The Spatial Apriori of Virtual Reality

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This contribution challenges the idea of space as an a priori form of intuition by foregrounding the limitations of Virtual Reality (VR) in HMDs, such as Meta's Quest, through the concept of a pre-given structure of spatial perception. This enables the original Kantian concept to be questioned by what Foucault termed the ›empirico-transcendental doublet‹, which was initially used to describe a historical configuration of knowledge. VR can then be redefined as a medium with a particular topology, exemplified by the Guardian that defines the boundaries of the playable space in a transcendental way while remaining empirical.

1. Virtual Reality as Stack

Before turning to the Guarding as a reflection of the empirical-transcendental double, it is important to briefly remind oneself of the origin of VR, which in fact is not only a present-day technology, but the sum of different discoveries and inventions that were made at least within the last six hundred years. It piles on to some sort of technological stack – to borrow a term from Benjamin Bratton used for the layering of the physical and the virtual – [1] that reaches back to Renaissance art and the discovery of ways to construct perspectival images. Besides some forerunners approaching linear perspective in an empirical way (like Giotto placing humans and heavenly creatures next to each other in a way that they all can be considered to share the same space),[2] towards the 16th century, namely by Viator in 1505 with the so called ›artificial perspective‹ the algorithm was discovered how to construct a coherent space prior to it being

1 Benjamin Bratton (2015): The Stack. On Software and Sovereignty, Cambridge/London: MIT Press.

2 Margaret Wertheim (1999): The Pearly Gates of Cyberspace. A History of Space from Dante to the Internet, New York/London: Norton.

filled with objects.[3] – This was done with the help of the distant point, located on the same horizon as the vanishing point, by which the transversal lines can be drawn that intersect with the lines connecting the base of the image with the vanishing point. Those intersections then allowed for the construction of the parallel lines defining the diminishing scale of the space and resulted in the typical check pattern of this era.

The next level in the stack of nowadays VR is the 360 degree-image of the panorama, which, in its modern form, was invented and named by the artist Robert Barker in the late 18th century. Even though one can find forerunners in the ancient world and also outside Europe, it can be considered to be the starting point of immersive imagery,[4] that aimed at hiding the frame, so spectators cannot tell anymore the difference between the picture plane and its outside. In the circular way those images were installed around a platform for the viewers, a ceiling above and a false terrain (*faux terrain*) around the platform prevented the limits of the picture to be visible.

A further level in the stack is not coming from the arts, but from 19th century physiology and the discovery of the stereoscopic effect: Charles Wheatstone in 1838 – the same year in which Daguerre created his first photograph – presented pairs of drawings in the style of wireframe graphics that were meant to either be viewed with crossed eyes or with a mirror apparatus that let each of the eyes of a viewer see only one picture, resulting in the synthesis of a spatial image.[5] For Wheatstone, it was the proof that vision ›receives‹ spatial information not only from proportion (smaller objects are seen as ›further away‹ than larger objects of the same kind) and occlusion (objects in the front block objects ›behind‹ them), but also from the ›layering‹ of planes. Therefore, his drawings were only outlining objects and not using surface structures or colours. In the long run, this led to the understanding of perception as an active synthesis and not a mere passive process.[6]

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3 William M. Ivins (1973): On the Rationalization of Sight. With an Examination of Three Renaissance Texts on Perspective, New York: Da Capo Press.

4 Oliver Grau (2003 [2001]): Virtual Art. From Illusion to Immersion, Cambridge/London: MIT Press.

5 Charles Wheatstone (1838): »Contributions to the Physiology of Vision. Part the First: On Some Remarkable, and Hitherto Unobserved, Phenomena of Binocular Vision«, in: Philosophical Transactions of the Royal Society of London 128, pp. 371–394.

6 Jonathan Crary (1990): Techniques of the Observer. On Vision and Modernity in the Nineteenth Century, Cambridge/London: MIT Press.

The next step towards VR that added to the stack of the before mentioned levels, is the use of the photographic camera for recording movement on film. Just like the stereoscopic effect, which synthesises two perspectives in space, movies allow the spectator to synthesise different frames (or pictures) to become one ›movement image‹. This is most obvious in early approaches to the new medium, that did not edit the film, but rather presented a continuous shot: The most famous example is *The Arrival of a Train* from 1896 by the Lumières; but for VR even more important is the genre of the so-called ›ghost rides‹ where the camera was mounted at the front of the train and filmed the movement through space from a first-person point of view.[7]

Several systems in the 20th century then tried to fuse the existing methods in approaching VR. One is Morton Heilig's *Sensorama* from 1962, that combined (amongst other elements) ghost rides with the panoramic element of hiding the picture's frame (by the use of a ›canopy‹ that people had to stick their heads into – later on he planned also to build a head-mounted display),[8] another one is Ivan Sutherland's *Sword of Damocles* from 1968, which combined the Panorama's 360-view with stereoscopic wireframe graphics in the style of Wheatstone.[9] The latter also used another technology, and that is computer graphics. Those can be considered the last level in the stack of VR, and also something that made use of the first level in the stack: the perspectival algorithm, as it can be found in 3D-video games, most outstanding in the arcade cabinet *Battlezone* from 1980,[10] that in addition also used a view-blocker to exclude the surroundings. On addition to that, computer games bring to the stack the fundamental interactivity of the simulation image – or its possibility of the image to be manipulated by the viewers,[11] hence users.

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7 Tom Gunning (1983): »An Unseen Energy Swallows Space. The Space in Early Film and Its Relation to American Avant-Garde Film«, in: John L. Fell (ed.), Film before Griffith, Berkeley/Los Angeles/London: University of California Press, pp. 355–366.

8 Morton Heilig (2001 [1955]): »The Cinema of the Future«, in: Randall Packer/Ken Jordan (eds.), multimedia. From Wagner to Virtual Reality, New York/London: Norton, pp. 239–251.

9 Ivan Sutherland (2001 [1965]): »The Ultimate Display«, in: Packer/Jordan, multimedia, pp. 252–256.

10 Steven Poole (2000): »Solid Geometry«, in: Id., Trigger Happy. The Inner Life of Video Games, London: Fourth Estate, pp. 125–148.

11 Lambert Wiesing (2010 [2001]): »Virtual Reality. The Assimilation of the Image to the Imagination«, in: Id., Artificial Presence. Philosophical Studies in Image Theory, Stanford: Stanford University Press, pp. 87–101.

2. Archaeology of the Apriori of Space

According to the critical philosophy of Immanuel Kant space is an a priori form of intuition, which means that any object that can be perceived is being seen (or heard, touched, etc.) ›in‹ space or spatially ›outside‹ of us.[12] And this is insofar ›a priori‹ as it is ›prior to‹ a particular perception. This claim is made to counter the idea of contemporary philosophers of the 18th century (like David Hume), who argued, that people experience space only from having the perception of objects, from which an idea of space is then derived. On the contrary Kant believes that space is not an effect of such an engagement with reality, but a way our mind (German: ›Gemüth‹) structures any possible perception. He describes this also as ›transcendental‹, which translates as ›the condition of the possibility of…‹. It is not immanent to perception (as the empiricists claim) and it is not transcendent (given by a superior entity), but it is just the way our perception is organized. To a certain extent this means it is ›innate‹, but more important, it is something that we cannot look at from ›outside‹ itself, since anything we observe is already ›in space‹.

The same goes for time, only that Kant calls time the ›internal‹ form of intuition. This causes problems for the following centuries in conceptualizing space and time, especially that time is prioritised over space as being ›closer‹ to the very nature of the subject (or the mind), and, furthermore, that space or objects in space is, respectively are to be considered (a) static entity/ies. This view will be overcome in the 20th century by Henri Lefebvre, who considered time as process to be inherent to space.[13] – Nevertheless, for the context of VR one can reduce the focus to space as the outer sense of perception in the context of Kant's ›Transcendental Aesthetic‹, which is the title of the opening section of the main body of his seminal publication *Critique of Pure Reason* from 1781, whereby ›aesthetic‹ has to be understood in the literal sense as regarding the *aesthesis* (which is the Greek term for ›perception‹) and not in narrow sense of experiencing artworks or judgements about particular sensations.

An important critique of the *Critique of Pure Reason* has been published already in the 18th century by a former student of Kant, Johann Gottfried Herder, who in a close reading of that opus magnum highlights all the flaws and errors

12 Immanuel Kant (1998 [1781/87]): Critique of Pure Reason, Cambridge: Cambridge University Press.

13 Henri Lefebvre (1991 [1974]): The Production of Space, Maiden/Oxford/Carlton: Blackwell.

of transcendental philosophy, foregrounding that despite the claim that one cannot go beyond the conditions of possibilities, in performing transcendental philosophy is exactly doing that.[14] And this is primarily done by using language (a topic that was central to Herder's philosophy) – one nowadays could generalize this also to the extent of the medium that is used to present transcendental philosophy. One example is Kant's separation between the internal and the external sense, implying that the inner is not spatial – and thus, ›outside‹ space. Obviously, this runs into a paradox caused by the necessity to use language – in particular prepositions (like ›in‹ and ›out‹) – to describe the setting of the mind.

Not many readers took notice of Herder's book, also because it was supposed that it was basically him taking revenge on Kant for a devastating review he published on Herder's *Ideas for the Philosophy of the History of Mankind* in which the author suggested that according to the place on earth (the culture in which you grow up) your understanding of the world might be a different one, simple due to practical reasons of engaging with for example nature differently.[15] Already in earlier research about the question why the Bible describes the creation taking place in six days plus one day of rest, Herder argued for the simple fact that this mirrors the lifeworld of an ancient culture. The method he applied in this early investigation (that only got published posthumously) Herder named ›archaeology‹ – and the title of the book should have been *Archaeology of the Orient*.[16]

Without mentioning and maybe in fact without knowing about Herder's manuscripts, in 1969 the French philosopher Michel Foucault published a book called *The Archaeology of Knowledge* in which the central chapter presents the idea of the ›historical a priori‹.[17] With this Foucault tried to describe the method he had been applying in his previous investigations, namely in his ground-breaking book *Les mots et les choses* from 1966, published in English (and other languages) under the title *The Order of Things*, which subtitle was (here all translations follow the French original) *An Archaeology of the Human Sciences*. This is the

14 Johann Gottfried Herder (2022 [1799]): Metakritik zur Kritik der reinen Vernunft, Hamburg: Meiner.

15 Id. (2024 [1784-91]): Ideas for the Philosophy of the History of Mankind, Princeton/Oxford: Princeton University Press.

16 Id. (1883): »Fragmente zu einer ›Archäologie des Morgenlandes‹ (1769)«, in: Id., Sämtliche Werke. Vol. 6. Ed. by Bernhard Suphan, Berlin: Weidmann, pp. 1–129.

17 Michel Foucault (1972 [1969]): The Archaeology of Knowledge and The Discourse on Language, New York: Pantheon Books.

first time the notion of the »historical *a priori*«[18] is used, creating – again – a paradox for transcendental philosophy, only that this time it is addressed directly and not occurring by the constellation described by Kant (and criticised by Herder).

It is very likely that Foucault was inspired by a late text by the German phenomenologist Edmund Husserl that was recognised by a wider audience in 1954 as a supplement to his monograph on *The Crisis of European Sciences*,[19] compiled from several talks Husserl gave in the mid and late 1930ies, after he was banned from teaching by the Nazi-regime. Despite this context the ›crisis‹ Husserl is talking about is not primarily a political one, but an even ›deeper‹ one that neglects the observation that the sciences are rooted in the human ›lifeworld‹, just like any other form of knowledge that once was practical before it turned ›theoretical‹, and whose most impactful results are the ›positivistic‹ sciences of the 19th century (which in turn became also the basis for political constellations like racism in the first place, based in ›scientific‹ anthropology and ethnology [example by me, not by Husserl]).

The appendix to the crisis-text was written in 1936 and first published in 1939 in a French philosophy journal by Husserl's assistant Eugen Fink as *Inquiry Concerning the Origin of Geometry: A Problem of Intentional History*.[20] This text then was translated by no one less than Jacques Derrida in 1962 and published with an introductory comment.[21] The comment as well as Husserl's original text focus on the tension that Fink highlighted as ›intentional-historical‹, because the intentional is basically what can be described in the tradition of Kant as the formal condition of intuition a priori, and the historical, which lies outside what transcendental philosophy can describe.

The link to the topic of space – and to VR in the following – is Husserl's example by which he demonstrates that tension: geometry. Which refers to geometry as it was invented by Euclid in his book *Stocheia*, Greek for the ›elements‹. Here, the elements of measuring forms in a mathematical manner,

18 Id. (1989 [1966]): The Order of Things. An Archaeology of the Human Sciences, London/New York: Routledge, p. 172.

19 Edmund Husserl (1970 [1954]): The Crisis of European Sciences and Transcendental Phenomenology. An Introduction to Phenomenological Philosophy, Evanston: Northwestern University Press, pp. 353–378.

20 Id. (1939): »Die Frage nach dem Ursprung der Geometrie als intentional-historisches Problem«, in: Revue Internationale de Philosophie 1/2, pp. 203–225.

21 Jacques Derrida (1978 [1962]): Edmund Husserl's ›Origin of Geometry‹. An Introduction, Stony Brook: Hays.

providing definitions and axioms, including Pythagoras' theorem and the parallel postulate.[22] What links Euclid to the starting point in Kant is the fact that the latter compared his ›revolution of thought‹ (as he himself calls his transcendental approach) to the invention of geometry by Euclid, which seems to invent a coherent system to describe and construct geometrical objects. As it is known from so called post-Euclidian geometry (coming into being towards the end of Kant's lifetime) the postulate of ›not a second line can be drawn through a point outside a given line without intersecting with it‹ is only true for an idealised plane surface that endlessly stretches out ›in space‹ without ever bending. (On a sphere many lines can be drawn through a point – like the poles on the globe – without intersecting with another line drawn on that sphere.)

For Husserl – and in turn Derrida as a possible inspiration for Foucault – it is relevant to take the historical precondition of Euclidian geometry into consideration, which literally is the ›measuring of the earth‹. Pythagoras' theorem (the sum of the areas of two smaller squares of a rectangular triangle equals the large square), for example, was discovered when ›empirical‹ reasons forced people in Egypt after the river Nile flooded the fields to measure the size of the original acres to distribute the land amongst the farmers. What nowadays appears to be a priori nests in the (historical) lifeworld.

It comes as no surprise that in the context of deconstruction, Derrida considers the reference to history as such being just another metaphysical claim, replacing the formal a priori; but what is important here is that Foucault develops the idea of the tension between the ›intentional‹ (or formal) and the ›historical‹ (or a priori) into what in *The Order of Things* he names the »empirico-transcendental doublet«.[23] Here, obviously the historical is substituted by the empirical, which causes some confusion, because to Kant the empirical is what occurs within the transcendental, so in the literal sense, what can be ›experienced‹ (in space – and time).

The reason for Foucault to do this on the one hand might be that the term of *historia* originally means ›exploration‹, which does take place within the sensual world, but more important is, on the other hand that Foucault tries to specify a certain configuration of knowledge, namely the one in which transcendental philosophy itself occurred. And the method by which this is described is the above-mentioned archaeology, which means looking for the ›ori-

22 Thomas Heath (ed.) (1926): The Thirteen Books of Euclid's Elements, Cambridge: Cambridge University Press.

23 M. Foucault: Order of Things, p. 347.

gins‹ (Greek: *archê*), in this case the origins of certain structures of thinking. Something Foucault also calls ›episteme‹, i.e. a form(ation) of knowledge.

And those origins cannot be found within philosophy, but outside of it in the way knowledge in general was organized in a given historical layer; and the episteme in which Kant's philosophy itself was possible can be described as an empirical-transcendental duplication, because what is considered to be the a priori structure of the mind by Kant was addressed by the (empirical) sciences around him as the basis of defining human beings (which then led to the invention of the Human Sciences). The three main examples of Foucault are: economy, biology and linguistics. All of them turn away from a pure description of objects that are relevant to them to the precondition of what allows them, to be such objects. Instead of calculating goods in economy, drawing taxonomies of plants and animals, or asking for what object a particular word represents, in the shift from the 17th to the 18th century, those sciences started referring to categories like ›labour‹, ›life‹, and ›language‹. Thus, instead of asking for how different languages represent objects by different words, linguists started comparing the grammar of different languages or form of articulation (no matter what the content of it is).

Whereas the former, according to Foucault, is taking place in the episteme of representation, the latter is taking place in the episteme of the empirico-transcendental doublet, and the transcendental philosophy of Kant, then, is just mimicking this structure by declaring the (empirical) properties of the mind to be transcendental. To ›illustrate‹ this shift, Foucault in the first chapter of *The Order of Things*, describes the painting *Las Meninas* from 1656 by the Spanish artist Diego Velázquez, which shows the painter himself, supposedly painting a picture of which only its backside is shown. While the canvas is turned away from the spectator, one can start coming up with some hypotheses; what actually the ›object‹ of the image in creation is (is it the girls, named in the title of the painting, standing next to Velazquez, is it King and Queen, reflected in the mirror in the back – that in fact turns out to be what could be seen on the canvas – or is it us the spectators, who Velazquez stares at when one is positioned in front of the artwork). There is no final answer to the question, but more importantly a confusion about what is represented, so representation itself is in doubt. The dawn of a new age, for Foucault, is symbolized by a person leaving the room through a door at the back of the room, entering the new episteme (of the empirico-transcendental doublet), which gives rise to the human sciences – and consequently transcendental philosophy.

From looking at the technological stack of VR one can already get an idea of how that links to Kant's claim of an a priori of space as the external form of intuition and Foucault's description of the particular episteme as an empirico-transcendental doublet. Viator's algorithm of artificial *perspective* describes the Euclidian paradigm in which Kant not only defines space as a priori to perception, but also the very comparison of transcendental philosophy itself (as the shift from empirical to formal). The very method that the *panorama* and subsequent immersive media use is hiding the frame of the picture to make the image fuse with the environment; this equals the aim of transcendental descriptions to fence itself off from any empirical content, which nevertheless is itself the condition of possibility (according to Foucault) for transcendental philosophy to make its claim. *Stereoscopy* then can be considered to be the tipping point in which the formal structure of perception turns empirical, because the fusion of the two pictures can only take place in the human being, with the result of a depth-image. The *movement image* requires the same, in the perception of a continuous experience of motion through space, and *computer graphics* finally allow for creating any possible content for VR-media, amongst which the most relevant today are head-mounted displays,[24] like the *Oculus Quest*, now renamed *Meta Quest*.

3. Setting the Guardian

There is a notable contradiction in using VR-devices and the way the experience is promoted. Usually, one sees footage of a seamless experience, without any flaws. Besides the problem of latency or bugs in applications, before the virtual experience is possible, one has to set up the device – and more important: one has to set up the virtual space within the physical space itself. With the *Quest*, this happens in form of the so-called Guardian. Its set-up here ›takes place‹ in two steps: The first one defines the floor level of the space one stands, sits, or even lies on. It is expected to make the actual floor match with the floor of the virtual space. Since the room is scanned by the headset's cameras under regular light conditions this happens automatically, but sometimes needs to done by hand, literally by touching the floor with a controller. A mismatch would result in an almost out-of-body-experience of the Avatar.

24 Jaron Lanier (1989): »Virtual Reality«, in: Whole Earth Review, Fall, pp. 108–118.

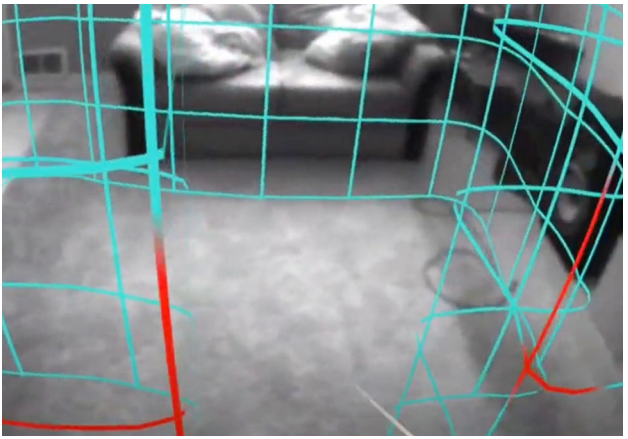

fig. 1: (Hidden) Visibility of the Guardian in the Quest

The second – and even more important – step delimits the boundary of the virtual and the physical, not according to the immanent limitations of the virtual world, but to the range within the physical world that needs to be provided to be active in the virtual. There is also the possibility to use a stationary boundary (a fixed circle around the users' position), especially for the sitting position when watching movies or playing games on virtual consoles with a game controller, without moving one's own body to move the Avatar. With the latest model, the *Quest 3*, it is also possible to have the room, or even a complete house, scanned in total, so that the boundaries of the Guardian are identical with the boundaries of the architecture and/or furniture of a space. This is what is now usually addressed as Mixed Reality (MR), which can also blend the camera feed (the pass-through of reality, now also in colour) with the virtual content or textures.

As claimed from the outset, the Guardian is not only a precondition for using VR, it also gives an insight into the topological ›nature‹ of the medium, which is essentially rooted in the epistemological structure of modernity: On the level of the dispositive, this is the technological stack, as described in chapter one; on the level of the discourse, it is the split between the actual experience and the extrapolation of the empirical as a condition of the possibility, as described in chapter two. Thus, the spatiality of VR is not only determined by the spatial geometry on the inside of the Guardian, but also by the surroundings

outside the Guardian that provide the physical space for the experience. Regarding Augmented Reality (AR), this structure has already been termed aptly as the ›area‹, which »encompasses the image and its surroundings, as well as an image of the surroundings. It is the condition that makes a collision between the image and its surroundings possible.«[25] Just like in AR the image becomes foregrounded as an image when the image-object no longer fits the environment and becomes seen as an image, in VR the Guardian blends into the field of vision when the boundary between the image and the image-carrier is crossed; only that the image-carrier in this case itself is virtual (being the imaginary boundary between inside and outside).

Notably, this empirico-transcendental duplication has been addressed by art at a very early stage. This is not only the case for the above mentioned painting by Velázquez, for the crisis of representation, but it can also be found in the early days of panorama art: Caspar David Friedrich's famous *Wanderer above the Sea of Fog* from 1818 is not a rear facing portrait of a man standing on a hill overseeing a physical space, but it is an image of a visitor on a platform of a panorama painting,[26] being separated from the canvas by the fake terrain (in this case, the fog) that prevents him from crossing the boundary between the image and the medium. This does not contradict the common interpretation of it showing a situation in which the landscape is contemplated, but it gives it a medial turn, in the way that the Romantic has already considered the loss of the object it tries to reach out for. What is lost here is the actual nature that has been substituted by an image of nature. (It thus does not come as a surprise that Kant in his *Critique of Judgement* defines the experience of nature as ›sublime‹: by not being exposed to the forces of nature, one is witnessing and enjoying.)

25 Manuel van der Veen (2025): Augmented Reality. Für eine Kunstgeschichte der Kollision von Bild und Umgebung, Leiden: Brill/Fink, p. XXVII (transl. by author).

26 Gregor Wedekind (2021): »Philosophie der Landschaft bei David d'Angers und Caspar David Friedrich«, in: Nina Amstutz/Anne Bohnenkamp/Mareike Hennig/Gregor Wedekind (eds.), Das Bild der Natur in der Romantik. Kunst als Philosophie und Wissenschaft, Paderborn: Fink, pp. 45–76.

fig. 2: Transcendental grid and empirical nature in Char Davies: Osmose, 1994/95

Looking at early VR-Art one can notice a similar situation being addressed in works like the often-referenced work *Osmose* by Char Davies and her company Softimage from 1994/95 that foregrounds the grid structure of the virtual geometry being the condition of the possibility of VR to be experienced. However, in contrast to the artists' intention – as well as common interpretations based on that –[27] the attempt to regain an original experience of space or nature (with the help of a breath-controlled interface) within VR, only repeats the structure of the empirico-transcendental double and thereby is deeply ›humanistic‹. This is astonishing to a greater extend, since the presentation of the artwork refers to Gaston Bachelard,[28] with the quote »by changing space […] we do not change place, but we change our Nature«.[29] Bachelard indeed was very critical about the geometrical understanding of space and its continued life in philosophy, but as an alternative he did not praise returning to ›nature‹,

27 Laurie McRobert (2007): Char Davies' Immersive Virtual Art and the Essence of Spatiality, Toronto: University of Toronto Press.

28 Gaston Bachelard (1994 [1958]): The Poetics of Space, Boston: Beacon.

29 Char Davies (2014): »Osmose«, in: immersence.com. Online: https://www.youtube.com/watch?v=bsT59fp8LpY (last access: 10.12.2025).

but was suggesting to think different spatialities or spatial forms (like spirals or spheres). Nevertheless, *Osmose* enables the illusion to sink below the horizon or to be immersed in the ground. This is not transgressed in most VR applications today, as it is the foundation of the Guardian.

fig. 3: External perspective in: MOSS, 2018

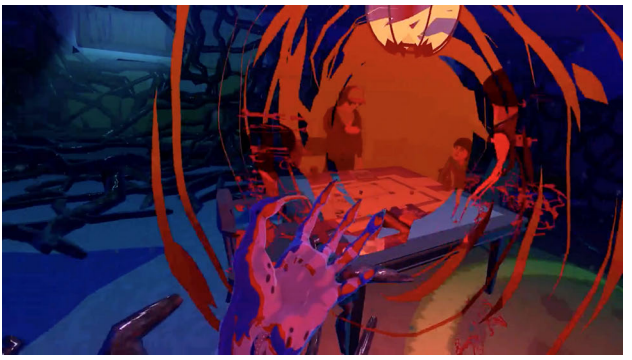

fig. 4: Vecna's perspective in: Stranger Things VR, 2024

But one cannot only detect the iteration of that very structure in artistic reflections, but also in contemporary approaches to escape the anthropocentric view in VR-games deliberately by detaching the point of action from the point of view and using supposedly non-human Avatars or lacking a player's representation at all. The first approach can be found in the Game *MOSS* (2018), in which players navigate a mouse located in an environment as well as also can manipulate that environment, too. The second can be found in *Iron Guard VR* (2021), a tower defense game, in which the players have to place gun turrets to stop the approaching forces. One of the most notable examples, however, can be found in *Stranger Things VR* (2024), in which players can take on the role of Vecna, the embodiment of evil, haunting humans from a counter-world, the ›Upsight Down‹. When reaching into the ›real world‹, the collision effect is used in a Guardian-style manner inside the game itself, whereby the outside of the players' area is the inside of the human world. Thus, the empirico-transcendental duplication is both reversed and confirmed at the same time. All these applications stick to the camera perspective as well as all the other elements of the VR-stack while trying to escape the common paradigm of VR.

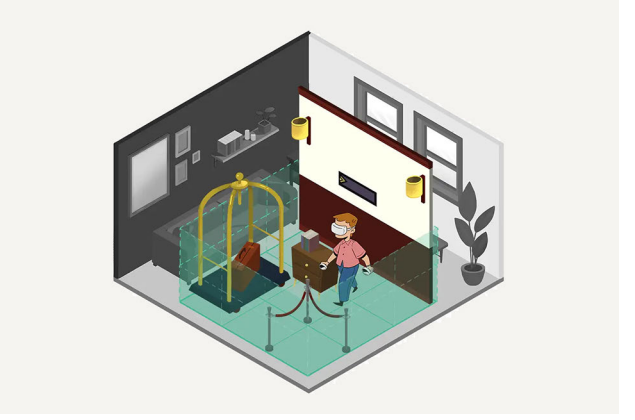

fig. 5: Infinite walking in: Hotel Infinity, 2025

Overall, the main reason for this might be the fact that the 3D-engines that are used for creating VR-experiences be default suggest the use of a camera – but beside the egocentric view also orthogonal or flat projections are offered.

Those would truly be the mode in which the above-mentioned games should be played. But designing for VR seem to not allow creators to think outside the layers of VR's stack (yet). Alternatives to think about should look into different traditions of the arts outside Europe, before the modern era, or after the heydays of photorealism.[30] Inspirations could for example come from Chinese panoramas, like the famous *Qingming*-scroll by Zhang Zeduan using orthogonal projection, or from Persian miniatures, as created by Mir Sayyid Ali, using depicting the inside and outside the same time; like in the game *Monument Valley* from 2014 for mobile devices. A very recent VR-game that started considering alternative spaces was developed by the Studio of William Chyr, who is well known for his 2019 PC and console game *Manifold Garden*, in which the game space is repeated endlessly in all directions. Inspired by the idea of transcending the limitations of the given medium, the 2025 VR game *Hotel Infinity* now requires players to walk in circles (or squares) inside the Guardian. With every turn, the interior of the Guardian can ›expand‹ or be replaced by a different bit of a virtual space that would physically have to be located outside the Guardian. Additionally, certain situations allow you to see the space you are in from outside or above at the same time. This does not yet overcome the empirico-transcendental double, but it can let users start thinking about the limits of VR – in VR.

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