3. Identity, Reflection, and Spatial Challenges
Navigating Self-Reflexive Game Worlds

The Aesthetics of Non-Euclidean Game Spaces
Multistability and Object Permanence in *Antichamber* and *P.T.*

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Abstract   In recent years, an increasing number of games have created spaces which radically depart from our experience of space in reality. Digital games have used clandestine relocations of the avatar and semi-scripted reconfigurations of game spaces to great effect. Often characterised as non-Euclidean, virtual environments such as these foreground otherwise barely noticeable principles of navigation. Drawing on the well-established theories of game spatiality, neuroscience, and developmental psychology, this article investigates how two of the most well-known and extreme examples, *Antichamber* (Demruth 2013) and *P.T.* (7780s Studios [Kojima Productions] 2014), defamiliarize game spaces and their navigation. The result is an identification of shared aesthetic principles of non-Euclidean game spaces, which evoke fundamental disorientation and helplessness by withholding information we learn to rely on in reality at an early age for basic cognitive processes.

Keywords   Aesthetics, multistability, game space, phenomenology, game design, neuroscience, horror games

Introduction

Spatiality was identified as one of the central challenges of digital games already in some of the foundational texts of game studies. Janet Murray (1998) assesses spatiality as one of the four distinctive properties of virtual environments, while to Espen Aarseth, spatiality is even the *"raison d'être"* of computer games (emphasis in the original, 2001, 161). Unsurprisingly, games research has produced numerous typologies

(e.g. Nitsche 2008; Günzel 2008) and ontologies (Fernández-Vara, Zagal, and Mateas 2007) of virtual environments and engaged with their aesthetics (Švelch 2008, 214; Fernández-Vara 2011). Other approaches put the player's physical and psychological relation to virtual environments in the centre. Questions of embodiment and immersion appear as particularly pertinent, both on the individual (Taylor 2003) as well as collective level (Babic 2007), because the experience of virtual environments is unlike that of reality or that of traditional depictions of space. A player of digital games "experiences a phenomenon that cannot be experienced in traditional imaginative space, namely the experience of motion as navigation. […] Thus, […] computer games are characterized by the fact that they present artificial navigation" (Günzel 2008, 172).

The result is an aporia common to all research on virtual environments. Characterised by "fundamental differences" (Nitsche 2008, 3) from what we encounter in reality, they are not spaces but a representation of space that is not in itself spatial, but symbolic and rule-based, or, in other words, "allegories of space," "a three-dimensional scheme carefully designed to offer a balanced challenge to the player" (Aarseth 2001, 168). And still, these essential differences notwithstanding, players will inevitably approach them based on (perceived) similarities to reality. Games do not reinvent patterns of spatial use but reuse, reapply and restructure basic patterns that occur in reality. The fundamental situations of play correlate with familiar spatial configurations because any environment is experienced based on what we *do* in it (McGregor 2007). The empirical observation that architectural theory and real-world facilitation of navigation translate well to virtual environments (Totten 2014) has been theorised as the "shared fundamental experience of the way our knowledge of space develops both inside and outside of the video game" (Fraser 2011, 102).

How this transfer of knowledge from the real to the virtual works exactly is rarely foregrounded, while it is apparent that most games work towards making it effortless. Yet in dealing with virtual environments that depart from the parameters of reality in fundamental ways, the differences become unmistakable. The most well-known and well-researched departure from real life is the use of portals, warps, or wormholes (Gazzard 2009; Leirfall 2013), i.e. means of traversing space that have been theorised as well as depicted in fiction, yet have no equivalent in reality. Moving in this way disrupts the sequential fluidity of paths, temporarily takes navigational control from the player, and calls into question the coherence of time, space, and causality (Gazzard 2009, 2). In *Portal* (Valve Corporation 2007), the prototypical example for games with such environments, the use of portaling is the central game principle, and accordingly follows static and predictable rules, derived quite faithfully from real-world physics. The spaces of *Portal* only change in ways that are compatible with our experience of spaces in reality, and generally do so in plain sight and with the cause of their reconfigurations (pistons, tracks, rails) exposed.

Some games confront players with spatial situations that are cognitively different from spaces encountered in real life, and appear as featureless or impermanent. In doing so, they not only defamiliarize movement, but space itself. The game environments of the chosen examples—*P.T.* (7780s Studios [Kojima Productions] 2014) and *Antichamber* (Demruth 2013)—are sometimes called non-Euclidian to identify their deviation from real-world spaces.

The logic of space postulated by Euclid forms not only the fundamentals of geometry, but is at the root of conceiving of space as a neutral, static container within which things happen. In mathematics, 'non-Euclidean' refers to the complications produced by curved surfaces, where the angles of a triangle add up to more than 180 degrees (Hartshorne 2000). Non-Euclidean virtual spaces deviate from the laws of simple geometry in a different fashion. Most games resort to tricks of reconfiguring their game spaces, making things appear connected that are not, and teleporting the avatar, mostly to optimise performance, but do so without drawing attention to it. The games discussed here use the same techniques, yet instead of hiding them to make the game space appear more similar to reality than it actually is, they do the opposite: instead of streamlining the avatar's progress, they have them move in circles. These spaces produce a very particular, primordial form of cognitive challenge. They are ontologically different, yet in a way that is not immediately apparent, and which undermines the player's ability to use fundamental spatial epistemologies acquired as infants. What we encounter in these game environments therefore goes beyond disorientation or even cognitive dissonance (Cooper 2007). It is a throwback to a stage in child development before the attainment of object permanence.

In the following, I will briefly outline the challenges posed by the examples and discuss the pertinent game studies concepts, particularly uncertainty and agency. Having thus identified the theoretical challenges, I will go into more detail with spatial epistemology, showing that there are recurring challenges posed by spatial multistability and universal strategies humans develop early in life to cope with them. I will then return to the examples to discuss how they undermine said strategies and how this creates a very specifically unsettling feeling in players.

Challenge Spaces to the Second Degree

The digital games chosen for this article are by far not the only ones to exhibit the features discussed here, yet they do so throughout the whole of their gameplay, and while one of them contextualises its spatiality within discourses of insanity, the supernatural, and the loss of cognitive faculties, the other presents its ever-changing environments as a given.[1]

 P.T. was released as a platform-exclusive game on Sony's PlayStation Store as a part of a mystery advertising campaign. Eventually, players realised that *P.T.* stood for 'playable teaser' and was a preview for a new *Silent Hill* game.[2] In its minimal gameplay, the player controls a first-person avatar whose abilities are restricted to walking and minimal interaction. Spawning in a bare concrete room with only one door, the player steps into an L-shaped hallway which leads past the locked front door of the house they are in, ending in a featureless room similar to the one they begin the game in. In this room, a short flight of stairs leads downward to another door. Stepping through it, the player finds their avatar back at the entrance of the L-shaped corridor. All of *P.T.*'s gameplay takes place in this strange spatial loop, varied through locked doors that can be opened by solving increasingly obscure puzzles, surrounded by gruesome details, a haunting soundscape, and the occasional jump scare. The basis of the nightmarishness of the overall experience is, however, the unsettling space that appears to loop back on itself.

 Antichamber, the second example, is a first-person game like *P.T.* or, maybe more accurately, like *Portal*, with which it shares the appropriation of the gun metaphor for different purposes. The player is trapped in a labyrinth of featureless white hallways, equipped with a gun-like tool that allows them to manipulate small, coloured cubes. Not only do the untextured white walls provide few landmarks for orientation, but walls and floors are impermanent and might manifest or disappear for a number of reasons, including whether or not they are being looked at. Gameplay revolves around navigation through the labyrinthine, shape-shifting hallways and activating mechanisms, elevators, and doors by using the small coloured cubes to e.g. open doors. One of the first puzzles of the game is a staircase. No matter whether one takes the left downward path doused in deep red light, or the right upward path illuminated in blue light, the avatar ends up in a straight hallway that, after three right-angle bends, leads

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1   I apply the same approach and many of the same theories to further examples in a paper focusing on the aesthetic potential of non-Euclidean spaces outside the narrative context of horror and existential dread (Backe 2020).

2   For undisclosed reasons, Konami decided to withdraw *P.T.* from the PlayStation Store, the sole source of distribution, setting a precedent for a major publisher attempting to delete a game from public discourse, making the game an urban legend and turning PlayStation consoles with the 30-minute game installed a collector's item with skyrocketing prices.
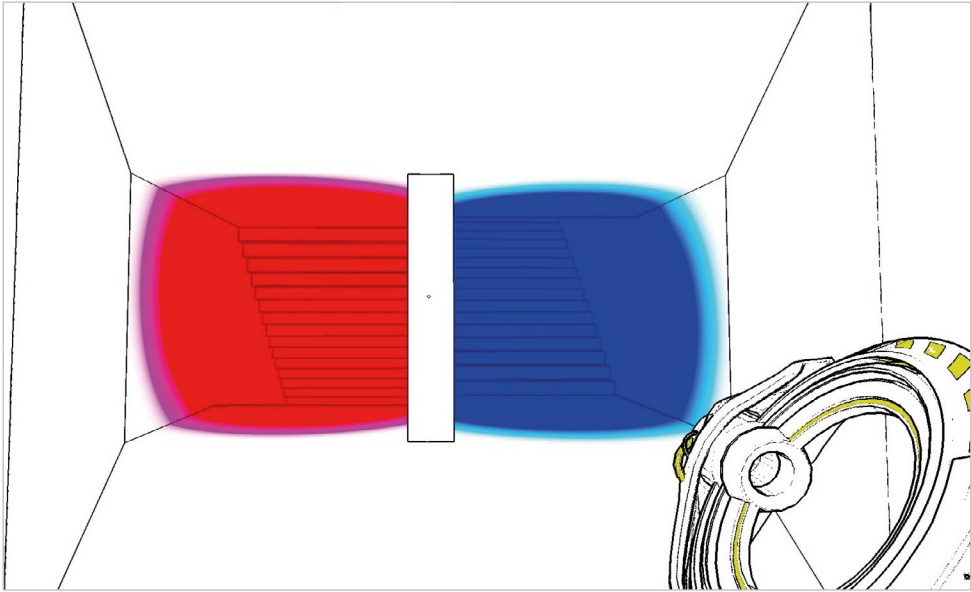
Fig. 1 The initial stairwell in *Antichamber*.

back to the same staircase (*» Fig. 1*). The solution to the puzzle is to turn around and walk away because after taking the stairs once, the path behind the avatar has changed and now leads to a different, bright green archway. *Antichamber* achieves this and many of its other dazzling effects by teleporting the avatar in a way that goes unnoticed by the player, a technique used in countless other games as devices of convenience for developers. Yet, where other games use this technique as inconspicuously as possible, *Antichamber* uses it to thoroughly defamiliarize movement and spatiality. Throughout the length of its campaign, *Antichamber* exposes the artificiality of game environments as much as the fact that their traversal can pose a significant challenge in itself. Here, spatiality truly is the game's "*raison d'être.*"

The spaces in *P.T.* and *Antichamber* are, of course, not unusual simply because they pose a challenge to the player. Challenge spaces are the first of six patterns of spatial use in digital environments identified by Georgia Leigh McGregor, and they are ubiquitous in games of all genres: "Problems of navigation and environmental obstacles, whether they require a simulated physical response by the player's avatar or an intellectual solution, are configurations of challenge space" (2007, 540).

The difference lies in how they construct the challenge. Greg Costikyan has identified 11 distinct types of uncertainty in games, four of which we find in the spaces of the examples. Analytic complexity is present here, as in most challenge spaces, because sometimes, the spaces need to be approached like puzzles in that multiple elements

need to be evaluated both individually and in their relation toward each other to arrive at a single, non-obvious combination. Somewhat rarer for challenge spaces is hidden information, which to Costikyan is most commonly achieved through fog of war. To him, navigating such environments is an "exploration—but of the parameters of the system rather than of physical space" (2013, 93). What sets the spaces in the example games apart from traditional uses of fog of war is that the player's exploration does not change the presentation of the world. Arriving at an understanding of how to navigate specific passages is traditionally paralleled with rendering this epistemological process palpable in a map or the world itself, which happens neither in *P.T.* nor *Antichamber*, at least not in an unambiguous way. Through this, the games add an element of uncertainty of perception, "the difficulty of perceiving what's going on in the game space" (ibid., 101). Even when the perception of things is not actively impaired, many game elements are characterised by semiotic contingency, forcing the player to perform considerable hermeneutic work to interpret the ambiguity of signs. So, while in most games "[m]ultiple paths, open landscapes and convoluted layouts require the player to negotiate and remember spatial configurations" (McGregor 2007, 540), *P.T.* and *Antichamber* are designed to complicate and even resist these basic problem-solving strategies.

In fact, even basic navigation is complicated in both games. In *P.T.*, it is impossible to tell whether one walks in circles or moves through a series of nearly identical spaces. *Antichamber* adds to this by imbuing otherwise irrelevant parameters with meaning, like when a threshold can be crossed only while walking backwards. In both games, the environment withholds information about spatiality generally taken for granted, and thus becomes hard to "read," in the sense that "players need accurate information about their state in the game and will make choices based on that information" (Sicart 2013, 87). This feedback loop of receiving updates about the game state and acting upon it was influentially identified by Murray as the source of agency in virtual environments, "the satisfying power to take meaningful action and see the results of our decisions and choices" (1998, 126). Game designer Paolo Pedercini has suggested that the lowest level and the precondition of any deeper feeling of agency is the control of purposeful movement: "As long as the players feel in control of movements in space, even the most linear narrative and the most constrained level design will provide enough agency. In a way, that's what we've come to expect from mainstream games" (Pedercini in Sicart 2013, 104). Withholding or disturbing agency has been identified as a powerful aesthetic strategy in digital games (Habel and Kooyman 2013; Wilson 2003), yet the cognitive disenfranchisement of *P.T.* and *Antichamber* is unlike the frustration of malfunctioning controls or work-like game mechanics used by other games (Johnson 2015). Here, players encounter less "the human pleasures of lack of agency, of being controlled, of being acted upon" (Giddings and Kennedy 2008, 30) than a fundamental sense of disorientation.

Spatial Epistemology, Multistability, and Object Permanence

Yet, what are the principles commonly found in digital games that *P.T.* and *Antichamber* deviate from? The experience of space in digital worlds, just like that of time, is never isomorphic with reality. To this day, great conventionalisation dominates the design of game spaces even in Virtual Reality. Digital game worlds still customarily foreground similarities to real life architecture, movement, and social behaviour. The sense of spatial presence "is best understood as the sense of being physically located in a virtual environment […] or interacting with virtual objects as though they have actual, physical properties" (Tamborini and Bowman 2010, 88). In other words, a virtual space is a combination of the generality of fundamental spatial articulations (figure-ground, solid-void) and the expressive, communicative specificity of a fleshed-out virtual environment (Totten 2014, 104–12). The former organises and channels gameplay, while the latter creates meaning and atmosphere, effectively turning a space into a place: "A world with a properly defined sense of place is a world that players can learn to use" (ibid., 323). These two articulations of space are epistemologically different: the first we approach in the Euclidian tradition as an absolute, as a container, as "arrangements of bodies, a geometry of things in themselves" (Babic 2007, 2). The second, the details of an environment, is processed as a relational space as described by Henri Lefebvre, in which space does not exist a priori, "*but only through the context given by the relations and interactions of the actors and objects within*" (emphasis in the original, ibid., 2).

In one of the few dedicated studies of the epistemology of space in digital games, Benjamin Fraser posits that "the epistemological mode of video games is the epistemological mode of reality" (Fraser 2011, 95). He argues for an understanding of spatial epistemology in digital game environments as a form of *mētis*, the Ancient Greek concept of embodied, tacit knowledge of practices that are only learned through experience, not study. Fraser goes so far as to declare: "there is the shared fundamental experience of the way our knowledge of space develops both inside and outside of the video game. […] [T]he method through which we form knowledge of video game space is in fact the very method through which we form knowledge of 'real world' urban spaces" (ibid., 102–3).

Where Fraser foregrounds the similarities between our epistemologies of real and virtual spaces, Bjarke Liboriussen suggests that phenomenologically, the landscapes of games are experienced simultaneously as environments and images (2008). He draws on Jean Piaget to distinguish between three phenomenologically distinct levels of spatiality: On the most basic level, termed *topological space*, an environment is perceived; if perception alone is insufficient, perception is augmented with imagination in a *projective space* that creates an idea of a place; on a yet higher level of abstraction, the *metric space* of a landscape is created purely through (in Piaget's terms) imagination or (Liboriussen's conceptual update) cognitive mapping (Liboriussen 2008, 152).

Subsuming these reflections, the understanding of and orientation in game spaces are crucial for exerting agency within them, and players process these spaces analogously to both their experience and mimetic depictions of reality. Being able to process the spaces of digital games explains how "my sense of embodiment can become distributed across both sides of the glass" (Keogh 2018, 4–5) to form an "amalgam embodiment in and as a part of the videogame performance" (ibid., 28). Embodiment in a game world, particularly from the first-person perspective found in both examples, "might be called 'whole body activity.' This is to say that we humans are multidimensioned perceptually; that kinaesthetic-sensory actions are primary and implied in all our activities; and that this is the basis for what we take to be our opening or relation to any 'real' environment" (Ihde 2012, 134). For post-phenomenologist Don Ihde, "perceptual isomorphism" (ibid., 136) is the key to successful simulation environments in e.g. flight simulators. Ihde suggests that we switch our attention involuntarily back and forth between the virtual and the real embodiment in a quite classical form of bistability.

There are, however, two additional forms of multistability at work in navigating game spaces. Players 'read' the environment for directional and behavioural clues, in which the aesthetic dimension of elements often is what makes positions and paths memorable, and where different types of environmental (Jenkins 2004) or indexical (Fernández-Vara 2011) storytelling convey information that can simultaneously illuminate a fictional as well as the factual past of a game world and give the player valuable strategical clues. Both strategies are more closely related to the aesthetic multistabilities than the functional ones Ihde focuses on. Cognitive science indicates that both visual and semantic ambiguity are resolved through oscillation of focus (Yevin 2006, 79). In the arts and literature, ambiguity stems from diverging—often even opposing—meanings that are produced by the same sign configuration, yet "according to the common law of perception of ambiguous patterns, an oscillation of our attention takes place, and we see in turn either the actor or his role" (ibid., 81). The visual and semantic multistability of traditional aesthetics is therefore one of perceiving a static object in different, objectively co-present and therefore equally legitimate ways. In the bistability of alternating incorporation in the real and virtual body, both the player's body and the configuration of their relationship to the virtual world are generally static and reliable.

Non-Euclidean spaces in digital games exhibit additional spatial multistability: in them, navigational paths are not isomorphic with the perceived environment, and the objects change when interacted with or even just looked at. To return to the examples: *P.T.* has its players repeatedly walk through what both seems simultaneously the same and not the same corridor. On the most fundamental level, this is a simple variation of Euclidean logic: The hallway of *P.T.* appears to remain identical in form and shape while its contents change—space is an apparently neutral container. Moving down the
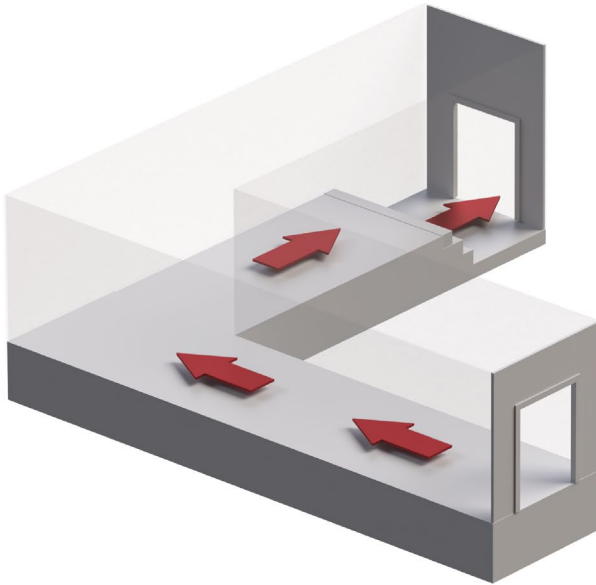
Fig. 2 The individual corridor in *P.T.*

corridor, rounding its single corner, exiting the door on the far end, the player finds themselves stepping through the door into what appears to be the same corridor again (*» Fig. 2*). Disorienting as it is, this relocation might be shrugged off as a clandestine teleportation back to the entrance. There are, however, two complicating factors. The first is that the hallways always have the same layout, but differ in decoration and furnishings. This can be explained either temporally—these changes happen in the time it takes to move from the exit back to the entrance—or spatially—there are not one, but many hallways.

The second complicating factor is the short flight of steps at the end of the corridor, leading down into a windowless basement room. The players descend every time they reach the end of the corridor, which means that regardless of whether they perceive one or several hallways, the path of the player character is a downward spiral (*» Fig. 3*). This is not only symbolically relevant—in the supernatural world of *P.T.*, one would be hard-pressed to not understand this motion as a descent into madness or hell—but contributes to the disorientation the space evokes. The three conceptions of the space—an identical hallway undergoing changes through time, many nearly-identical hallways located in the same space, and a downward spiral of iterations of the same room—are three states of a multistable object.
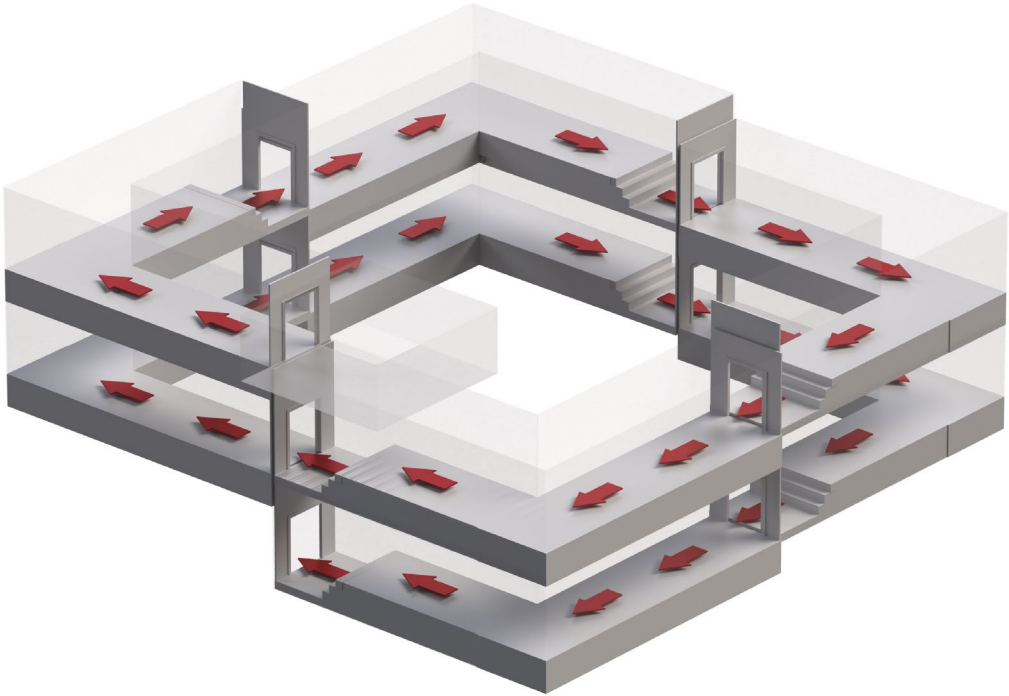
Fig. 3 The string of corridors forming a downward spiral *P.T.*

The stairwell in *Antichamber* functions similarly, bringing the player back to where they started after walking downward or upward. While the navigational path and perceived space are anything but isomorphic in both cases, the geometry of the space is less defamiliarizing than that of *P.T.* Here, the player rounds three corners before returning to their starting point, thus preserving at least correct directionality. Whilst *P.T.* unsettles the player through sometimes minute changes in the interior's arrangement between different versions of the hallway, *Antichamber* omits any and all detail. Untextured white walls make it impossible to distinguish one from another, turning the interspersed coloured lights into abstract, unambiguous markers of particularity. The only elements of the game world the player has direct agency over are coloured cubes which can be used for many purposes, from activating switches to building walls or platforms. They are, however, highly impermanent and evaporate under a number of circumstances. Even some walls, floors, and ceilings have varying solidity depending on e.g. whether the player is looking at them or not. Most of the game's doors will close behind the avatar, but in many cases, it is nearly impossible to determine when

their threshold is crossed, i.e. how far into a corridor the avatar can safely move before blocking off the way back. The only way to grasp the details of geometry in this case is to keep the gaze fixed on the door and move in the smallest possible increments, and to eventually mark the point of no return or block the door with one of the game's user-manipulable cubes. Only then may the player feel safe in turning their avatar's back to the door in question, by virtue of having reaffirmed object permanence. All these actions produce, however, only what might be oxymoronically called temporary permanence as the in-game objects the player controls, the cubes, are impermanent and will be removed from the avatar's inventory in airlock-like transitory spaces and more importantly, reset to their original positions upon the avatar's (very frequent) respawns.

The result of this combination of featurelessness and constant change is a form of multistability that differs fundamentally from the visual and semantic forms, which rely on the perception of a static object in different, equally meaningful ways. The profoundly unsettling effect of these environments results from an ambiguity that cannot be resolved with familiar methods because the multistability of the object is not perceptual but ontological.

Differently put, the objects encountered in non-Euclidean game spaces lack permanence, and thus subvert one of the first principles humans rely on in their "striving to preserve order and coherence in the world" (Moore and Meltzoff 1999, 641). Object permanence is generally assumed to be acquired by humans in their second year of life,[3] at which point infants begin to "parse multiple appearances as manifestations of a single underlying individual […] Both classifying groups of entities and tracing the identity of individuals over time and space are effective in isolating invariants and reducing apparent multiplicity" (ibid.). The cognitive processes of parsing the world for variants and invariants are so complex that they lay the groundwork for many advanced cognitive processes we only learn much later: "Infants do not at first understand that material objects, qua objects, are permanent, but rather discover that certain transformations are ones that preserve permanence" (ibid., 642). Among the connected cognitive developments are an understanding of cause and effect as well as of the agency of others (Piaget 2013, 378).

With regard to the examples, object permanence is tangibly undermined when the player has to keep the avatar's gaze directed at an object in order to make sure that it does not disappear—exactly what we learn as infants to be unnecessary and precisely not an act imbued with agency. These spaces are ontologically multistable, changing from one spatial configuration to another, defying Euclid's assumption of spatial stability. As the identity of objects, cause and effect, and agency are apparently

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3   There is some debate about the average age and the mode of attaining object permanence. Given the inevitable methodological challenges (Krøjgaard 1998) of the topic, "[i]nfant object permanence is still an enigma after four decades of research" (Moore and Meltzoff 1999, 623).

deeply connected with object permanence, the shared aesthetic of non-Euclidean game worlds comes into clear focus. Non-Euclidean games connect these factors through their spaces and undermine some of our most fundamental heuristics for meaning making, acquired in early childhood. They confront their players with environments that are not permanent, lack uniquely identifying traits, and thus make it difficult to even identify the starting position of the avatar, let alone to navigate through complex environments. Intentional movement becomes impaired, leading to a loss of agency (Sicart 2013, 104).

Conclusion

When game spaces deny players the ability to navigate them reliably by withholding immutable rules, they not only undermine one of the most fundamental aspects of the game, spatial navigation, but impede players' general ability for reasoning. Even though *Antichamber* allows its players to identify logical solutions to its spatial configuration (by thinking outside the proverbial as well as, in this case, very literal box), it introduces additional difficulty in this process by suggesting to its players that not only pre-formed behavioural patterns may not be applicable, but that the methods by which we have formed them as children (and which are the basis for all our rational thought) may no longer hold. This is, without any apparent similarity to what we would normally call a horror game, a profound unsettling that has the potential to induce sublime terror in the players—a potential fully realised in *P.T.* to horrendous effect.

In stripping us of our ability to trust in object permanence, the games discussed here do more than create a playful navigation of game spaces. They go beyond cognitive dissonance in defamiliarizing space and throw us back cognitively to a past stage in child development, robbing us of some of our most essential, most fundamental, and most relied-upon means of dealing with the world. By confronting us with spaces that withhold our primary cognitive achievement, object permanence, we are left with trial and error, the preceding phase in child development, and later on forced to do non-Euclidean mental mapping—to transcend our established navigational faculties for a heightened sense of accomplishment. So, despite their difference, both examples have a shared aesthetic: fundamental cognitive defamiliarization.

Figures

Fig. 1: Screenshot by the author (Demruth 2013).
Fig. 2–3: Graphic by the author.

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