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The authors discuss virtual reality (VR) in relation to its characterisation as the "ultimate empathy machine" that allows passive spectators of fictional or non-fictional narratives to become active agents of unfolding events. They concentrate on how the change in the form of the narrative through immersive VR impacts the audience, stressing the difference between the position of the spectator in an ongoing storyline and being a spectator engaged with elements of the story's narrative. The possibility of acting on behalf of the Other can activate empathic responses, which in turn may lead to a more direct integration of the characters' perspectives into the life experience of the VR user. The authors relate to several experiments and offer their conlusions.

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Being Somebody Else: The Future of Narrative Storytelling

Introduction

Virtual reality (VR) is characterized by some as the "ultimate empathy machine" that allows passive spectators of fictional or non-fictional narratives to become active agents of unfolding events.[1] 3D environments, whether simulations of physical locations or representations of fantastical destinations, constitute fountainheads of potentially unlimited storytelling narratives. Of special interest is immersive VR, which reshapes the form of narrative storytelling by adhering to sensorimotor contingencies that are in accordance with physical reality more persuasively than any prior technology pertinent to storytelling. This change in the form of the narrative through immersive VR is arguably significant enough to make a long-lasting impact on the VR audience. There is a salient distinction between simply being a spectator in an ongoing storyline and being a spectator who has the option to actively engage with elements of the story's narrative or even change the narrative itself. The combination of being in the shoes of fictional characters, in the literal sense, and acting on behalf of said characters can activate empathic responses, which in turn may lead to a more direct integration of the characters' perspectives into the life experience of the VR user.[2] What this implies is the potential emergence of storytelling experiences that are far more impactful than those we have experienced so far in traditional media, including cinema, theater, TV, and books or video games. In this article, we go beyond analyzing the poetics of VR storytelling to provide an understanding of the cognitive intricacies that ensue from the interplay between the interpretative mind of the VR user and the narratives of immersive VR technology.

With the commercialization of VR and its accessibility to an ever-growing audience gaining momentum, this understanding could serve as a foundation for envisioning the future of narrative storytelling.

Dwelling in presence

A key concept characterizing immersive VR is "presence," which refers to the illusory experience of being in the place depicted by the virtual environment, even though one is physically located elsewhere.[3] In his 2009 paper "Place illusion and plausibility can lead to realistic behaviour in immersive virtual environments," Mel Slater breaks presence down into two different components, namely "place illusion" and "plausibility."[4] The first is described as the experience of "being there," in one place or environment, and is a perceptual illusion where the real-world sensory data are replaced by the virtual. Plausibility, on the other hand, represents a more dynamic aspect of presence – a cognitive illusion where a person experiences the scenario depicted (the events that are taking place) as really happening. Put simply, place illusion is about *how* the world is perceived, whereas plausibility describes *what* is perceived. For place illusion, even though nothing might be happening during the virtual scenario, one can still have the experience of *being there.* A very good example of this phenomenon is demonstrated in the so-called "pit room" experiment,[5] where participants found themselves in a virtual room where the floor was a narrow ledge around an open hole to another room six meters below. The participants' task was to get to the other side of the room, with most of them making their way carefully around the ledge rather than simply walking across the non-existent pit. The plausibility illusion is somewhat more complicated, and it has been suggested that it requires three key conditions to arise. Firstly, the scenario must be directly related to the user personally; secondly, the virtual world must respond to the user;

and lastly, the scenario must adhere to the user's expectations.[6]

Concomitant to presence is the illusion of co-presence, which can be described as the subjective experience of being together with others (humans or computer-generated characters) in the virtual environment.[7] Despite these illusions arising even when one knows with certainty that nothing real is happening, it is typical that the stronger they are, the more realistically people respond to the virtual events.[8]

What is specifically characteristic of immersive VR systems is an additional illusion that relates to how one perceives and experiences their own body. Simply put, in the real world, when we look down, we see our body, and when we move, our body also moves. In VR, it can be programmed that when a person, wearing a wide-field-of-view, head-tracked, head-mounted display, looks down at themselves, they see a virtual body, which substitutes entirely their own and onto which the person's full body movements are mapped in real-time. This process of substituting one's body with a virtual one by employing specific VR hardware and software, known as "embodiment," gives rise to the subjective illusion of "body ownership" – *the experience of this virtual body being mine*.[9] The effect of embodiment was first demonstrated by Botvinick and Cohen,[10] with the rubber hand illusion. In this set-up, subjects can feel a rubber hand as their own when it is placed in an anatomically plausible position, the corresponding real hand is hidden from view, and the rubber and real hands are stroked in temporal and spatial synchrony. Since the rubber hand illusion, body ownership illusions have been replicated in many studies, both in physical reality and VR, over virtual hands and other body parts as well as entire virtual bodies, even when those are entirely different to the own body.[11] Interestingly, strong experience of body ownership has been reported with respect to a virtual body of the opposite sex[12] or different age, including young adults in a much older body,[13] or both young and older adults in a much younger, child body,[14] and

even a body of different race,[15] or virtual bodies representing historical figures, such as Albert Einstein, Sigmund Freud, or Vladimir Lenin.[16]

More remarkably, however, it has been widely demonstrated that body ownership illusions over such distinct virtual bodies can affect one's perception, behavior, attitudes, and even lead to higher cognitive changes. Scholars Nick Yee and Jeremy N. Bailenson referred to this phenomenon as the "Proteus effect," showing, for example, that having more attractive virtual bodies changes peoples' proxemics behavior, or that people negotiate more and less aggressively if their virtual body is taller or shorter, respectively.[17] The Proteus effect relates to the self-perception theory, according to which people determine their attitudes, beliefs, and preferences by interpreting their own behavior.[18]

How it works

In the course of several experiments, it was found that embodiment in a child body led adult participants to accept implicit attitudes about themselves as being more child-like, and resulted in an overestimation of object sizes, as opposed to being embodied in a scaled-down adult virtual body[19] (Figure 1). Comparably, embodying an older-looking virtual body has been shown to lead to a reduction of implicit bias toward the elderly in young people.[20] With respect to implicit attitude changes, the study titled "Putting yourself in the skin of a black avatar reduces implicit racial bias"[21] shows that embodying white participants in a black body for twelve minutes resulted in a reduction of implicit bias against black people, as measured by the Implicit Association Test (IAT) first introduced by Anthony G. Greenwald and colleagues.[22] The findings were replicated in another study, showing that the effects lasted at least one week after the virtual reality exposure, suggesting their permanence[23] (Figure 2). This reduction in implicit bias after embodying a black

body has also been simulated through a neural network model, as discussed in the article titled "A mechanistic account of bodily resonance and implicit bias."[24] Similarly, the authors of the paper "Virtual race transformation reverses racial in-group bias"[25] demonstrated that white participants in a black virtual body tended to unconsciously mimic the gestures and postures of a black virtual partner more than a white one (or imitate the white virtual partner more than a black one when in a white body), indicating that mimicry outside conscious awareness, which is linked to greater social rapport – known as the "chameleon effect"[26] – is also influenced by body ownership.

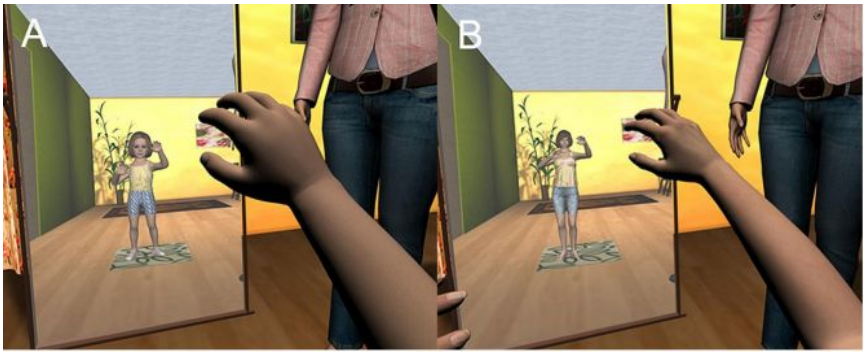

Figure 1. In the study reported by Banakou et al.,[27] the body of the participant was substituted by a sex-matched virtual body. The body was viewed from a first-person perspective (1PP), and could also be seen reflected in a virtual mirror. Body and head movements were mapped in real time. (A) a female participant in a child's body. (B) a female participant in a scaled-down adult's body.

Contrary to the above results, however, the study conducted by Victoria Groom, Jeremy N. Bailenson, and Clifford Nass showed that the implicit racial bias of a white person against a black one increased after they were embodied in a black virtual body.[28] In line with this, recent evidence suggests that when the surrounding social situation induces negative affect (a job interview in the case of the latter study), then the effect of embodiment in a black virtual body on implicit bias is reversed.[29]

As has been observed, embodiment in a different type of body than one's own can also affect cognitive abilities, such as

performance or engagement. For example, when male participants were put in the virtual body representing Albert Einstein[30] and saw themselves as virtual Einsteins, they exhibited improved performance during a cognitive test in comparison with embodying another, regular-looking virtual body. Likewise, when embodied in Sigmund Freud, as the study by Sofia Adelaide Osimo, Rodrigo Pizarro, Bernhard Spanlang, and Mel Slater shows, people were found to offer themselves better counseling than when embodied in a virtual representation of their own real body (their virtual self).[31] To give one more example, when participants were embodied as Lenin in a virtual scenario addressing Red Army recruits in 1920, they were more likely to later follow up historic information about the Russian Revolution than those who just observed the scenario.[32]

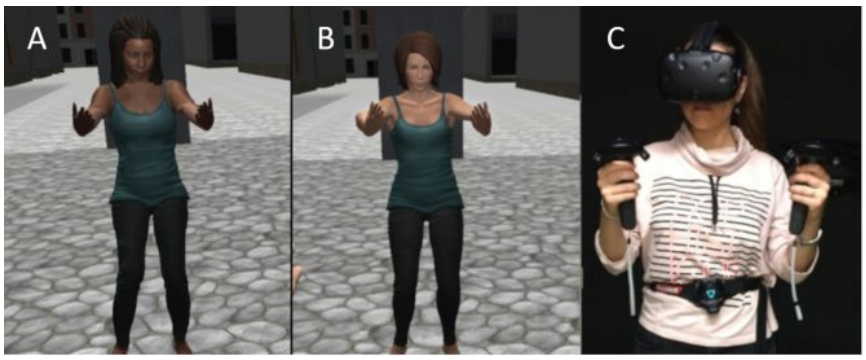

Figure 2. In the study reported by Banakou et al.,[33]

the participant embodied either (A) a black virtual body, or (B) a white virtual body while standing in front of a mirror and carrying out embodiment exercises. The body was viewed from a first-person perspective and could also be seen reflected in a virtual mirror. (C) Body and head movements were mapped in real time.

Findings from the above studies and other related research have led to a certain idealization of VR as an "empathy machine."[34] According to this concept, embodying people in virtual bodies or living through situations of less privileged or victimized groups can lead to an increase in empathy toward these groups. A well-known example is the 360° VR production entitled *Clouds Over Sidra*[35] by Chris Milk and Gabo Arora, depicting life in a refugee camp in Jordan as narrated by Sidra, a 12-year-old

Syrian girl. A similar immersive production, *Carne y Arena*[36] by renowned director Alejandro G. Iñárritu, immerses viewers in the lives of migrants to the U.S., based on the actual experiences of undocumented individuals.

Other examples include simulations of eye-witnessing an emergency at a Los Angeles food bank[37] or being interrogated in a Guantánamo-like prison under conditions of stress, and in solitary confinement,[38] works led by immersive journalist and documentary filmmaker Nonny de la Peña, or experiences of violence against women[39] and LGBTQ youth,[40] and intimidation of abortion patients.[41] Although whether such experiences truly lead to heightened empathic responses or, on the contrary, risk putting the user "too close" to a sensitive topic is still under discussion,[42] positive changes in behavior toward people from different social groups, countries, races, or situations that are quite different from their own are of great potential as the subject of future research to address bias and reduce prejudice and discrimination. To give an example, in an immersive VR study presented in the article co-authored by Catherine Hamilton-Giachritsis,[43] mothers of young children spent time embodied as a child inside a VR scenario where they interacted with a virtual mother who appeared to be either nice and loving (positive interaction) or very angry and rude (negative interaction).[44] Participants were found to improve in empathy toward their children's needs in real life after the negative interaction with the virtual mother. In a similar scenario presented in an experiment held by Sofia Seinfeld and colleagues,[45] domestic violence offenders (all male) experienced a virtual domestic violence confrontation from the perspective and body of the female victim. The scholars found an improvement in the offenders' ability to recognize fearful female faces after embodying the victim, and a reduction in their bias toward classifying fearful faces as happy – both common deficits observed among violent offenders. A different study addressed

the sexual harassment of women, whereby men were placed in a VR bar scenario amongst a group of four other virtual men, who verbally harassed a lone woman sitting nearby. Participants then re-experienced the scenario embodied as the woman, or as one of the virtual men[46] (Figure 3). There was also a control group where participants were sat in the same VR bar, but nothing more happened. A week later, participants took part in a virtual Stanley Milgram[47] obedience experiment, giving electric shocks to a virtual woman whenever she answered a question incorrectly during a word-learning task. Participants who had been embodied as the lone woman in the bar scenario gave the least number of shocks before withdrawing, those as another man the most, and the control group was between these two.

In yet another study by Sameer Kishore and colleagues, police officers were embodied as white male officers and were involved in the virtual interrogation of a black male robbery suspect. Participants carried out the interview alongside another virtual officer who was racially abusive toward the suspect. They then re-experienced the scenario, either being embodied as a suspect or through a window from outside the interview room (i.e., from a third-person perspective [3PP]). Three weeks later, participants experienced a different scenario, where they found themselves in a virtual coffee shop talking with the abusive officer from the previous experience. The officer was seen accusing a black male customer of wanting to steal the handbag of a white woman standing nearby, eventually drawing his weapon. Participants who had been embodied as the suspect in the interrogation scenario exhibited greater helping behavior toward the victim in the coffee shop than those who had just witnessed the interview from outside the interview room (3PP).[48]

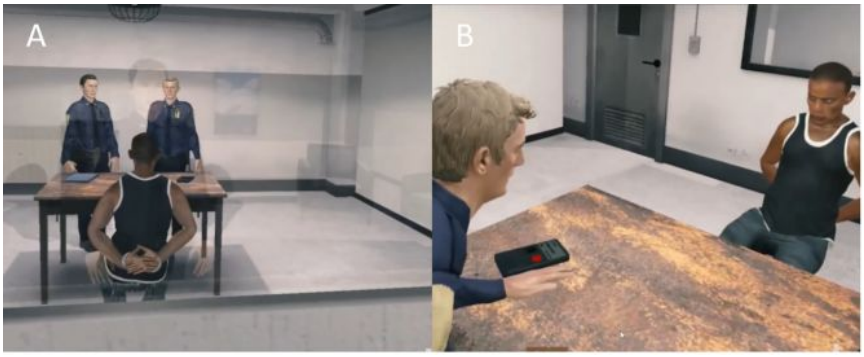

Figure 3. In the study reported by Kishore et al.,[49]

the participant either (A) viewed the interrogation from outside the interview room (3PP), or (B) embodied the police officer or the black male suspect from a 1PP.

New grammars of storytelling

Contemplating this evidence of the power of body ownership illusions over distinct virtual bodies to alter perception of ourselves and others, behavior, and also cognition, an interesting question emerges as to the future of VR, specifically in terms of embodiment. Over the past years, VR technology has been expanded from laboratory settings and increasingly used in entertainment and art. Unlike most traditional media, though – including TV, cinema, theater, and even video games – VR does not yet have its own "grammar" of telling stories. Yet, great effort is made toward understanding narrative and how stories can best be structured, created, and then told in virtual spaces based on traditional storytelling principles.[50] There are several elements to telling a story and increasing presence in VR narratives, such as the establishment of place and storyline, relations between characters and dialogue, scene transitions, story flow, style, and audio enhancement.[51] A critical point, nonetheless, concerns the user's active participation in the narrative. Personal experiences and emotions in the interaction with the narrative are what transforms the technology from a storytelling medium to what Céline Tricart (creator of VR experience *The Key*)[52] conceptualized as "story-living," and the user from a mere spectator into an agent. Agency, the sense of

ownership, and the sense of self-location (egocentric – first-person perspective) are key elements of embodiment.[53] The three aspects together are what eventually makes the user feel present in and part of the environment, as embodiment itself has been found to result in higher levels of presence than not having a body.[54]

Several conceptual models have been proposed to address body ownership illusions, which are suggested to rely on a combination of bottom-up and top-down processes.[55] For example, the rubber hand illusion is less likely to occur when there is asynchronous visuotactile stimulation between the real and the rubber hand, as was evidenced,[56] or when the rubber hand is rotated in an anatomically implausible position.[57] In VR settings, it has been repeatedly shown that asynchronous visuomotor correlations between participants' real-body movements and those of the virtual body lead to a reduction in agency and subsequently body ownership,[58] and that other top-down influences such as continuity between body parts[59] and the disposition of the virtual body are equally important, as evidenced in the paper titled "The building blocks of the full body ownership illusion" by Antonella Maselli and Mel Slater.

In the study conducted in 2017 by Ana Tajadura-Jiménez,[60] where adults were embodied in a child or scaled-down adult body (which spoke with a corresponding child or adult voice), it was found that body ownership was reduced in incongruent conditions – embodiment as an adult speaking with a child's voice – suggesting the importance of the top-down expectation that the voice matches the body in inducing body ownership. Consequently, congruent sensorimotor contingencies are crucial in inducing the desired effects following a VR experience. As discussed above, embodiment in a child virtual body led to changes in implicit attitudes and size estimation only under visuomotor synchrony conditions when the ownership illusion arose. On the contrary, no effect was found

under sensorimotor asynchrony, and therefore low or no body ownership (the virtual body moved irrespective of the participant's movements). Similarly, it has been demonstrated multiple times that participants respond physiologically to threats against the surrogate body (rubber arm, virtual arm, or whole virtual body) when it is incorporated into the body representation (increased body ownership). Such physiological reactions can include elevated skin-conductance responses and greater heart-rate deceleration,[61] but also corresponding brain activation that reflects an impulse for withdrawal.[62]

It becomes clear, then, that it is not sufficient to make a participant feel present in an environment – through improving, for example, as many realistic or aesthetic features of the virtual world as possible – but it is necessary to provide her with adequate ownership and agency over a virtual body, which she can use to interact with the virtual world. To date, most VR storytelling experiences can fulfil the self-location aspect of embodiment, mainly through employing first-person perspective techniques – this is particularly the case in immersive video-based paradigms.[63]

Body ownership is also tackled in the 360° film *Miyubi*,[64] where the viewer is embodied as a toy robot in a first-person perspective, and when looking down can see the robot's arms. It has been argued that, for realistic virtual bodies, the sole effect of congruent visuoproprioceptive cues is a sufficient condition for the body ownership illusion[65] – here, over the robot body. But agency is less addressed and accommodated for, and becomes increasingly challenging to implement, mainly due to the limitations of the technology itself, but also access to it when available. To move past this constraint, some artistic productions, such as that of BeAnotherLab,[66] employ techniques that rely on the camera switching perspectives between two individuals who harmonize their body movements in real-time. Nonetheless, such approaches are restricted to synchronized live performers and

cannot be generalized for immersive interactive embodied experiences. The authors of the 2020 article "Virtual Embodiment Using 180° Stereoscopic Video" proposed an alternative embodiment approach for immersive VR narration that relies on 180° video-based techniques. It incorporates a pre-recorded first-person view of the virtual body, and synchronous sensory correlations that include both visuotactile (with the use of haptic feedback on the seen hand, equivalent to the rubber hand illusion) and visuoproprioceptive synchrony.[67] The latter is based on pre-recorded interactions between the virtual speaker and the participant, which are then performed during the embodiment experience on the participant's arms or hands correspondingly (i.e., the participant's hand is guided by the experimenter in a certain gesture to match the pre-recorded movement at that specific time). Such passive movements, analogous to visuotactile correlations, have also been found to induce ownership.[68] The downside here is that the technique is very limiting in terms of its interaction capabilities, as it is only applicable to pre-defined scenarios and, also, participants are not able to navigate or freely explore the virtual environment.

In this direction, immersive VR games exemplify interactive storytelling design, capable not only of immersing the player in a detailed simulated narrative environment, but providing her with total freedom of movement and exploration using her body. In examples such as *Lone Echo*[69] or *The Elder Scrolls V: Skyrim*,[70] the player can direct her gaze anywhere in the environment, walk in any direction, have full control over a virtual body, and interact with the virtual world, the elements of which are responsive to the player's actions in real time. Nonetheless, even in such experiences, the main problem of ownership and agency affecting storytelling practices remains, oftentimes shattering the illusion of presence (a "break in presence")[71] and ultimately the experience itself.

Nicolas Bilchi, in his essay on directorial style for interactive

storytelling, gives an illustrative example of this by using the VR version of *Resident Evil 7: Biohazard*[72] as a case study.[73] The game is considered representative of the "state-of-the art" in interactive design experiences, and is widely praised by both players and critics in its genre. As Bilchi argues, however, the narrative efficacy of the game, despite how perfect the simulation may be, is doomed to fail because the medium is "unable to match the sense of agency it arouses with a tantamount sense of actual ownership of one's body."[74] More specifically, Bilchi explains that during one of the most frightening segments of the experience – the fight against Marguerite, a spider-woman, when she attacks for the first time – can cause the player a very intense scare. But as she keeps attacking, her claws go through the player's body, and hence the tactile stimuli that are internal to the environment are not matched with the tactile stimulation on the physical body, thus leading to a quick decrease of the fright effect as the player grows accustomed to it.

As far as multi-sensory feedback in VR goes, haptics seem to be another important piece of the puzzle. Haptic interaction has been applied in VR for more than twenty years, and there have been many novel variations over the decades to enhance virtual experiences, gaming, manufacturing, and training.[75] It does though remain a structural problem of VR affecting most immersive works, but which is, nevertheless, bound to change with the immense effort put into it by the academic research community and by industry. From wearable devices such as the HaptX Glove[76] – which uses microfluidic technology to mimic human touch, and BiFrost[77] – relying on electrical impulses to stimulate muscles and approximate resistance, or the infamous Teslasuit[78] – comprising a fine web of electrodes arrayed over the body that vary in amplitude, frequency, and amperage to deliver the wearer a long list of so-called "tactile animations,"[79] to Ultrahaptics[80] – a technology that uses ultrasound to make

one feel a variety of sensations in the air without touching any physical object. These are just a few examples of a handful of companies and research groups working on haptic technology which, though far from reaching the mainstream, will be slowly incorporated into VR experiences and stories to make them more real, emotional, and engaging.

Nevertheless, despite its potential, embodiment in VR raises several ethical, societal, and legal concerns that are interesting yet important to address and be aware of. As one could see at the beginning of this article, virtual embodiment can lead to behavioral, physiological, emotional, and cognitive changes that, though regarded overall as beneficial (for example improving empathetic aspects or implicit attitudes toward other groups), can nevertheless lead to adversarial effects, where in negative affective social events the embodied situation may lead to increased implicit biases. At the same time, while we might crave the simulated feeling of a warm hug from a loved one who is far away or the delicate sensation of raindrops on our skin during a VR experience, the question of how real the brutal impact of a bullet feels, or Marguerite's claws tearing through our body and other unimaginable acts of violence that we now watch in movies, become more crucial to consider and address. These and further ethical questions arising from "hyperrealistic" sensory feedback, embodiment, and other elements of virtual experiences that constitute them, indistinguishable from reality, have been discussed, among others, by Michael Madary and Thomas K. Metzinger in "Recommendations for Good Scientific Practice and the Consumers of VR Technology,"[81] and by Mel Slater and colleagues in their 2020 paper "The Ethics of Realism in Virtual and Augmented Reality."[82]

Conclusion

In conclusion, it is speculated that narrative storytelling will keep converging with real-life experience at the pace of advancements in VR technology. From the optimization of the suspension of disbelief in VR presence to the refinement of sensorimotor integration through VR embodiment and haptics, each milestone is crucial for elevating the unique storytelling capabilities of immersive VR, which remain underexplored but promising. Even though some ethical considerations have been raised throughout this paper, the authors endorse the idea of further experimentation with the underexplored capabilities of VR storytelling, because the empathic component of immersive VR should not be viewed as problematic per se. As we have already stressed, immersive VR offers an apt opportunity for creating more impactful storytelling experiences, which could potentially cater to identity formation, the reduction of social discrimination, and the acquisition of new skills. In this sense, "being someone else" refers not only to the short-term embodiment of a virtual avatar of choice, but also to the long-term internalization of feelings, perspectives, and attitudes, which are structural elements for the concept of the self,[83] and are effortlessly acquired through impactful experiences of storytelling narratives. Therefore, we speculate that future storytelling narratives will predominantly take the form of VR experiences, as an attempt to maximize their efficiency and versatility. Even so, this speculation should be contested, because many questions that pertain to the limitations of VR technology and storytelling narratives remain unanswered. In terms of embodiment, this will play a central role in the development of new narrative storytelling for VR, and will eventually be integrated into the new VR grammar, which will form a unique way that stories will be told – stories that cannot

be told in any other form except VR.

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