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## Towards an ontology of virtual environments: A critical account

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**Abstract.** The growing critical and economic success of Virtual Reality technologies is generating renewed scholarly interest in virtual environments. One of the most long-lasting and influential perspectives on the topic has been labelled «virtual realism» (Heim [1998]), and it has passed throughout the entire history of *virtual environments studies* up to recent days (Chalmers [2022]). Virtual Realism frames virtual environments in terms of realism, and precisely of perceptive soundness and isomorphism between physical environments and virtual ones, producing a convincing illusion of being physically present in the digital space. This article develops a critical counter-argument to this account. By employing James J. Gibson's ecology of perception and Deleuze's and Lévy's philosophy of the virtual, the article aims at demonstrating that the ontology of virtual environments is rooted in a domain of predetermined possibilities, and that the resulting aesthetics can not be fully immersive. Instead, the latter should embrace the «emersive» and anti-realistic qualities of the medium as an expressive device.

**Keywords:** virtual environments, ecology of perception, affordances, philosophy of the virtual, virtual realism.

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### 1. INTRODUCTION

What is a virtual environment (henceforth, VE)? At the present time, such a wide and encompassing question is yet to be answered, in spite of the relatively recent growth of the field of *virtual environments studies*, which has provided an in-depth analysis of specific aspects of the user experience of digitally-generated immersive environments, mainly by means of experimental inquiry. Research in the field has achieved many important results, among which one of the most remarkable is, arguably, the formalization of the concept of «sense of presence» as a key feature in the media experience of the environments produced by immersive technologies: that is – regardless of the slightly different meanings bestowed on this notion according to the perspective adopted – the cognitive and perceptive

illusion of being physically located in, and surrounded by, the representational space<sup>1</sup>, and recognized by it as an active subject who can interact with it and suffer the effects of the virtual entities inhabiting it (Steuer [1992]; Slater, Wilbur [1997]; Zahorik, Jenison [1998]; Biocca [2003]; Riva, Davide, IJsselsteijn [2003]; Slater [2005]; Slater [2009]; Slater et al. [2009]; Calleja [2011]; Riva, Waterworth [2014]; Lombard et al. [2015]; Micalizzi, Gaggioli [2018]; Riva, Gaggioli [2019]; Rogers [2019]). But what this corpus of researches generally seems to lack is the prowess to connect its outputs to a wider aesthetic theory of VEs, one which may help us grasp a better understanding of how VEs work for their embodied user.

This article aims to offer a contribution to such a project by linking together the notion of presence, philosophical accounts of the virtual and psychology of perception. I claim that in this way it will be possible to confer on the «virtual» in the expression «virtual environments» a theoretically grounded definition, which may shed light upon the strategies of engagement devised by immersive media and their conceptual criticalities.

However, it is paramount to clarify that the critical discussion which will be developed in what follows is not intended to provide a holistic theory of VEs. In fact, our starting question («what is a virtual environment?») is likely to be, as such, ill-posed: being VEs produced by a vast range of heterogeneous media and technologies, to adopt an all-encompassing, metaphysical notion of virtual environments would be a grave methodological mistake, since it would lead to overlook the distinctive qualities of different typologies of VEs. To reach a totalizing theory is well beyond the goals of this text, whose theoretical framework has a scope that is more realistically limited to

the analysis of a specific, yet very common, class of VE: the one, usually devised by media such as Virtual Reality films and videogames, which is based on the co-presence of a completely computer-generated virtual environment and of a human interactor being the only entity able to exert (or at least *willing* to exert, as we will see) an agency, by consciously and freely deciding what to do in the experience. So, this also means not to take into account those VEs structured to foster interactions between a plurality of living human users (i.e. VR social media or collaborative practices), as well as other unique hybrid systems such as Augmented Reality and Mixed Reality: all of them would demand an *ad hoc* inquiry that is not possible to develop here.

## 2. SHORTCOMINGS OF VIRTUAL REALISM: AN ECOLOGICAL COUNTER-ARGUMENT

As a starting point, it seems consistent with main trends in the design practices of VEs to argue that one of the most coveted aims they pursue is the fulfillment of a strong effect of *realness*: that is, the temporary illusion that the VE possesses all the attributes of material environments and, thus, has a full existence of its own. In order to produce such an impression, a convincing sense of presence must be reached, meaning that the VE has to be interactive: in fact, a fundamental feature of real environments, simulated by artificial ones, is that the former allow us to interact with them. This does not necessarily mean physically acting upon the environment, since even just looking at it is a form of interaction. As proposed by Noë (2004), visual perception is intrinsically imbued with action, meaning that we never see the world around us in the form of a stable, snapshot-like image; on the contrary, to see implies movement, meaning that the perceiving subject moves (at least with her eyes), as well as the elements of the environment change their position before us. Visual perception is, thus, based on patterns of «sensorimotor contingencies» (the changes in the appearance of the perceived environment, result-

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<sup>1</sup> The illusion of presence is, obviously, a goal pursued by immersive formats and technologies long before the advent of digital media. For centuries, images have strived to hide their nature by trying to reconfigure themselves as boundless and enveloping environments, as demonstrated by research devoted to an archaeology of VR and virtual environments (Grau [1999], [2003]; Pinotti [2018], [2021]; Bilchi [2021a]).

ing from movements) which are evidence of the dynamic and enactive nature of our visual experience of the environment.

Therefore this basic form of interaction, that in VEs corresponds to the so-called «three degrees of freedom» (3 DOF), which allow the user to visually explore the VE via rotational movement without leaving a stationary position in space (Eugeni [2018]), is enough to reach the impression of realness in VEs (although the virtual experience must also provide a justification, at the representational level, for the fact that the user can not freely move and act in the environment).

This idea that a VE can be experienced as a real one has been labelled «virtual realism», and it was originally proposed by Michael Heim, who claimed that «virtual realism requires the capacity to reconstitute the real through computers» (Heim [1998]: 6). The remarkable intuition of Heim's theory was that the digital reconstitution of the real was not meant merely as the simulation of existing and knowable spaces; instead, «realism in VR results from pragmatic habitation, livability, and dwelling, much more than from scientific calculation. [...] A virtual world can achieve a functional isomorphism with a primary world – it does not have to re-present the primary but only to foster a similar livability» (ivi: 48-49). So, it is not a matter of mimetic representation, but of «livability», or, said better, «believability» of the VE (Casati, Pasquinelli [2005]): namely, that «it is not the fidelity to the real model (the world) that makes the synthetic environment looking and feeling real, but the fidelity to the perceptual conditions involved in the mental construction of perceived objects» (ivi: 435).

More recently, virtual realism (and, indirectly, the issue of believability) has resurfaced in the philosophical account on Virtual Reality proposed by David Chalmers (2022), who expressly makes reference to Heim's theory and advocates for acknowledging full value of reality to digitally-created environments and entities. According to Chalmers, VEs can be ontologically qualified as real because they possess at least one of the philosophical criteria that must be matched in order

to recognize something as real: they have «causal powers», meaning that their parts (the virtual objects and beings inhabiting them) can perform actions which cause reactions in, and responses by, the rest of the environment<sup>2</sup>. This allows Chalmers to even claim that «you can always interpret a three-dimensional VR as a physical space, and some of your perceptual mechanisms will interpret it this way» (ivi: 225).

These scholars hint at how VEs, if properly designed, can replicate the same perceptual conditions, and involve the same «perceptual mechanisms» regulating our experience of real environments. To express this in more fine-grained theoretical terms, one must turn to James J. Gibson's ecology of perception, and employ one of its most influential concepts: that of affordance. According to Gibson (1979), affordances are possibilities for interaction with the material entities (both inanimate objects and living beings) of the environment, recognized by a subject who is understood as an embodied being whose body is surrounded by the environment, and who looks at the environment from within (instead that from a metaphysically detached position like in the tradition of Renaissance perspective). Moreover, affordances are not objective attributes of things, but dynamic properties emerging from the relationship between the physical specificities of an animal and those of the environment, thus forming an «animal-environment system» (Stoffregen [2003]).

Since the appearance of VEs (as three-dimensional spaces surrounding the subject and populated by volitional creatures) resembles that of

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<sup>2</sup> Besides, Chalmers lists other reasons to recognize VEs as real: for example, he stresses the materiality of the apparatuses (headsets, cables, equipments). That is indeed true, but it also shifts the focus to, so to speak, the means of production of the VE, thus foregrounding its nature as artifact. This is an important topic, but it can not be addressed in this article, which is focused on the representational dimension of the alleged isomorphism between virtual and physical environments. However, the apparatus can indeed affect the illusion of presence in VEs experiences, often to its detriment, as has been discussed by Slater and Steed (2000).

physical environments, VEs would seem particularly suitable, at a perceptive level, for fostering affordances. In fact, several studies have demonstrated that virtual objects can offer affordances for the human observer (Regia-Corte et al. [2013]; Meyer, Draheim, von Luck [2019]), and also that the user's expectations about what oneself can do in the environment are heightened by the level of realism of the latter (Grabarczyk, Pokropski [2016]). These findings would seem to validate the theoretical stance of virtual realism, because the idea of isomorphism between real and virtual environments would be confirmed by the ecological validity achieved by virtual ones. In other words, VEs seem able to replicate what Gibson (1979) defines as an «ambient optic array»: that is, the (dynamic and variable) asset that an environment assumes specifically for an animal, which perceives the environment from its own embodied perspective. However, I contend that this is not enough to grant that «you can always interpret a three-dimensional VR as a physical space», as stated in Chalmers' previous quote.

In order to clarify my critique, now I have to express what, according to the literature discussed up to this point, can be legitimately understood as a general principle of the design practices of VEs: VEs engage their user by trying to replicate the perceptual pre-conditions that are the core of how human beings experience the physical world. From an ecological perspective, that means that the VE has to be enveloping and rich in affordances; but such a configuration elicits in the user a variety of stimuli for action in the environment, and this can pose major issues for the theory of the isomorphic relationship between real and virtual environments. In fact, to be (or feel) present in an environment «is tantamount to successfully supported action in the environment» (Zahorik, Jenison [1998]: 87), and is, therefore, also related to experiencing a corresponding sense of ownership of one's own body (Slater et al. [2009]) as potentially suffering the effects of the actions performed by the other beings that are in the environment. I argue that for completely digital VEs it is *ontologically* impossible (and not just a temporary condition

caused by the technical limitations of a medium which could be improved in the future) to reproduce the complexity of human beings' enactive engagement with the environment, and I will try to explain why in what follows.

VEs are digital objects created by someone (the designer, or the design team) according to a set of rules and parameters which determine the specific form that the environment takes, and the number of affordances that it allows to actualize. Thus, I propose to analyze VEs in terms of *textualities*: they are, in spite of their appearance as boundless and living spaces, pre-organized formal configurations, based on laws imposed *from outside* the environment and which can not be violated, due to their being embedded in the codex (or being the codex altogether) of digital artifacts (Myers [2017]). If this interpretation is correct, then VEs are characterized by a certain degree of *closeness*: although much more open than non-interactive media, VEs preprogram everything that can be done, and constrain both the user's agency and that of the virtual entities into a range of possibilities that is always limited, even if disguised as complete freedom.

Here lies a discrepancy between the affordances recognizable in the environment and those that can effectively be actualized, which can have important disruptive effects on the user experience of VEs: the user perceives an environment which offers a wide variety of possibilities for interaction, and thus she could be driven to perform the corresponding actions; however, she would soon realize that only a small percentage of the perceived affordances can be translated into what Zahorik and Jenison call, as we have seen, «successfully supported action». With this expression the scholars mean that:

When actions are made in an environment, the environment reacts, in some fashion, to the action made. When the environmental response is perceived as lawful, that is, commensurate with the response that would be made by the real-world environment in which our perceptual systems have evolved, then the action is said to successfully support our expectations. (Zahorik, Jenison [1998]: 87)

So, if a user's action does not receive an adequate response by the environment, the user feels a strong inconsistency in the ecological array she is experiencing, one that finds no correspondence with the ways our interaction with material environments unfolds, since in the latter case any action has consequences. Moreover, the same goes for what virtual entities are concerned: they may perform actions intended to affect the user, but which would fail in fostering an appropriate response by the user's virtual body, thus hampering the sense of ownership of it (Bilchi [2021b]).

Such discrepancy is usually conceived as a flaw of the medium that must be carefully concealed, rather than employed as an expressive device. This is particularly evident in 3 DOF Virtual Reality experiences, whose very functioning reduces the user's allowed actions to rotational movement and visual exploration from a fixed position. In these cases, it is often unjustified, at the perceptive level, why the user is unable to physically interact with the surrounding environment although she recognizes in it a wide variety of affordances that nothing in the simulation prevents to actualize. Similarly, in 6 DOF experiences a user who has performed an action according to an actually perceived affordance may discover that the action is not supported by an adequate environmental response. Examples of this are manifold; just to mention a few, taken from very different expressive projects: in the horror 3 DOF experience *Face your Fears* (2016), the user is lying in her bed while eerie phenomena occur before her eyes. From an ecological perspective, the environment is organized in such a way as to offer all the affordances needed in order for the user to leave her position and escape; yet the 3 DOF-based design of the experience prevents her from doing that, without providing an ecologically valid explanation. While in Alejandro G. Iñárritu's 6 DOF art installation *Carne y Arena* (2017), the user is placed among a group of migrants who are trying to cross the Mexican border in order to reach the USA, when they are violently stopped by a military patrol. The user is free to move in any direction, but can not inter-

act with the other characters in the representation (nor with its inanimate entities), although she can come close to them and thus perceive the affordances they foster.

Circumstances like these are very common when one is experiencing completely digital VEs, and they will ultimately result in what Slater and Steed (2000) define «breaks in presence»: unwanted occurrences which shatter the illusion of being present in the environment by revealing its artificial and mediated nature, thus interrupting, at least temporarily, the hitherto unhindered immersive flow of the experience. What consequences does this produce for an aesthetics of VEs? I will now address this topic by trying to integrate Gibson's ecology of perception with philosophical theories of the virtual.

### 3. TOWARDS AN ONTOLOGY OF VIRTUAL ENVIRONMENTS

In the previous section, I have highlighted a fundamental conflict involving the textual nature of VEs and their appearance as boundless, self-sufficient worlds. Such contrast comes from the fact that by emulating an ecologically sound «ambient optic array», VEs take on the look of a living complex of beings and objects, open to never-ending changes of state which result from the interactions happening in the environment. That is to say, the artificial environment deceives our perception, presenting itself as a space of possibilities characterized, as physical environments are, by a substantial *indeterminacy*: it is not possible to foresee with absolute certainty what transformations will be brought in the environment by the events occurring in it, because the active entities of the environment possess, at least to a certain degree, a free will which can change the shape of the environment in unexpected ways, continuously recalibrating and updating the system of affordances perceived by the subject. As stated by Carr: «In the midst of an action, the future is not something expected or prefigured in the present, not something which is simply to come; it is some-

thing *to be brought about by* the action in which I am engaged» (Carr [1986]: 34). This account is not at odds with ecology of perception, since Gibson seems to hint at it in the following passage:

The richest and most elaborate affordances of the environment are provided by other animals and, for us, other people. These are, of course, detached objects with topologically closed surfaces, but they change the shape of their surfaces while yet retaining the same fundamental shape. They move from place to place, changing the postures of their bodies, ingesting and emitting certain substances, and doing all this spontaneously, initiating their own movements, which is to say that their movements are *animate*. These bodies are subject to the laws of mechanics and yet *not* subject to the laws of mechanics, for they are not *governed* by these laws. [...] When touched they touch back, when struck they strike back; in short, they *interact* with the observer and with one another. Behavior affords behavior. (Gibson [1979]: 126-127)

By claiming that living beings are not governed by laws of mechanics, Gibson is refusing any deterministic drift in the theory of affordances: behavior is made of free choices, and thus, to state that «behavior affords behavior» can mean that the actions freely performed according to the affordances available at a given moment create new, and not completely predictable, sets of possibilities for interaction. The system of relationships between the components of the environment changes anytime one of the latter acts.

Clearly, freedom can never be total, since a variety of constrains indeed affects human behavior: natural constrains (i.e., laws of mechanics and physics) restrict human agency by making impossible to contravene the laws themselves; while contingent constrains which have social, economic or cultural origins can influence and orient (but not determine) behavior. Therefore, by free choice I mean the faculty to act according to consciously developed decisions and resolutions. On this basis, contingent constrains are not of particular interest for my argument, since they can only partially hamper, and not actually deny, free decision-

making (that is, one is never ontologically prevented from acting against contingent constrains, although that may indeed represent a hard choice and carry grave consequences). On the contrary, what is important to take into account in this context are natural constrains.

In fact, advocates of virtual realism could argue that a crucial point in defense of the theory of isomorphism between real and virtual environments is that both would be governed by laws determining what can or can not be done; so that one can never, neither in real environments, be in a condition of total freedom of choice and action.

This is true to some extent; however, VEs are artifacts, entirely designed by an external creator who sets the laws governing them according to a certain aesthetic project. As repeatedly stated in this article, a dominant trend would seem to be that of simulating the mechanisms ruling our experience of real environments, as the adoption of an asset of the VE that is consistent with the principles of psychology of perception demonstrates. The problem is that the artificial and coded nature of wholly digital VEs makes it impossible to reproduce the human experience of the environment in its full complexity: that is, its identity as a system of dynamic and ever-changing interactions between entities provided with decision-making powers which produce consequences and transformations in the structure of the environment itself. Transformations can occur in VR environments, but only within the limited amount of responses that the designer has programmed, and in spite of all the other responses conceivable (that is, ecologically plausible), but unrealizable, during the experience. Therefore, human beings are indeed only partially free in the ordinary experience of physical environments; but they are even less free when interacting with digitally created environments. What this implies for an ontologic, and consequently aesthetic, analysis of VEs may be better clarified by approaching the matter through the lenses of the philosophy of the virtual.

More specifically, here I employ the theory of the opposed conceptual pairs «virtual-actual» and «possible-real» proposed by Deleuze (1968)

and later reprised by Lévy (1995) in the form of an «ontologic quadrivium». According to them, these four concepts have, each, a full ontological value; they can be grouped in two couples because between virtuality and actuality, on the one hand, and between possibility and reality, on the other, stands a relationship of procedurality: the virtual is involved in a process of actualization (that is, what exists at a virtual level becomes actual), while the possible in one of realization (that is, what exists as possibility becomes real).

The difference lies in their ontological status: the possible is predetermined, «static and already constituted» (Lévy [1997]: 24), meaning that the dynamic of realization of possibilities unfolds as a predetermined path, a compelled transformation sustained by a rigorous logic. The virtual, on the contrary, «is a kind of problematic complex, the knot of tendencies or forces that accompanies a situation, event, object, or entity, and which invokes a process of resolution: actualization» (*ibidem*). Deleuze and Lévy's definition of the virtual is inherently *pluralistic*: virtuality is presented as a multiplicity of tendencies and forces whose mutual interaction leads to the actualization of one of the uncountable virtualities of the situation. Therefore, actualization truly results in a heterogenesis, which leads the virtual entity to a new, unforeseeable, state. As argued by Lévy in a telling passage:

Actualization thus appears as the solution to a problem, a solution *not previously contained in its formulation*. It is the creation, the invention of a form on the basis of a dynamic configuration of forces and finalities. Actualization involves more than simply assigning reality to a possible or selecting from among a predetermined range of choices. It implies *the production of new qualities, a transformation of ideas, a true becoming* that feeds the virtual in turn. (ivi: 25. Emphasis added)

And still:

Actualization creates a solution for the problem presented by the virtual. In doing so it does not simply replenish its resources or provide a form for the mechanism of realization. Actualization *creates*

*form*. It creates a radically new kind of information. Efficient cause is related to actualization because the laborer, sculptor, or demiurge, if it is a living and thinking being, can never be reduced to a simple executant, for it interprets, improvises, and resolves problems. (Ivi: 174. Emphasis in original)

This interpretation of the virtual as a problematic complex of forces seeking for an actualization is consistent with both Lévy's account and Deleuze's one. But there are at least two distinctive elements of Lévy's theory that are important for my discussion of VEs: first, Lévy's examples of actualizations are usually taken from situations involving a human actor, thus stressing the importance of freedom of choice in exercising one's agency. And second, Lévy is not primarily interested in actualization, but in its reverse, and consequent, process: virtualization, that is, the return of a previous actuality to a state of virtuality. One should not understand actualization and virtualization as opposed processes, since they are actually co-essential to one another: an actuality is indeed what results from the resolution of a problem, but *in the very moment* of this resolution the new state of affairs that has been produced constitutes a new virtuality, a new «knot of tendencies or forces» open to multiple actualizations. Therefore, the actual immediately runs through a process of virtualization; that is, it returns to the state of problem, not in the sense of a regression, but as the opening of a new space of interaction between the world and a human agency. Still, with Lévy's words: «virtualization is not a derealization (the transformation of a reality into a collection of possibles) but a change of identity, a displacement of the center of ontological gravity of the object considered. Rather than being defined principally through its actuality (a solution), the entity now finds its essential consistency within a problematic field» (ivi: 26).

Therefore, the never-ending loop of actualizations and virtualizations represents, in Lévy's theory, the infinite processuality of existence itself. This account can be integrated with ecology of perception: since, as discussed above, the actual-

ization of an affordance generates new affordances, the experience of the environment can be understood, at this point, as a problematic complex, truly as a knot of tendencies (those expressed by the actions of the living beings inhabiting the environment). What one does in the environment affects its general structure, and can change the latter in unexpected ways, creating a new system of relationships. Moreover, both the idea of virtualization and the experience of environments seem to share three essential properties: the crucial presence of a human agency, the availability of other beings to be transformed by the latter, and the opening of a space of interaction where changes can happen.

Now, as previously demonstrated, VR environments tend to replicate the conditions of our being present in the environment; that is, to configure ecologically sound environments. So, if some basic principles of philosophy of the virtual can be related to ecology of perception, they can also be employed to question the ontological status of VEs. I have discussed how the illusion of presence seems likely to be shattered when, behind the ecological plausibility of the VE, the textual nature of the latter resurfaces. Being texts, completely digital VEs can not reproduce a process of actualization-virtualization, because any change of state in the environment is already pre-programmed, inscribed in the laws regulating how the artificial space works. It is not a matter of how many actions the system allows: indeed, they can be a lot, but no more than the number determined by an overarching rule set by an external creator (and always less than those characterizing the physical environment simulated); and consequently, even the effects of such actions will be unavoidably inscribed in the system.

I want to stress again, as already done in the introduction to this text, that its findings are valid for a vast, but indeed not all-encompassing number of VEs. A relevant exception is represented by those VEs which are primarily intended as spaces of interaction between existing human beings (the virtual world *Second Life* is one of the most famous cases, but any multiplayer videogam-

ing system suits well this definition). Here it is legitimate to claim that actualizations of virtualities (and consequently new virtualizations) happen, but due to the fact that who is involved in the interaction are two or more entities provided with actual decision-making power and, albeit between the boundaries set by the arbitrary laws of the artificial environment, freedom of choice. That is, provided precisely with what AIs (the apparently living creatures inhabiting the VE) and the characters of pre-recorded images of VR movies lack. Thus, the shortcomings of the alleged isomorphism between real and virtual environments discussed in this article characterize those VEs in which a human user, acting directly with her own body or by means of an avatar, interacts exactly with entities and objects that are completely digital and, as such, programmed to act and be responsive according to limited schemas and rules of behavior. So, it is reasonable to interpret the media experiences fostered by such cases in terms of realizations of pre-determined possibilities, as revealed by the fact that the actual degree of agency bestowed on the user by the medium is inconsistent with the far wider number of affordances perceived in the ecologically sound VE. A consequence of this is that the experience enables only an amount of interactions which is inferior to the corresponding one characterizing the physical environment.

Therefore, as a closing remark, I believe that if one assigns a philosophically grounded meaning to the word «virtual», it is legitimate to claim that the typologies of VEs analyzed in this article should be more appropriately rethought as *possible* environments: that is, they entirely fall under the domain of the couple possible-real. This is due to the fact that at least two of the three aforementioned attributes of virtuality are missing in VEs: the agency of the human subject is partial and constrained, forced to follow predetermined paths; and there is no actual availability of the environment to be transformed by our actions, since only limited and calculated changes can happen.

All that is at odds with the illusion of freedom and self-sufficiency that the majority of VEs seem



to seek. In pragmatic terms, the user of VEs lives a condition of inherent «inter-passivity» (Montani [2017]), meaning that she results much more passive than active, if one confronts her apparent agency with what she is actually allowed to do and what is denied to her. Plus, the aesthetics of VEs would seem bound to cause, in the user, an interweaving of immersive (in which the user experiences a proper sense of presence) and «emersive» states (D'Aloia [2018]), with the latter being the occurrences which arouse acknowledgement of the mediated properties of the environment.

If designers try to conceal these qualities, as well as the ontological roots of VEs in the domain of the possible, proposing instead the illusion of freedom and self-sufficiency, then the immersive and emersive conditions seem doomed to clash, with disruptive effects which hamper the communicative and expressive power of the experience. I hope that the critical analysis of certain typologies of VEs developed in this article may prove useful to suggest an alternative way to design them: one that embraces their predetermined nature, their limits, conceiving them as an expressive device, rather than a flaw to be (unsuccessfully) corrected. This implies an altogether different aesthetics: for example, one could experiment with creative assets for the artificial environment, thus disrupting the simulative logic of the attempted isomorphism with the physical environment. A few cases of such an effort to problematize our ecological relationship with the VE exist: in *Superhot* (2016), events occurring in the environment stops if the user stands still, so that the illusion of the VE as a self-sufficient system is shattered; in *Astro Bot Rescue Mission* (2018), the user is immersed in the artificial world and at the same time controls another avatar from a third-person perspective, multiplying the affordances available at a given moment and undermining the supposed transparency of the ambient optic array; in *Moss* (2018) the system lets the user adopt a god-like perspective, achieving a totalizing and detached view on the environment that is impossible to replicate in the physical world, since in the latter case our body is always surrounded by the environment.

However, at the present time these cases represent an absolute minority of current design practices of VEs; nonetheless, their creative potential should be understood and exploited, especially in light of the crucial shortcomings of the aesthetics of isomorphism that I hope this article has highlighted. Opportunities for creative design of VEs abound; but in order to grasp them, it is necessary, first, to address the not easy task of emancipating oneself from the logic of isomorphism.

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