceptual system (e.g. VR headset and sensory feedback devices) that is mediated by a user within the physical environment of a living space.

The technology of VR showed signs of development in 1929 when the first mechanical flight simulator was designed (Sherman, Craig 2003; Bankov 2022). Additionally, similar to how the application of the metaverse emerged from a fictional literary text, the term virtual reality was mentioned by the science fiction writer Stanley G. Weinbaum in the short story *Pygmalion's Spectacles* (Weinbaum 2010[1935]). From the technological aspect of VR, Bankov (2022: 56) notes that the visionary of VR was Morton Heilig who developed the *Sensorama* in the 1950s and built the first prototype of an immersive, multisensory and multimodal cinematic experience in 1962. In more recent years, VR technology could be experienced by users who visited VR arcades – although the pandemic drastically affected the success of this niche market[4]– however, VR headsets are predominately being commodified as household goods, meaning that the prospective user will most likely interact with this form of technology in relation to some form of a living space.

Virtual reality should be modelled as a closed visual perceptual system, meaning that the VR headset replaces any visual stimuli that exist within the user's physical environment – overall, the visual stimuli in the physical environment are substituted with digital visual stimuli. This is not the case with AR technology because it is an open visual perceptual system, meaning that the AR device blends the physical environment with the digital stimuli. This research applied the four degrees of nature to closed visual perceptual systems, using VR immersive environments as the focus. Future research for applying the four degrees of nature to hyperreal environments should focus on the concept of mixed reality; this will provide a deeper understanding of how a user's experience of being immersed in a virtual environment affords interoperability for the continuous processing of an unfolding stream of consciousness perceiving digital milieu that is contextualized as closed and open visual perceptual systems within the user's physical environment.

[4] The Estonian Virtual and Augmented Reality Association (EEVR) released their 2021 annual report for the VR and AR industry in Estonia and indicated that all VR arcades in Estonia closed their operations in 2021. Access to full report can be found at https://eevr.ee/vr-ar-estonia-2021/.

Mixed reality (MR) technology refers to the blending of the real and virtual worlds that construct experiences which distort the perceived boundaries for physical and digital milieu interacted with by a user, the notion of mixed reality technology implies the modelling for both closed visual perceptual systems (e.g. VR headset, screen technology) and open visual perceptual systems (e.g. AR glasses, AR app/filter). Tamalee Basu, Olga Bannova and Jorge Gamba (2021) provide a novel study of incorporating MR architecture for space habitats and their research demonstrated how the co-development of MR technology within the specified physical space could assist the crew to adapt to the confines and limits of space habitats, as well as alleviate the detrimental impact of sensory deprivation, stress, and isolation during long-duration space missions, and improve the overall spaceflight experience (Basu, Bannova, Gamba 2021: 549). This novel study demonstrates that the design and development of MR technology can be utilized to improve a user's relations with their physical environment, in addition to strengthening theoretical modelling related to meaning-making for the paradoxical nature of reality and hyperreality, modelling how a certain technology can improve a specific form of living space requires a drawn out (i.e. designed) approach which goes beyond the existing conception of what is perceived and experienced as true and real.

The lens used for this research focuses on the proponents of immersion for a closed visual perceptual system experienced while using VR, for a user to experience the feeling of being immersed requires a state of immersive realism which transcends perceptual process of the user from their physical stimuli and becomes reliant on the IVE stimuli for semiosis. Because of the evoked immersive realism of constructing meaning in a closed perceptual system, the VR user may forget that a ceiling fan is above them when they interact within the IVE, or that they are not actually riding on a roller coaster – although the ground beneath the user's feet may be flat, the visual stimuli of the IVE of being on a roller coaster are experienced as real. As the architect and semiotician Farouk Seif (2014: 59) states, "Virtual reality has provided sensational experiences in imagining physical objects and visual environments. Paradoxically, the virtual is, in fact, complementary to the visual."

2. Intentionality of design and semiotics

Within the boundaries of academia that establish the schism between humanities and sciences, both design and semiotics traverse across several fields and disciplines to signify their essence; this is exemplified by John Locke (1959[1690]) who made the assertion that semiotics is the new branch of human knowledge. As Seif points out, humanities tend to deal with *real* human experiences, which falls within a cultural system and is shaped by several forms of real interpretations; "the real is distinguished by prescriptive composition of that which is yet-to-come" (Seif 2016: 5), and the prescription for that which is yet-to-come can be viewed as design inquiry, which is to perceive how things could be rather than perceiving the way things are (Seif 2016: 14). Sciences, on the other hand, observe what is *true*, which is dependent on factual information and "is characterized by descriptive explanation of that which already exists" (Seif 2016: 5). The paradox of real and true is what Seif considers to be an outcome that is congruent with the humanities–sciences schism (Seif 2016, 2019), indicating that both design and semiotics go beyond the boundaries of humanities and sciences and emerge as what the Swiss psychologist Jean Piaget (1972) discussed in his essay about the interactions amongst disciplines, which provided the foundation for transdisciplinary research (Nicolescu 2008, 2010; Seif 2017).

Design and semiotics are intimately related when it comes to the etymological convention (Seif 2017: 20). The word 'design' has roots in Latin, as the word *designare*, which means to 'mark out', 'to devise', 'to choose', 'to make a *signum* (sign)' and the word 'design' implies that there is a semiotic nature in the design activity, such as 'from the sign', 'on account of the sign', 'concerning the sign', and 'according to the sign'.

In a broader sense, design is the application of signs; we use design to construct an object; we use design to disassemble an object into smaller signs within itself (e.g. reverse engineering); signs are the meaning-making elements that the creator employs to formulate an act of design. The following excerpt is from an unpublished text[5] by the computational designer and semiotician, Mihai Nadin, which offers excellent insight on how design and semiotics are connected:

> The material substratum of the sign is probably more relevant to designers than to many other semiotic practitioners. When people relate to designed artifacts, they ignore or are unaware of the underlying semiotics (involving the commissioned aspects of design) and interpret the artifact for what it is supposed to be, or for what they make of it in a given pragmatic context. For designers to be aware of

[5] Mihai Nadin's text about design can be accessed at https://www.nadin.ws/archives/283.

> semiotics, or to apply it, means to understand, in addition to technological, social, physical, and other aspects, that the sign process embodied in design continues in the use of what was designed. This forces into the equation of design the future user as a component of the design semiosis.

Regarding the materiality of design, Seif (2019) identifies two relevant terms within the design process, design outcomes and design deliverables. Design outcomes relate to the semiotic process of identifying the qualitative essence of physical things, which relates to the Peircean notion of qualia. On the other hand, design deliverables can be viewed as the final product that is exposed into the world, this is the materialized object that is designed by conceptualizing the essence of a certain quality.

To build on the concept of design outcomes and design deliverables, we must now consider how intentionality for design and semiotics contributes not only to how humans perceive the world, but also to how they make meaning of it (Seif 2017). It is worth noting that the development of intentionality is a two-pronged endeavour that includes epistemological and ontological understanding. As Seif points out, the historical development of intentionality began with considering intentionality to be an epistemic construct for the mental act of knowing reality. However, from an ontological standpoint, intentionality provides understanding for the relations of objects and things through the conceptualization of knowing (Seif 2022: 289).

Humans, whom John Deely (2010) considers as semiotic animals, do not only interpret signs – we also think in signs. The ability to think in signs allows us, as a species, not to rely on deterministic ends: we can predict and formulate an outcome which has *yet-to-come* by envisioning "what could be and of what should be and what will in [the] future be" (Deely 2002: 110). The unexpected emergent outcome in a future state allows us to experience the essence of intentionality, which is the umbilical relation between design and semiotics (Seif 2020a). Regarding the design process, Seif (2019, 2020a) emphasizes that deliberate acts are a linear trajectory aimed at obtaining a specific result, and there is intentionality which is the non-linear navigational process that goes beyond the boundaries of expectations that ultimately leads to unexpected emergent outcomes. Intentionality, as Seif (2022) expresses it, is a journey, not a destination.

As we will see in the following section, the voyage into the modelling of Kull's (1998) four degrees of nature within IVEs brings to light the paradox of reality and hyperreality, which will be linked to the intentionality of meaning-making events that a user can experience while being immersed within a virtual environment.

3. Applying Kull's ecosemiotic model of nature to immersive virtual environments

Since we are dealing with the topic of nature, creating, and the creator, it is worth bringing to light the linguistic significance that the Estonian language provides for these three terms. In Estonian, the word '*loodus*' is a noun that signifies 'nature'. Concerning *loodus* (nature), there are nouns that represent 'animal' and 'beast' ('*loom*'), 'being' ('*loomus*'), and 'instinct' ('*loomusund*'); these examples shed insight that the root '*loom-*' denotes an ecological understanding that nature is represented by the objects that are within the imagined boundaries of an environment. Additionally, the verb 'to create' is '*looma*'; this reinforces the notion that the act of creation is *within* nature itself. To take the linguistic connections even further, the noun '*looja*' signifies 'creator', 'maker', and 'originator', and an important distinction is that '*looja*' not only represents the deliberate act of creation from a singular agent, but it emphasizes the intentionality from agency during the processual transformation of '*loodus*' ('nature') itself. 'Nature', 'to create', and 'creator' are linguistic conventions in the Estonian language that signify how nature is an evolving creative process that originates from the agency of a creator and is represented by the objects that exist within what is perceived as nature. The purpose of describing the Estonian linguistic conventions is to express how my perception of nature has changed over the past three years of living in Estonia. Furthermore, the linguistic conventions related to nature form a fitting transition into a discussion of the theoretical contributions from the Estonian biosemiotician Kalevi Kull.

In respect to how humans interpret, re-design, and recreate nature's objectivity, Kull's (1998) article draws attention on how semiosis from the human umwelt impacts nature. Kull constructs an ecosemiotic model that identifies four degrees of nature that categorically describes the anthropocentric construction of meaning from the human umwelten in relation to an ecological system. Even though Kull's (1998) article focuses on biological processing of the human umwelt in relation to an ecological boundary, it argues that applying the four degrees of nature to model degrees of hyperreality which are inherent in immersive virtual environments can lead to more appropriate design outcomes. Hyperreality, as Seif (2014: 60) explains, "describes the inability of humans to distinguish the physical and known reality from the unfamiliar and simulated reality in a world of multitude of modalities". Applying the four degrees of nature provides designers and researchers with a deeper understanding of the environment-specific (i.e. VR as a closed visual perceptual system) relations on how a user perceives and performs meaning-making acts while being immersed in a hyperreal environment.

Kull (1998: 355) gives the following statement to emphasize how the four degrees are related to the human umwelt:

> As a result of the differences humans can make, the nature in their Umwelt is distinguished into first, second, and third nature; what we think is outside the Umwelt, can be called zero nature. Zero nature is nature itself (e.g., absolute wilderness). First nature is the nature as we see, identify, describe and interpret it. Second nature is the nature which we have materially interpreted, this is materially translated nature, i.e. a changed nature, a produced nature. Third nature is a virtual nature, as it exists in art and science.

The significance of this model indicates how the ongoing construction of humans' meaning-making process affects the objective nature that remains beyond the human umwelt. From a geological epoch perspective, the transition from the Holocene into the Anthropocene signifies the impact humans have made considering the state of our planetary boundaries – see Will Steffen *et al.* (2015) for a breakdown of the nine planetary boundaries.

For this research we are focused on how the paradoxical nature of reality and hyperreality affect a user's meaning-making process of simultaneously being in a physical realm while, at the same time, perceiving and interacting with stimuli that exist within a digital realm. The importance of applying this model to the paradox of reality and hyperreality emphasizes the role the environment has on the user's semiotic scaffolding process, which is closely linked to learning since semiotic scaffolding is a biological process that internally moulds how organisms "continually seek and extract meanings through their interactions within their umwelt" (Campbell, Olteanu, Kull 2019: 368). Using the four degrees of nature to model immersive virtual environments in hyperreality allows researchers to investigate how meaning is constructed within a subjective boundary of nature and carried over into the mental representation of images representing environmental milieu as objects in a degree of nature (see Fig. 1).

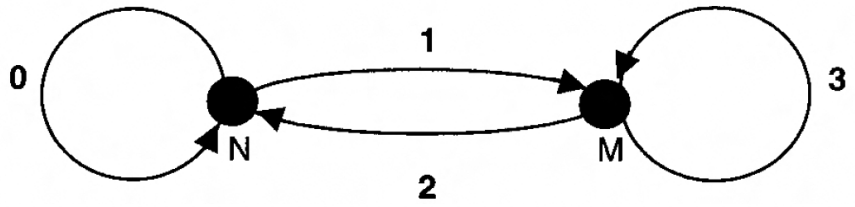

Figure 1. Kull's (1998) four degrees of nature; N represents nature, and M represents image.

Paradoxically, the user's umwelt is directly linked to the ecological system at hand, yet the immersion into a virtual environment produces a meaning-making process which could be understood as an umwelt within an umwelt. This can be viewed as the *immersed umwelt*, because the immersive environment is not truly an alternative substitution for the physical reality and the components of virtual environments exist and emerge as images within the mind of a user. The assertion that IVEs emerge from the user's mind and lack physical characteristics in intrinsic reality calls into question Jean Baudrillard's (1994) concept of simulacra. Baudrillard asserts that reality is a simulacrum that becomes true in its own right, implying that there is no such thing as reality. However, as Seif (2014: 58) comments on the position of Baudrillard's simulacra, "it is more appropriate to say that the new media have integrated the acute boundaries between the real and the true". What is experienced within an IVE is described as real within the mind of a user and can potentially lead to the risk of users disconnecting from the authentic, intrinsic state of reality (Rospigliosi 2022). However, since this research focuses on the paradoxical nature of reality and hyperreality, Seif (2019: 218) reminds us that paradoxes are not meant to evoke common sense and be looked at as problems to 'either–or' solve. Paradoxical thinking requires the modelling of 'both–and' to persevere through the boundaries of absoluteness using unexpected *uncommon sense*.

The model provided by Kull (1998) serves as an ecological process in which the environment and humans co-develop within the perceived boundary of nature. Paradoxically, this model is significant for explaining how a user's perception-induced immersion of hyperreality co-develops with the imaginative, exhibitive, manipulative, and reproductive nature. The following subsections break down each of the four degrees of nature and examine how digital, virtual environments are related to Kull's model. Breaking each degree of nature down provides insight into the underlying paradoxical nature of reality and hyperreality.

3.1. Imaginative nature: 0th degree

The role of a designer is essential when it comes to creating a virtual environment that provides a future user an immersive experience since the designed virtual environment is a representation of the creator's competence abilities and is firmly grounded in their capacity to imagine. A designer's imagination and meaning-making process during the design process provides the grounds in which a user of the IVE can construct meaning within the nature of the designed environment. Designing a virtual world first begins with a void, and the intentionality of the designer is the means on how a future user will interact with the designed virtual environment.

Kull (1998: 355) writes, "The true wilderness, obviously, is the untouched nature, which, in an absolute sense, is even untouched by our knowledge. It follows that we are not able to describe it, at least in correct scientific terms." This statement is significant when we juxtapose it in relation to "experiencing" the imagination of someone. Although we understand that imagination is a cognitive ability for most humans, this imaginative force is signified by virtue of a sign – i.e. someone who states their position is a creator or designer is framed by what is designed, whether this consists of expressing a compelling, passionate sales pitch or putting the actual designed object in the said someone's hand. Overall, imagination is represented as the semiosic process of creativity that emerges into existence as a sign.

Concerning the 0th degree nature of an immersive virtual environment, the imaginative nature virtually exists purely within the designer's mind, the designer relies on the design process to "mark out" (design) certain imaginative properties, which, in turn becomes a sign due to the designed, materialized object that links the designer's imagination with a specific act of creation. The design task of a designer is to bring into existence their imagination by constructing materialized objects; this can range from sketching a blueprint, formulating a model, talking in detail about the characteristics of an object they envision, and any other mode of verbal or non-verbal communication that can convey the essence of what is imagined.

Jakob von Uexküll emphasizes the underlying role of imagination in his statement, "Nature's techniques share common features with the creation of a work of art. We can, of course, see the painter's hand apply one color after the other to the canvas until he has completed the painting, but the creative melody that moves his hand is wholly hidden from us" (Uexküll 1982: 75). This supports the notion that imaginative nature, as the 0th degree of hyperreal nature, exists beyond what is currently experienced and perceived in an environment as real or true, "but [imagination] is a potentiality waiting to be actualized as real or true as much as the real and the true can be reframed differently by the imaginary" (Seif 2019: 266).

3.2. Exhibitive nature: 1st degree

The exhibitive nature of hyperreality relates to the meaning-making process that is evoked by a user who perceives stimuli within an immersive virtual environment. As Kull (1998: 355) mentions, the 1st degree of nature is "filtered via human semiosis, through the interpretations in our social and personal knowledge". Kull emphasizes that the 1st degree of nature is filtered by language, as this is what allows us to interpret the environmental stimuli which translate the zero nature (objective nature) into the 1st degree that relies on the image we construct of (3rd degree) nature.

First-degree nature in an IVE requires the designer to incorporate sensory information into the digital space. Immersive virtual environments primarily utilize visual stimuli as a central meaning-making component that the user can interpret. Dionisio, Burns and Gilbert (2013) offer a roadmap for the development of the metaverse and virtual worlds. In their paper they identify certain technological characteristics to convey how a user experiences immersion; in the following quotation they make a distinction between a text and immersive sensory information:

> Text was used to form imagery within the mind's eye and, to a certain degree, it remains a very effective mechanism for doing so. In the end, however, words and symbols are indirect: they describe a world and leave specifics to individuals. Effective visual immersion involves eliminating this level of indirection—a virtual world's visual presentation seeks to be as information-rich to our eyes as the real world is. The brain then recognizes imagery rather than synthesizing or recalling it (as it would when reading text). (Dionisio, Burns, Gilbert 2013: 9)

This quotation serves as a useful insight into the intentionality of the designer creating a virtual environment. It emphasizes the need for the digital stimuli to replicate physical things that exist in the intrinsic realm for the user to generate the perception of the virtual objects. The quote elaborates how an immersive environment relies on information-rich stimuli that signals to the user what is being perceived; it is apparent from it that Dionisio, Burns and Gilbert (2013) take the stance that indirect perception reduces the potency of an immersive experience. The aspect of indirect and direct perception discussed by them relates to the distinction of thing versus object and, as Seif (2020b: 198) mentions, "Things are only recognizable as a result of being objects in the human mind; without them, things would not exist, and without signs there could be no objects, and without objects there could be no awareness of things in the world." Therefore, direct perception refers to a user's response to the environmental stimuli which are things, and indirect perception is the mental construct of objects in relation to the things that are perceived within the environment.

Besides visual stimuli of an IVE, spatial audio designed into virtual environments can be understood as a form of textuality that can potentially induce a layer of audio realism. Audio as a text can be broken down as diegetic sound and extra-diegetic sound (cf. Lotman 1976). The diegetic sound relates to what emerges from communicative dialogue within the environment (e.g. a group of avatars communicating to one another in a virtual world), while extra-diegetic sound relates to designed auditory stimuli that is integrated by the designer into the virtual space (e.g. incorporating theme music into a virtual world, the sound

emitted from a cash register or barcode scanner, or the sound or raindrops hitting the outside of a window that a user can hear while in a virtual world). Lotman's modelling of diegetic and extra-diegetic sound focused on the semiotics of cinema (Lotman 1976); however, it is significant for designers to understand how diegetic sound unexpectedly emerges within an IVE, and extra-diegetic sound is programmed by a designer that is intended to evoke a level of realism.

Another form of stimuli that can evoke a sense of realism within an IVE is the integration of haptic perception. This allows the user to generate a meaning on what can be touched within a digital space. The integration of haptic feedback typically requires the user to possess additional wearable technologies to attain a degree of touch; the common VR headset found in today's market predominately affords visual and auditory stimuli to generate immersive realism, and peripheral devices interoperable to the user's VR experience such as vests or gloves can be used to integrate haptic feedback. Out of the three forms of environmental stimuli discussed in this section, the aspect of haptic feedback serves as a cornerstone component for evoking realism – how can a user genuinely create a real experience of touching a virtual object that does not physically exist?

3.3. Manipulative nature: 2nd degree

The second degree of nature, whether it concerns reality or hyperreality, is a manipulative nature. This relates to the process of how a user can alter what is exhibited within the perceived nature. Manipulating nature requires a user to have the negation of agency within the environment, and agency is "an essential component in the realm of human beings and their environments" (Seif 2022: 287). What we will see in the next subsection regarding the 3rd degree of nature is that the manipulation of nature requires the user to construct an image of nature, which is significant for the umwelt to transform perceived things into objects.

The manipulation of nature is a meaning-making process that directly relates to a species' umwelt. Before we begin modelling the manipulation of hyperrealistic nature, let us examine two examples from ecological nature. Regarding how humans change the state of physical nature, imagine the deforestation process of converting a rainforest into agricultural land, or any other form of development such as an industrial plant, shopping centre or housing complex. What we are doing is altering the physical space to match our meaning-making behaviours, such as manipulating space for production, consumption, or habitation. For an example related to a non-human umwelt, during mating season the male six-plumed bird-of-paradise (*Parotia Sefilata*) will find an area on the forest floor and will remove any debris from the surrounding space; then, the male performs a ritual mating

dance on the cleared forest floor with the intent of courting a female. The purpose of these two examples is to indicate how the manipulation of nature requires a goal-oriented behaviour designed by a species, which relates to an image[6] constructed in the 3rd degree of nature.

Concerning the interaction of an umwelt with its environment milieu, the research by Campbell, Olteanu and Kull (2019) provides insight into the four semiotic components (resources, affordances, competence, and scaffolding) that relate how the organism and its environment co-develop. Knowing these four components enables a designer to have a more detailed imagination of how a user is intended to perceive the designed artefact. In the 2nd degree of nature, since it deals with changing nature, there is an increased role for the semiotic components of resources and competence, and according to Campbell, Olteanu and Kull (2019) these two components are inseparable from one another. A semiotic resource is something within an environment that can be engaged with by a biological agent, which can lead to the discovery or generation of meaning (Campbell, Olteanu. Kull 2019: 358). Competence, on the other hand, refers to the capability of discovering resources and recombining the meaning within a new pragmatic function (Campbell, Olteanu, Kull 2019: 359). Overall, if a user is given the potentiality to change the nature of the IVE, then the user must have the competence on what can and cannot be manipulated, and the user must discover which resources within the IVE can serve as meaningful objects on how to manipulate nature.

For an example into the manipulative nature within a digital environment, let us examine the popular console and computer game *Minecraft*. The game was released in 2009 and is categorized as a sandbox game, meaning that the environment within the game offers the users to construct and deconstruct the milieu within the digital environment. Within a sandbox game the user has a range of agency to explore the boundaries of the environment. Sandbox games[7] give the users the notion of free play, which offers them a wide range of interactivity so that they can decide what to do within the game. Consequently, the endless potentialities that can emerge within a sandbox game evoke the user's creative ability. The user determines what the digital nature affords, e.g. regarding *Minecraft*, the user can cut down trees to make lumber which can be used as a resource to build houses or other forms of structures.

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6 In the Aristotelin sense, images are understood as *phantasmata* which reside in the mind and express our "thoughts, memories, desires, and actions, which are at the core purpose of changing or reconstructing reality" (Seif 2022: 292).

7 *No Man's Sky*, another sandbox video game, allows players to explore the environments of 18 quintillion planets, which cannot be fully experienced in a single user's lifetime.

Another example to bring into the discussion is the creative process of developing a virtual world for the VR and computer platform *VRChat*. The content within *VRChat* is user-generated, which means much emphasis is put on the avatar and the virtual worlds. Players can explore various virtual worlds and obtain new avatars to add to their account, and interact within various virtual worlds where specific types of behaviours and interactions emerge – e.g. working behind the counter at a virtual fast food restaurant, playing Russian roulette at a virtual club, or singing karaoke with a roomful of avatars inside a virtual home.

The aspect of *VRChat* being a platform driven by user-generated content is significant for the research because it gives the user the ability to be a designer of virtual worlds and other digital milieus within *VRChat*. For a user to construct their own virtual world or avatar they must have the necessary competence to use 3D modelling software such as *Blender*, and once the designing user creates the virtual world or avatar, they can upload their creation to the *VRChat* platform. This example indicates how competence undergoes a translation process, competence itself is not limited to environmental boundaries, but it is limited to the user's perception of the environmental characteristics. Semiotic resources are very much ingrained into an environment as things, but competence is the recollection of objects within the user's mind that allows them to construct a meaning-making act by recombining the resources that exist for the user.

3.4. Reproductive nature: 3rd degree

The last degree of nature in Kull's model is the 3rd degree, which is the image constructed internally within an umwelt of the 1st-degree nature. According to Kull (1998), the 3rd degree of nature is a virtual nature, as it exists in art and science. This includes theoretical and artistic texts that emerge from an experience in a 1st-degree nature – e.g. creating a poem about your favourite lake, or sketching a blueprint on where the fire pit will go in the backyard.

Concerning the paradoxical nature of reality and hyperreality, the usage of "virtual nature" can lead to confusion of semantics since hyperreal milieu is intrinsically virtual and lacks characteristics with physical existence. In this research, the 3rd degree of nature is considered as reproductive nature, because the 3rd degree of a hyperreal nature allows users to form a habitual act that is dematerialized from the actual, physical meaning-making event. One could say that if the 3rd degree of intrinsic nature is virtual nature, then, paradoxically, the 3rd degree of a virtual nature is a *realistic* nature.

Intentionality and reproductive nature are linked by a user's constructed semiosis and through the milieu that exists within a hyperreal environment. The

notion of reproductivity for this model is not to emphasize the biological process of producing offspring; however, what we as users are doing in hyperreality is reproducing meaning in relation to our Self.[8] Our physical identity, which is very much ingrained and shaped within the intrinsic nature, is now given the potentiality to be in a moment of existence as an avatar[9] – or even merely a screenname with a profile picture on some platforms – in a hyperreality. Semiosis is the component being reproduced, meaning itself cuts through the veil of the paradox of reality and hyperreality and attaches to the environmental milieu that an individual experiences. More so, the meaning-making events which comprise our semiotic reality that we all individually experience is not broken up or divided as being compartmentalized solely as either an intrinsic reality or a digital hyperreality. The meaning that a user scaffolds, regardless of if it is indeed reality or hyperreality, generates the action of signs (semiosis) that impacts our perception and intentionality of consciousness.

The 3rd degree of nature for hyperreality is where secondary systems emerge – this is where the agents of meaning-making (users) are provided the environmental components to reproduce meaning-making events. A handshake with someone you meet in VR is indeed still a greeting, but can we say that a handshake in the intrinsic reality contains the same quality as the experience in the hyperreality? Regarding this simple example, reproducing the act of a handshake differs in the meaning-making components, the two avatars are essentially re-enacting a social convention that exists within intrinsic reality and lack certain things which are the stimuli that we perceive to contain significance for a real-world greeting; a handshake in person is interpreted by the strength and firmness of the grip, the number of shakes performed, the eye contact of both individuals, and other meaning-making components, compared to a handshake in VR which is interpreted by the recognition and mimetic movement within a spatial proximity between two hollow avatars.

For a more complex example of 3rd-degree nature in hyperreality, I will discuss my personal experience of reproducing the role of a barista at a virtual coffeeshop within *VRChat*. For starters, what is imagined when a coffeeshop comes to mind?

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[8] As Seif explains throughout his book on the theory of *De-sign*, reality is a socio-cultural construct, and at the heart of it is the entanglement of self and others. Using Bakhtinian dialogism and Peircean agapasm, a dialogical imagination between self and others constructs "a loving relation that overcomes the barriers between the self and the other" (Seif 2019: 291).

[9] Etymologically, the word '*avatar*' originates from Sanskrit and means 'descent', and in Hinduism it refers to the "voluntary descent from higher to lower spiritual ranks" (Leone 2011: 341). As Leone (2011) points out, in relation to digital environments 'avatar' was first used in the video game *Ultima* (1985) and in Stephenson's *Snow Crash* (1992).

Is it remembering the scent of roasted coffee beans as soon as you walk in? Is it the reminiscing on the taste of your favourite drink that you usually order? Or is imagination drawn towards remembering the sounds and sights within your experience of being in coffeeshops? Regardless of what was specifically imagined, the mental images perceived are objects for the things that emerge within the subjective experience and conceptualization of a coffeeshop.

Figure 2. Interior of a virtual coffeeshop in *VRChat*.

The image above (Fig. 2) is from inside a *VRChat* virtual world that is a reproduction of the physical characteristics for a Starbucks coffeeshop, which was created by a user and not officially endorsed by the brand. Various texts within the picture show resemblances with actual Starbucks, such as the colour tones within the interior design, the style of the counter, the menu list on the back wall, the logo, and even the type of lighting fixtures. What was remarkable while walking around behind the counter was to witness avatars walk into the café and form a line in front of the cash register, and press a button on one of their VR controllers to "equip" a credit card, after which they would go through the process of informing the cashier on what they would like to order. During this fantasized, and reproduced, meaning-making event the barista could walk over to the coffee machine and press a button on their controller to make a drink, then hand the drink to an avatar, and the "reproduced consumer" could carry on with constructing semiosis within the IVE.

This example indicates how the digitally designed space of the iconic coffeeshop provided the agents of meaning-making the ability for a reproduceable nature. It was not a deliberate act of the designer of this virtual world to replicate the user experience of being a consumer at Starbucks; however, the designer provided intentionality for the users by including a certain milieu that offered the action-potentiality (affordances) for the players to interact and engage with the objects within the environment, such as the essence of using a credit card, the scanner, and the coffee machine. The cash register on the counter within this virtual space serves as a central object of importance which brings into existence conventions that we create from being at a real Starbucks. However, now the conventions are performed in the virtual environment – it is significant to understand how the deliberate act of ordering a drink can indeed become an unexpected outcome to simulate intentionally the experience of ordering a drink. As mentioned in the paragraph above, forming a line, swiping a card, and being handed a drink are all aspects that are dependent on the player's mind, and this relates to competence and scaffolding of semiosis. Overall, when a designer incorporates known objects and their characteristics into a virtual environment, the user can experience a reproductive nature in which the objects (e.g. cash register, card terminal, coffee machine) are contextualized within the virtual environment, causing the things perceived by a user in the virtual environment to be enacted as semiotic components to construct semiosis.

As a recap for the four degrees of nature for immersive environments in hyperreality, the 1st degree of nature, the exhibitive nature, allows the user to formulate meaning and interpret the sensory information that is experienced and perceived within an IVE. The 2nd degree, the manipulative nature, requires changing nature during the enactment of a user's goal-oriented behaviour, which is internally modelled in relation to an image constructed in the 3rd degree of nature, the reproductive nature. The 0th degree of nature, the imaginative nature, exists within the mind of the designer, and this is the paradoxical inversion of the 3rd-degree nature for the intrinsic nature. With this said, the umwelt within an umwelt (the immersed umwelt) exists within the realm of images and does not have a direct meaning-making process with objective nature itself; a user immersed within a hyperreal nature co-develops with the designer's ability to make a sign out of their imagination.

4. Paradoxical nature of reality and hyperreality shaping the home

The following section examines how technological artefacts integrated into the living space alter the mediation of semiosis for acts that exist within the physical boundaries of a person's inhabited space. The prior sections focused on how to model semiosis within the respective degrees of nature for reality (physical nature) and hyperreality (digital nature); this section spearheads the paradoxical performance of essentially simultaneously being in two environmental systems, one of which is constrained to the spatial-temporal components of physical reality, while the other is a cyberspace that emerged from the conceptualized imagination of a designer. Two subsections elaborate on how household technology from the past century has altered characteristics of the living space, which, in turn, has affected the scaffolding process for what the technological living space provides for the inhabitant.

4.1. Changing the nature of our living spaces with screens

A living space is an inhabited space that was designed from the umwelt process of a species to scaffold semiosis to attain specific, desirable meaning-making acts. The term 'home' is also used in this research to convey a type of living space, but it should be noted that the conceptualization of 'home' is culturally specific and anthropocentric, as opposed to the term 'living space' which is more connected to the mediation of signs by a species within an ecological niche. What is of interest for this research is to examine the theoretical components of what makes a technological living space a gateway that allows us, as users, to traverse into a digital realm where the images perceived are experienced as real and within the proximity of our agency.

The emergence of narration while interacting with screen technology in our home affects how we co-develop in our habitual space. Bankov (2022: 52) concurs that screen technology for digital culture provides the user with a "revolutionary phase in the representation of narrative, since its reality effect is beyond compare". The invention of cinematic texts integrated movement into the boundaries of the text,[10] which is what makes Lotman (1976) model the cinematic text as a moving image. Cecelia Tichi (1991) dedicates a book to discussing how

[10] Lotman differentiates between five levels of text: communication between addresser and addressee, communication between the audience and the cultural tradition, communication of the reader with himself, communication of the reader with the text, communication between a text and the cultural context, stating that, "Any particular text can fulfill the role of a descriptive mechanism in regard to the cultural context; but on the other hand, it can in turn enter into deciphering and structuring relations with some metalinguistic formation" (Lotman 1988: 56).

the commodification of the television as a household item in the late 1940s was conveyed to American families as being an "electronic hearth". This metaphorically continued the conventional role of the family hearth as a space that provides intentionality for members within the household to gather around together and share stories, which reinforces the essence of narration of screen technology within the symbolic space of a home. As Elliot Gaines (2006: 175–l76) points out in an article about communication and the semiotics of space:

> The technology of television literally brings distant places close while emulating a cultural space from another time and place. What is critical about TV is that the technology obfuscates the remote locations of events because viewers experience television programmes in their homes, so meanings are interpreted locally.

This statement is significant because the individuals living within the home are not the only agents responsible for mediating objects (e.g. technological artefacts) within their home. The cultural system that the individuals are a part of has an underlying role of the scaffolding process on how technology can be used within the space, therefore making the technological artefact in relation to a spatial context to be understood as a cultural artefact as well.

The bedroom is another textualized boundary within a home that has undergone a change regarding how the inhabitant integrates screen technology within the spatial context. As Bankov (2022) mentions, average Western teenagers in the 1980s could express themselves by putting up posters of their favourite musicians or movies on the walls, and they could utilize VCRs and tape decks to create their personalized mix tapes. Bankov (2022: 43) emphasizes that the above-mentioned conventions formed within the parameters of the bedroom that was the precursor for the *Facebook* wall.[11] The different forms of texts integrated into our bedrooms, or on digital platforms, reflect the inhabitants' self and their relation to a specific culture.

In the current era of live streaming from a smartphone or a computer, the bedroom is undergoing another transitive change on how the integrated technology for live streaming affects our representation of self within the spatial boundaries of our bedroom. For instance, individuals who stream content on social media are not only displaying their self (i.e. identity) as a text, but they also show their relations of things in the environment they are physically within. This means that the background and the objects within the frame of a live stream provide textuality which gives the viewer a glimpse into the streamer's relation to a specific cultural system. In some instances, the viewer of the live stream is given the potential to

[11] A *Facebook* wall is a space on a user's profile where the account holder and other users can upload written texts, images, videos, and other digital content accessible for their friends and even the public to see.

manipulate (2nd degree) the nature of the streamer's physical environment. Thus, texts within a physical culture are transformed and projected as a digital culture through the paradoxical means of hyperreal nature.

4.2. Immersion of screen technology and inversion of physical reality

From a theoretical perspective, little research has been undertaken to model the notion of immersion. The present study offers a novel approach to elaborate what immersion is by applying Kull's (1998) four degrees of nature. What this model provides is a deeper understanding of how meaning is paradoxically scaffolded by a user within a hyperreality, while still being contextually bounded by their present physical reality; again, to reiterate the central argument for this research, the subject not only co-develops with the intrinsic environment, but a subject immersed in new media also co-develops with the hyperreal environment where meaning is constructed. This subsection examines the underlying characteristics of immersion which emerges into the physical boundaries of a living space.

New media does not merely represent cultural objects and events, but it provides the possibility to "meaningfully modify them" (Seif 2014: 65). The process of transforming texts relies on the digital tools offered to the user and the means within which the user enacts the tools within a contextualized environment. This relates to how a phenomenon perceived as a meaning-making act within the intrinsic reality can transform into an infinite range of modifiable meaning within hyperreality – e.g. take how the AI artwork generator *Dalle-2* can create artwork purely from the user-inputted prompt to generate a visual text that emerges from the imagination of the user in relation to the dataset of *Dalle-2*'s neural network.

To be immersed implies that the user has agency within a text, and the agency required for an immersive reality is a two-fold mediation since the user must have agency within the physical environment but also within the virtual environment. Dionisio, Burns and Gilbert (2013: 18) reflect on the process of becoming immersed through the relations of things and objects within a user's physical environment:

> Visiting virtual worlds involves physically locating oneself at an appropriate station, whether it be a fixed desktop or a suitable setting for a laptop. Peripheral concerns, such as connecting a headset, finding a network connection, or ensuring an appropriate aural atmosphere (i.e., no excessive noise) frequently arise, and it is only after one is "settled in" that entry into the virtual environment may satisfactorily take place.

Immersion requires more than just interpretation; it offers the user the experience to reproduce meaning through the conceptualization of the environmental

stimuli in a perceived space. As mentioned earlier in the paper, the distinction of things and objects is necessary for understanding how realism is evoked within a digital, virtual environment which lacks the physical existence of the objects perceived by the user. Having an understanding on what things exist within an environment allows the subject to construct and perceive thoughts about an object; the distinction of thing versus object is essential for a subject to reconstruct reality because, "we can change objects more than we can change things. This is to say that once we change our habitual thoughts about objects, it is much easier to change our perception of things and change them" (Seif 2019: 86).

Modelling semiosis within an immersive reality requires the notion of 'both–and', as opposed to 'either–or'. Since agency of an immersed user is simultaneously inherent for both reality and hyperreality, the metalinguistic process of semiotic scaffolding resides in the mind of the user and is not purely bound to one form of the environment. The research by Alican Bayram (2022) about leisure time activities in the metaverse indicates that examining a user's recreational behaviour within the metaverse cannot be fully understood as being either indoor or outdoor recreation,[12] which is why it is essential to understand how the paradoxical nature of reality and hyperreality should be modelled as 'both-and'.

Take for example the recreational event of experiencing a virtual music performance within the video game *Fortnite* while being in your living room. In April of 2021, the rapper Travis Scott had a 10-minute-long music concert within *Fortnite*; altogether there were five identical performances, while a total of 27.7 million participants experienced the virtual concert. The concert was a mash-up of songs from Scott's newest album at the time, and the environment (the performance stage) consisted of transforming the open-world map of *Fortnite* into a new form of exhibitive nature – players who once viewed the virtual environment as only a place to compete in a battle royale style of gameplay could now experience the same environment but with the integration of new things and objects within the space. This example indicates how: (1) new media can indeed modify a cultural text in relation to a hyperreal nature; (2) an immersive experience requires the user to have agency within a text, but also in relation to the things within the physical boundaries; and (3) modelling behaviour that exists within the paradoxical nature of reality and hyperreality is 'both–and', the experience of being inside the comfort of your home while the reproducing an event (3rd degree) such as a music concert within an outdoor virtual space is the epitome of 'both–and' modelling.

[12] Indoor recreation consists of leisure activities inside the boundaries of a human-made structure, as opposed to outdoor recreation that implies activities performed outdoors or in nature (Bayram 2022).

5. Moving forward: What comes next?

Overall, this research has uncovered that applying Kull's (1998) four degrees of nature to model immersive virtual environments can provide designers with sufficient theoretical understanding on how a potential user would construct meaning within a virtual environment. Although Kull's article concentrated on biological processing of the human umwelt in relation to an ecological boundary, this research argues that implementing the four degrees of nature to model immersive virtual environments as an ecological system within hyperreality can lead to improved design outcomes. Furthermore, this research examined how the paradoxical nature of reality and hyperreality affects a user's meaning-making process when a user is simultaneously situated within a physical environment while perceiving and interacting in an immersive virtual environment.

Moving forward, this article provides the groundwork on how semiotic research can enhance our collective understanding of how to model appropriately semiosis of immersive technology. The notion of 'both–and' is an essential component to appropriately model a user's co-development of the paradoxical nature of reality and hyperreality. This approach allows researchers to investigate what is beyond the boundaries of a specific system; also, the 'both–and' structure allows researchers to take into consideration the essence of imagination and the ability to have transparency regarding the unexpected emergent outcomes which are *yet-to-come*. As mentioned in the research, paradoxes should not be framed as problems that need a deliberate solution; instead, we must incorporate uncommon sense to persevere through the boundaries to go beyond absoluteness.

The fourth section of the article intends to show the dynamics of the 'both–and' modelling approach for the paradoxical nature of reality and hyperreality by bringing into question how the concept of home has changed within the last century due to household electronic goods bringing in texts, which changes our perception and construction of the physical living space. Furthermore, the second half of this section examined how the immersion of *living within technology* has changed the perceptual components of the home. As a recap for the crucial aspects to model immersion: a cultural text can be modified within the realm of new media; an immersive experience requires the user to not only have agency in their physical boundaries, but also within a text itself; and modelling user behaviour for the paradoxical nature of reality is hyperreality is a 'both–and' structure and is exemplified in the statement that if the 3rd degree of intrinsic nature is virtual nature, then, paradoxically, the 3rd degree of a virtual nature is a *realistic* nature.

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Umwelt em um umwelt: codesenvolvimento em ambientes virtuais imersivos e a natureza paradoxal da realidade e da hiper-realidade

Este artigo examina como modelar ambientes virtuais imersivos usando o modelo ecossemiótico de quatro graus da natureza de Kalevi Kull. O uso desse modelo teórico permite uma investigação sobre a natureza paradoxal da realidade e da hiper-realidade, o qual configura uma nova abordagem para entender como um usuário se codesenvolve com seus ambientes virtuais, físicos e imersivos. A análise dos quatro níveis da natureza dentro do espaço virtual revela que um ambiente virtual imersivo emerge de um vazio imaginativo, contém um ambiente que os usuários podem reconhecer e interagir, oferece a potencialidade de ação (acessibilidades) para alterar e mudar materiais dentro do espaço virtual, assim como a natureza reprodutiva do espaço virtual. Além disso, este artigo trata de como os bens domésticos tecnológicos no século passado integraram os textos na construção cultural de uma casa. O artigo identifica como os ambientes virtuais imersivos alteram a percepção e as interações de um habitante dentro de casa e explica como modelar a imersão, o que é importante para futuras pesquisas sobre o comportamento do usuário na era digital das novas mídias.

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Artiklis vaadedakse, kuidas modelleerida immersiivseid virtuaalkeskkondi, kasutades Kalevi Kulli ökosemiootilist nelja looduse mudelit. Selle teoreetilise mudeli rakendamine võimaldab uurida reaalsuse ja hüperreaalsuse paradoksaalset olemust, mis on uudne lähenemisviis mõistmisele, kuidas kasutaja areneb nii koos oma füüsilise kui ka immersiivse virtuaalkeskkonnaga. Looduse nelja tasandi analüüsimisel virtuaalses ruumis ilmneb, et immersiivne virtuaalkeskkond tekib kujutlustühimikust, sisaldab miljööd, mida kasutajad ära tunnevad ning millega suhestuvad, ning pakub tegevuspotentsiaali (võimaldusi) virtuaalruumis materjalide muutmiseks ja teisendamiseks, ning esile tuleb reproduktiivne olemus, mis lähendab kasutaja jaoks tähendusloome protsessi vältel reaalsuse ja hüperreaalsuse piire. Lisaks käsitletakse artikli seda, kuidas kodutehnikakaubad lõimisid eelmisel sajandil tekste kultuurilisse kodukonstruktsiooni. Artiklis tehakse kindlaks, kuidas immersiivsed virutaalkeskkonnad teisendavad elaniku taju ning vastastiktoimet koduga, ning selgitatakse, kuidas modelleerida immersiooni, mis on oluline, pidades silmas kasutajakäitumise edasist uurimist uusmeedia digiajastul.