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Spatial Storytelling: Finding Interdisciplinary Immersion

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Abstract. In view of the growing interest in narratives and narratology with regards to virtual reality products and game design, this paper recognizes interactive digital storytelling as a vibrant immersive media example that carries the potential to address, and shape up a cohesive framework, on the concepts of immersion. In this paper, we will focus on Spatial Storytelling to examine the narrative technique in conjunction with Spatial Presence, a commonly accepted subtype of Presence. How our real-life occupation is a constant narrative making exercise and how storytelling is ingrained in our movement in space. It is argued here that immersion and presence models stand to benefit from spatial theory, in particular, the body of work surrounding spatial practices and narratives. Further, that the incorporation of spatial theory adds to the necessary versatility required in approaching immersion, which has been thus far dominated by positivist empiricism reducing it to a system property alone. This paper looks at our situated condition to build on Interactive digital narratives, as a novel immersive media requiring interdisciplinary research in order to fully understand immersion.

Keywords: Immersion, Presence, QoE, Spatial Storytelling, Urban Narratives

1 Overview

When BBC unveiled its coverage of the Fifa World Cup 2018 in Russia, it did so by announcing a dedicated high-tech broadcast trial in VR. A first-time-ever VR experience that is doing more than just providing live coverage of all 33 matches of the coveted competition to its eager, now curious, audience: "...we're giving audiences yet another taste of the future", said Matthew Postgate, chief technology & product officer at the BBC [1]. It is suffice to note that the BBC Sports VR app thrilled more than it surprised by presenting a "fully immersive" experience [1] of the matches through a "cleverly conceived VR" application [2]. It transports you into a simulated hospitality box (see Fig. 1) at the stadium where from you can not only watch a live game but also access highlights packages and on-demand content. Additionally, you can scan through information on each game, lineups and overall stats of the tournament.



Fig. 1. Simulated Hospitality Box inside the BBC Sports VR application.

The aforementioned thrill-not-surprise is congruent with the state of contemporary society where pervasive media systems have rendered physical space into what is now widely considered data-space [3][4]; some would even argue that space is media [5][6]. Terms like “fully immersive” and “as-if-real” have become synonymous with the coming of age of audiovisual, multimodal and interactive media that are now capable of occupying our perceptual system and simulating environments that evoke a feeling of ‘being there’ [7][8][9], or thereabouts [10]. Referring back to BBC Sports VR app, the user is transported into a spatial experience of the interior space of a generic hospitality box, which serves a virtual double of the numerous hospitality boxes spread over the many stadiums across Russia. The richness of experience here is extracted from providing a virtual experience that could simulate as-if users truly were in Russia. The experience does not limit itself to a mere delivery of a live broadcast. In fact, to enrich this VR experience, the virtual hospitality box lets users interact with other media within, doubling on the illusion. By choosing content, users feel more involved. This plays fairly to secure user attention and provide interaction, which are both considered vital for rich experiences [11]. Is choice of content in seemingly real space simulations enough for feeling present? Or, are shared experiences (multi user) required to emulate reality? Or is it content generation inside participatory narratives that can summon that all evasive feeling of as-if-real? These questions are of particular interest to developers and creatives working in game design, immersive media and interactive storytelling who aim to create spectacular synthetic/narrative/virtual environments that would imbue a willful suspension of disbelief, or presence. In this paper we discuss these efforts for richness, realness or

believability with emphasis on Interactive Digital Storytelling, in specific the subgenre of Spatial Storytelling, due to the opportunities it presents for cross-disciplinary research in immersion.

2 Immersive New Media

2.1 Immersion and the Spatial Presence Models

The consequential challenges posed by such immersive and interactive new media have resulted in an abundance of theory surrounding the terms Immersion and Presence [12][13][14][15]. This has produced numerous notable frameworks [16][17][18] over the years that have been successful in shaping the discourse landscape of new media applications and our evolving sense of self. However these frameworks are many, incoherent and consensus scarce. This is effectively due to the interdisciplinarity and multi-dimensionality of Presence research. Apropos to media technologies, Spatial Presence has emerged as the most relevant subtype of Presence in line with the theories of machine-mediated telepresence and teleoperation developed by Minsky in the 80's [19]. This interest has yielded a more concentrated evaluation of Spatial Presence as a "psychological" [18] "state of consciousness" [17] defined as "the subjective experience of a user or onlooker to be physically located in a mediated space" [11] even though one is not. From a media-psychological standpoint there are two aspects involved: first, a simulated spatial environment where one feels located; and second, for that mediated environment to offer perceivable options for activity [20].

In effect, most Spatial Presence models view Immersion as a "sensation of being enveloped" [18] by such media-based environments. Wirth et al [20], refine this to the "features that give rise to Presence" by stating that, "presence is conceptualized as the experiential counterpart of immersion". While Spatial Presence has drawn interdisciplinary interest, immersion has mostly been treated as a system characteristic, i.e., the input properties of the mediated technology to provide stimuli (vividness) and afford action (interactivity) [16][21][22]. Immersion as technology or immersion as the experience of being enveloped by technology is addressed from an empirical viewpoint, in that, it enables researchers to quantify these otherwise subjective mediated experiences. This localizes immersion to a system's sensorimotor contingency, i.e. to map and match the user's proprioception; and the range of information it affords the senses (visual, haptic, aural, etc.). Thus making it possible to study immersion as an objectively and technically measurable property of the system. A familiar framework in this regard, and of interest to this paper, is the white paper on the definition of Quality of Experience (QoE) offered by Qualinet [23]. Its

evaluations are based on the influence factors of: user, characteristics and mindset of the subject; system, technical specifications and the assigned task structure; and context, which comprises of the physical setting and service factors in use [23]. It is worth noting that QoE evaluations of immersive media remain fairly limited, which makes it an opportune subject for exploration.

Such unilateral frameworks have reinforced positivist models that favor data-oriented approaches to perception and representation in these media forms. As a system property, immersion is thus reducible to a degree of correspondence — higher fidelity of display and tracking yields greater level of immersion — enabling a “productionist metaphysics” [24] largely responsible for a preoccupation with low-mimetic realism [25] or skeuomorphs; often confused with believability [26]. While calls for interdisciplinarity vis-à-vis immersive and interactive media have existed for sometime now [27][28][29][30], it is the increasing, and more active, intersectionality of hard science and digital humanities that has offered a shift. Works [31][32][33] that discuss immersive and interactive new media draw from fields as diverse as art, narratology, ludology, social anthropology, phenomenology, and psychology to name a few (See Fig.2). There is a significant rise in the number of research and commercial projects in virtual reality and gaming sectors turning to low-tech features, such as involved narrative and social participation, to enhance the immersive qualities of their applications and products [34][35][36][37].

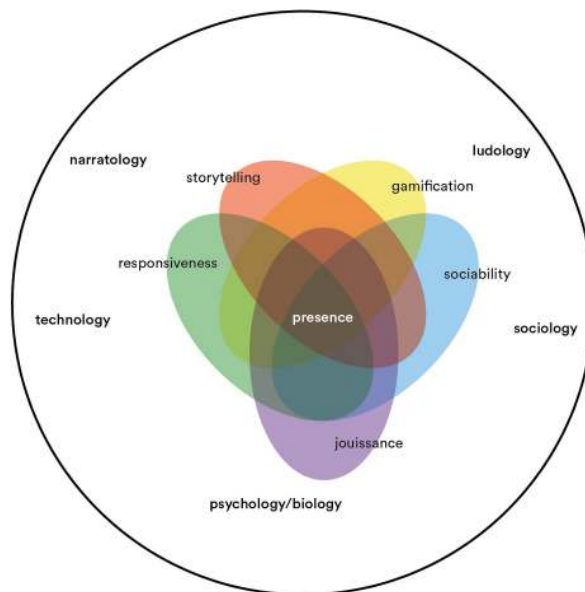


Fig. 2. Immersion radar illustrates the various overlapping influence factors on presence.

2.2 Immersion in Interactive Digital Narratives

Considering this, Interactive Digital Storytelling, or Interactive Narrative Design, propositions a method that approaches the same problem of QoE in immersive media through providing agency to the user. As co-authors and co-creators, users can influence plots and characters. This agency for content-generation allows them to interactively indulge in making meaningful decisions in order to advance these non-linear narratives [38][39]. Succinctly put, the goal of interactive narrative design is creating meaningful participatory story experiences using interactive systems [40]. In reference to the previously discussed QoE framework, we can see here that content (creation/generation/edition) emerges as an influence factor in determining quality of experience. Such design methods allow for an appreciably flexible immersive media forms capable of integrating various emerging technologies, popularly artificial intelligence and virtual reality. The cultivation of this position is owed to earlier works at the crossroads of narratology (study of narratives and socio-cultural narrative structures), ludology (study of game play and design) and HCI (human-computer-interaction). Murray [41] identifies four essential properties found in computer-based narrative media; procedural (computational), participatory (interactive), spatial (experiential) and encyclopedic (database). These features illustrate a system's behavioral capacity to issue cause-and-effect sequences in response to an engaged participant from a vast pool of indexed information [42]. This offers close comparison to the plausibility illusion mentioned by Slater et al [14][17], strong advocates of immersion as system property, who note that believability has to be achieved through congruity to real-life in order for immersive experiences to evoke presence. Consequently, it can be reasoned that computer-based narrative media, described above, can attain better congruence given their larger access to immersion. This, including system immersion [17], refers to, but is not limited by, the following: absorption & engagement [43], strategic and tactical immersion [43], imaginative immersion [44], challenge-based immersion [44], ludic immersion [45], and narrative immersion [46].

Looking back at the previously mentioned two aspects (simulated environment and possibility to act) considered vital for Spatial Presence, the approach taken by Interactive Digital Storytelling is found to be consistent across quite a few frameworks [47][48]. In that, it is a media experience, which utilizes a storytelling engine (system) offering action possibilities (interactivity) to intentionally influence the narrative (immersive) experience. Unlike Spatial Presence models where an immersive experience is predominantly interpreted inside a simulated spatiality, it is narrative, which pursues that role here. Appropriately, narrative is not to be treated as a binary categorization of 'stories non-stories'. Instead, it is the potential for 'storiness' that is valuable [45][49]. Ryan's theorization of narrative as a "semiotic object" is

important in this regard since she conceptually develops narrative for use across varied media, i.e. as a cognitive template.

In continuation of the above discussion, we seek to explicate Ryan's aforementioned cognitive template in its application inside Spatial Storytelling. Cognitive templates can be understood as mentally designed codes or stored templates used for the comprehension of our environment. They refer to so-called bottom-up in information processing that go by the structuralist formulation of piecing together disparate data to arrive at a bigger and bigger picture. Like this, they aid in the interpretation of experience and shaping an individual's perception of reality [50]. The term 'storiness' can then be seen as the furnished possibilities of a given environment (natural or artificial) for a narrative unfolding; also called affordances, but this will be discussed later.

Spatial Storytelling. A good example for 'storiness' is Spatial Storytelling, not just because of foregoing linguistic traditions and textual form, but for putting storiness to great effect. Spatial Storytelling works by spatially engaging a user inside a mediated environment whose discovery through exploration advances a non-linear narrative, and where space is the essential communication medium. Inspired from 'immersive theater' [51][52], it closely follows environmental storytelling in creating preconditions for immersive narrative experiences in four possible ways:

spatial stories can evoke pre-existing narrative associations; they can provide a staging ground where narrative events are enacted; they may embed narrative information within their mise-en-scene, or they provide resources for emergent narratives. [53]

Inasmuch as immersive theater learns from environmental storytelling to evoke phenomenological multi-sensory experiences through the involvement of visual, aural, olfactory and tactile elements; so far it has been game designers [54][55], who through Spatial Storytelling, look to restructuring narratives from temporal to spatial bodies of information — narratives distributed across the game space. This appropriation comes easier for games since they do not usually rely on temporal markers common to narratives like "once upon a time..." or "the next day..." and vice versa. Games are usually characterized by spatio-temporal markers, that is, we point at a certain 'thereness' (dungeon, lake, downtown library, etc.) to communicate how far we are in a game; space relays information on time. This explains the readiness witnessed in game designers towards Spatial Storytelling. However, this research considers it to be a compelling model that can prove massively useful for

stimulating presence in immersive environments, largely due to the induction of a variety of immersions.

3 Immersive Spatial Narratives

3.1 We are Immersed in Space

By shifting focus onto space, Spatial Storytelling turn to the narrative potential of locations and places in our everyday life. It is space, marked with disparate anchors of locations and places, each carrying meaning, temporal significance and past memories, which serves as the backdrop against which our individual life stories unfold. The same space also works as a force field simultaneously accumulating formal, psychological and ideological histories, discourses, and economies over time — “to any one aspect of which it cannot be reduced, from any one of which it cannot be removed” [56].

Anything we do ‘takes place’ in this space. Therefore, our actions become a “spatial practice” [57] “that shapes, and is shaped by, the social, economic, political and cultural” [58] forces within this space.

It is our movement, participation, action and recreation, which we use to “mark” this impersonal space and “inscribe” meaning within it through the repetitive patterns of daily routine. These spatial inscriptions emerge over denominated temporal cycles of days, weeks, months and years in the course of our interaction with space, resulting in “spatial narratives”. As Michel De Certeau says of space that “through practice we transform it into a place of meaning and value” [59].

3.2 Time and Space

In spatial theory, space is defined as the “physical setting in which everything occurs”. Whereas, place is, “the outcome of the social process of valuing space; a product of the imaginary, of desire, and the primary means by which we articulate with space and transform it into a humanized landscape.” [60]. While time and space have been long recognized as the criteria for studying everyday life. Western social theories have been favorably modeled around time, dispassionately assuming compliance from space. This position of dominance is most obvious when one considers the separation of history from geography. To this effect, spatial theory studies offer reflectivity by turning such institutionalized tendencies on their head. Led by theorists and philosophers like Henri Lefebvre, Michel Foucault and Edward Soja among others, the spatial turn pointed at the “[...]implicit subordination of space to time[...].” [61] helped by overdeveloped historicism. Recent cross-disciplinary

discussions have invited contributions [62][63] from disciplines like politics, geography, archaeology and narratology among other, which are fundamental, but have been previously absent, in framing discourses and informing our conceptualization of space.

Returning to our earlier discussion on immersion and presence, one can observe similar tendencies in immersive media, particularly immersive virtual environments (IVE), in their “reenactment of Cartesian ontology” [28][30]. This can be also evidenced in most Spatial Presence models that treat space as an a priori given; a Cartesian box. These are not self-acquired position rather cultural values inculcated through traditions of Western technosciences. The conceptualization of space as a container is an attractive proposition for its ease of offering a completeness to its elusive nature [64]; a problem, which Einstein, dubbed aptly as the “problem of space”. This ontic position, which assumes the world (space) to be present-to-hand, finds a challenge in Heideggerian phenomenology contending that space is learnt — one learns it — through involvement [65]. Space is an “artifact” [66], which we constantly innovate and mold through our active participation. By being in space we create space, our agency is consumed by the continuous production of space [58]. Space is not a mere container nor an a priori. It is “an experiential environment whose qualia and character are produced through behavior, ritual, and human activity, space becomes place in a non-mystical but inflected manner that does not map directly onto standard metrics” [67].

3.3 Body and Space

Activity, our immediate involvement, also finds a bodily interpretation in theories of embodied cognition. That space allows for action and movement, performed through the body as a tool, over a temporal cycle of time — making narrative. Space is experienced through the body. We can observe this in terms of spatial literacy; if you compare spatial descriptions like north, south, vertical, horizontal, etc. to more experience-based descriptions such as lying down, in front of, straight up, etc. we’d see more people understanding the latter set to the former. This is because humans, from their childhood, develop through a bodily experience of space, which helps them in learning and understanding space (spatial literacy). Earlier affordances, as furnished action possibilities, were discussed, which is a core concept for embodied psychology models. It has also used in fields ranging from industrial design to interface and interaction (UX) design. To address a common contemporary misinterpretation, it is vital not to confuse affordances with mere things that one do inside an environmental (natural or artificial). With this concept, Gibson [68] implies a relational complementarity between subject/environment, subject/object, object/environment. Where affordance has both projectable and non projectable

properties, for example, a door presents a projectable property of opening but can also have a non projectable property of one being excited to open the door for your friends; the latter is informed by our past experiences inside space [47]. In his Spatial Presence model, Schubert et al, calls these “anticipated” actions that help in presence, which he considers a “cognitive feeling”:

spatial presence is a feedback of unconscious processes of spatial perception that try to locate the human body in relation to its environment, and to determine possible interactions with it. If the spatial cognition processes are successfully able to locate the body in relation to the perceived environment, and construct possible actions in it, the feeling of spatial presence is fed back and becomes available for conscious processes. [48]

Such research developments in theorizing Spatial Presence are a refreshing and inclusive take on the matter. Schubert’s Spatial Presence as a cognitive feelings brings together a psychological embodied cognition model closer to its phenomenological situated cognition counterpart leaving enough space for the potential role of affective processes.

3.4 A way forward with Spatial Storytelling

The insistence upon reinforcing the Cartesian way of seeing-the-world (mind over body, subject over object) has produced skeuomorphs that have more in common with renaissance perspectivism than with space. Our example, the BBC VR hospitality box, at the beginning of this paper is the most recent illustration of such representationalism. Granted that a single commercial app is hardly any conclusive evidence and such generalizations are best avoided. However, such inclinations prevail over immersive media industries and, as previously discussed in relation to data-oriented system immersion, remain a popular conceptualization for research models and frameworks.

Alternatively, we can find encouragement in niche research projects like Holojam [34][69], developed by the NYU Future Reality Lab, which mixes physical and virtual objects (mixed-reality) to create interactive, participatory and shared immersive experiences. The team adopts a nonpartisan approach by settling for low-tech solutions but integrating sociability through collective activity. In this, Holojam employs multiple immersion for effectivity proving a useful precedent for study. Users find themselves as little more than stick figures (See Fig.3), as opposed to photorealist avatars, walking around a shared space where other users are there to interact with. In this prototype, users in the same physical room, or remote locations, contribute in making spatial art together.

An outside observer looking at the participants will see people running around, talking, laughing, looking at each other, or drawing in the air. However, if that observer looks at a computer graphic view of the VR world, they will see participants as avatars, drawing in the air, looking at each other, and having conversations about the art they are creating together. Holojam was designed to be a highly social experience for participants. Participants can talk to, observe, and physically interact with one another in the space. More participants provide more activity to observe. [34]



Fig. 3. Holojam Immersive Experience. Two separate images compare what outside people observe to what participating users see in the shared virtual space.

Holojam can be seen as an opportune prototype for Spatial Storytelling because it favors believability to realism, and to ensure this, it does the following: one, transports physical objects into the ambient virtual space to create familiarity, or grant some spatial literacy; two, requires participation; three, that this participation is not limited to the virtual environment but is social too, meaning, interaction with other users; four, these multi-user interactions are used for collaborative activity; and five, the activity takes place in a shared virtual space allowing remote users to congregate. Through a shared (social) activity performed in space (spatial practice) participants create unique narratives that they can reflect back on. A study [69] reports that user testimonies claimed “disconnection” from the real-world and a strong sense of presence inside Holojam.

4 Conclusions

In conclusion, this paper notes that Spatial Storytelling presents promising theoretical interstices, which can help in the development of a more cohesive models for immersion and presence. It creates an opportunity for technicians, designers, narrators

and theorists to contribute inside a diverse team. It identifies some immediate research directions for pushing forward interdisciplinary research on immersion, such as:

- conducting comparative QoE evaluations for immersive experiences using system-based immersion against immersive media that involve multiple immersions, in specific, narrative immersion and storytelling.
- assessing narrative content-generation and manipulation as an influence factor in Quality of Experience (QoE) evaluations;
- achieving presence through enhanced spatial literacy in participatory situated immersive media;
- comparing ease-of-use in mixed-reality and virtual-reality applications through the benchmark of spatial practice.

With the burgeoning growth of immersive media products, dominated by gaming apps, providing entertainment material for a content-craving consumer market. It is imperative that the excitement doesn't deflate like it did in the early 90's following similar anticipation. A cautious course should be approaching content with similar vigor as that shown to technology development. New media applications offer an exciting new paradigm that requires to be explored in its own right. Passive content that shows little consideration to the interactivity of the media run the risk of undermining its potential. Spatial Storytelling provides that agency to the user inside immersive media through required attention to content generation and manipulation done in a meaningful way resonating believable narrative behavior of our daily lives.

5 References

1. BBC Sports page, <https://www.bbc.com/sport/football/44305845>, last accessed 2018/07/01
2. Stuff Magazine, <https://www.stuff.tv/app-reviews/bbc-sport-vr-fifa-world-cup/review>, last accessed 2018/07/01.
3. Mattern, Shannon. "Interfacing urban intelligence.": Code & the City. 1st edn. Routledge, UK (2016): 49-60.
4. Lodi, Simona. "Spatial narratives in art." *Augmented Reality Art*. Springer, Cham (2014): 277-294.
5. Mattern, Shannon. "Deep time of media infrastructure." In *52nd Annual Society for Cinema and Media Studies Conference*, pp. 21-25. Boston (2012).
6. Mantei, Marilyn M., Ronald M. Baecker, Abigail J. Sellen, William AS Buxton, Thomas Milligan, and Barry Wellman. "Experiences in the use of a media space." In *Proceedings of the SIGCHI conference on Human factors in computing systems*, pp. 203-208. ACM, New Orleans (1991).
7. Pausch, Randy, Dennis Proffitt, and George Williams. "Quantifying immersion in virtual reality." In *Proceedings of the 24th annual conference on Computer graphics and interactive techniques*, pp. 13-18. ACM Press/Addison-Wesley Publishing Co., LA (1997).
8. Burdea Grigore, C., and P. Coiffet. *Virtual reality technology*. Wiley-Interscience, London (1994).

9. Spagnolli, Anna, and Luciano Gamberini. "Immersion/Emersion: Presence in hybrid environments." In *Proceedings of Presence 2002: 5th Annual International Workshop*. Porto, Portugal (2002).
10. Bowman, Doug A., and Ryan P. McMahan. "Virtual reality: how much immersion is enough?." *Computer* 40(7), 36-43 (2007).
11. Hartmann, Tilo, Werner Wirth, Peter Vorderer, Christoph Klimmt, Holger Schramm, and Saskia Böcking. "Spatial presence theory: State of the art and challenges ahead." In *Immersed in Media*, pp. 115-135. Springer, Cham (2015).
12. Biocca, Frank. "Lighting a path while immersed in presence: A wayward introduction." In *Immersed in Media*, pp. 1-9. Springer, Cham (2015).
13. Lombard, Matthew, and Matthew T. Jones. "Defining presence." In *Immersed in Media*, pp. 13-34. Springer, Cham (2015).
14. Slater, Mel. "A note on presence terminology." *Presence Connect* 3(3), 1-5 (2003).
15. Mestre, Daniel, Philippe Fuchs, A. Berthoz, and J. L. Vercher. "Immersion et présence." *Le traité de la réalité virtuelle*. 1st Volume. Ecole des Mines de Paris, Paris (2006): 309-38.
16. Morie, Jacquelyn Ford. "Ontological implications of Being in immersive virtual environments." In: *The Engineering Reality of Virtual Reality 2008*, pp. 680-688. SPIE Vol.6804, USA (2008).
17. Slater, Mel, and Sylvia Wilbur. "A framework for immersive virtual environments (FIVE): Speculations on the role of presence in virtual environments." *Presence: Teleoperators & Virtual Environments* 6 (6), 603-616 (1997).
18. Witmer, Bob G., and Michael J. Singer. "Measuring presence in virtual environments: A presence questionnaire." *Presence* 7(3), 225-240 (1998).
19. Steuer, Jonathan. "Defining virtual reality: Dimensions determining telepresence." *Journal of communication* 42(4), 73-93 (1992).
20. Werner Wirth, Tilo Hartmann, Saskia Böcking, Peter Vorderer, Christoph Klimmt, Holger Schramm, Timo Saari et al. "A process model of the formation of spatial presence experiences." *Media psychology* 9(3), 493-525 (2007).
21. Biocca, Frank. "The cyborg's dilemma: Progressive embodiment in virtual environments." *Journal of computer-mediated communication* 3(2), (1997).
22. Zeltzer, David. "Autonomy, interaction, and presence." *Presence: Teleoperators & Virtual Environments* 1(1), 127-132 (1992).
23. Le Callet, Patrick, Sebastian Möller, and Andrew Perks. "Qualinet White Paper on Definitions of Quality of Experience (2012). European Network on Quality of Experience in Multimedia Systems and Services (COST Action IC 1003). Version 1.2." Mar-2013 (2013).
24. Coyne, Richard. "Heidegger and virtual reality: the implications of Heidegger's thinking for computer representations." *Leonardo* 27(1), 65-73 (1994).
25. Davies, Char, and John Harrison. "Osmose: towards broadening the aesthetics of virtual reality." *ACM SIGGRAPH Computer Graphics* 30(4), 25-28 (1996).
26. Vanderbilt, Tom. "These Tricks Make Virtual Reality Feel Real." *Nautilus* 32 (2016), <http://nautil.us/issue/32/space/these-tricks-make-virtual-reality-feel-real>, last accessed 2018/06/28.
27. McMahan, Alison. "Immersion, engagement and presence.": *The Video Game Theory Reader*. 1st edn. Routledge, NY (2003): 67-85.
28. Davies, Char. "Osmose: Notes on being in immersive virtual space." *Digital Creativity* 9(2), 65-74 (1998).
29. McLellan, Hilary. "Virtual realities." *Handbook of Research for Educational Communications and Technology*. 4th edn. Springer, London (1996): 457-487.

30. Morie, Jacquelyn Ford. "Performing in (virtual) spaces: Embodiment and being in virtual environments." *International Journal of Performance Arts and Digital Media* 3(2-3), 123-138 (2007).
31. Qvortrup, Lars. "Introduction—Welcome into the Interface." *Virtual Interaction: Interaction in Virtual Inhabited 3D Worlds*. Springer, London (2001): 1-18.
32. Nilsson, Niels Christian, Rolf Nordahl, and Stefania Serafin. "Immersion revisited: A review of existing definitions of immersion and their relation to different theories of presence." *Human Technology* 12(2), 108-134 (2016).
33. Harding, Tobias. "Immersion revisited: role-playing as interpretation and narrative." In *Knudepunkt 07*, pp. 25-33. Dansk Ungdoms Fællesråd, Copenhagen (2007).
34. Perlin, Ken. "Future Reality: How emerging technologies will change language itself." *IEEE Computer Graphics and Applications* 36(3), 84-89 (2016).
35. De la Peña, Nonny, Peggy Weil, Joan Llobera, Elias Giannopoulos, Ausiàs Pomés, Bernhard Spanlang, Doron Friedman, Maria V. Sanchez-Vives, and Mel Slater. "Immersive journalism: immersive virtual reality for the first-person experience of news." *Presence: Teleoperators and virtual environments* 19(4), 291-301 (2010).
36. Upload VR Gaming page, <https://uploadvr.com/exclusive-preview-loading-human>, last accessed 2018/06/30.
37. The Symbiosis of Narrative and Immersion in Virtual Reality, <http://www.newinc.org/news-posts/synergizing-virtual-reality-narrative>, last accessed 2018/07/02.
38. Klimmt, Christoph, Christian Roth, Ivar Vermeulen, Peter Vorderer, and Franziska Susanne Roth. "Forecasting the Experience of Future Entertainment Technology: "Interactive Storytelling" and Media Enjoyment." *Games and Culture* 7(3), 187-208 (2012).
39. Crawford, Chris. *Chris Crawford on Interactive Storytelling*. 2nd edn. New Riders, Indianapolis (2012).
40. Meyer, Sylke Rene. "Right, Left, High, Low Narrative Strategies for Non-linear Storytelling." In *International Conference on Interactive Digital Storytelling*, pp. 325-335. Springer, Cham (2016).
41. Murray, Janet Horowitz, and Janet H. Murray. *Hamlet on the holodeck: The future of narrative in cyberspace*. The Free Press, NY (1997).
42. Koenitz, Hartmut, Gabriele Ferri, Mads Haahr, Diğdem Sezen, and Tonguc Ibrahim Sezen, eds. *Interactive Digital Narrative: History, Theory and Practice*. 1st edn. Routledge, NY (2015).
43. Adams, Ernest. *Fundamentals of Game Design*. 3rd edn. New Riders, Indianapolis (2014).
44. Ermi, Laura, and Frans Mäyrä. "Fundamental components of the gameplay experience: Analysing immersion." *Worlds in play: International perspectives on digital games research* 37(2), 37-53 (2005).
45. Ryan, Marie-Laure. "Narrative as virtual reality." *Narrative as Virtual Reality: Immersion and Interactivity in Literature and Electronic Media*. 1st edn. John Hopkins University Press, Baltimore MD (2001).
46. Ryan, Marie-Laure. "Interactive narrative, plot types, and interpersonal relations." In *Joint International Conference on Interactive Digital Storytelling*, pp. 6-13. Springer, Berlin (2008).
47. Schubert, Thomas, Frank Friedmann, and Holger Regenbrecht. "Embodied presence in virtual environments." In *Visual representations and interpretations*, pp. 269-278. Springer, London (1999).
48. Schubert, Thomas W. "A new conception of spatial presence: Once again, with feeling." *Communication Theory* 19(2), 161-187 (2009).
49. Ryan, Marie-Laure. "Narrative modes in old and new media." *Avatars of story*. 1st edn. University of Minnesota Press, Minneapolis (2006).

50. Solso, Robert L., and Judith E. McCARTHY. "Prototype formation of faces: A case of pseudo-memory." *British Journal of Psychology* 72(4), 499-503 (1981).
51. The Symbiosis of Narrative and Immersion in Virtual Reality, <http://www.newinc.org/news-posts/synergizing-virtual-reality-narrative>, last accessed 2018/07/02.
52. Eglinton, Andrew. "Reflections on a Decade of Punchdrunk Theatre." *TheatreForum* 37, *Questia Online*: 46 (2010).
53. Jenkins, Henry. "Game design as narrative architecture." *First Person: New Media as Story, Performance and Game*. 1st edn. MIT Press, Cambridge MA (2004): 118-130.
54. Upload VR Gaming page, <https://uploadvr.com/exclusive-preview-loading-human>, last accessed 2018/06/30.
55. IDNA page, <https://www.metalocus.es/en/news/idna-%E2%80%93-spatial-storytelling>, last accessed 2018/07/03
56. Rakatansky, Mark. "Spatial narratives." *Strategies in architectural thinking*. 1st edn. MIT Press, Cambridge MA (1992): 198-221.
57. Gilded age plains city page, <http://gildedage.unl.edu/narrative/topics.php?q=theory#refn01> last accessed 2018/07/06.
58. Lefebvre, Henri, and Donald Nicholson-Smith. *The Production of Space*. Basil Blackwell, Oxford (1991).
59. Certeau, Michel de. *The Practice of Everyday Life*. 2nd edn. University of California Press, Berkeley (1984).
60. University of Texas Spatial Theory Homepage, <https://sites.utexas.edu/religion-theory/bibliographical-resources/spatial-theory/overview>, last accessed 2018/07/07.
61. Soja, Edward W. *Postmodern geographies: The reassertion of space in critical social theory*. Verso, London (1989).
62. Ryan, Marie-Laure, Kenneth Foote, and Maoz Azaryahu. *Narrating Space/Spatializing narrative: Where narrative theory and geography meet*. The Ohio State University Press, Ohio (2016).
63. Foucault, Michel, and Jay Miskowiec. "Of Other Spaces." *Diacritics* 16(1), 22-27 (1986).
64. Neuhaus, Fabian. "Body Space and Spatial Narrative." In *Emergent Spatio-temporal Dimensions of the City*, pp. 37-54. Springer, Cham (2015).
65. Coyne, Richard. "Thinking through virtual reality: Place, non-place and situated cognition." *Techné: Research in Philosophy and Technology* 10(3), 26-38 (2007).
66. Dunn, Stuart. "Space as an Artefact: A Perspective on 'Neogeography' from the Digital Humanities." *Digital Research in the Study of Classical Antiquity*. 1st edn. Ashgate, Burlington VT (2010): 53-72.
67. Drucker, Johanna. "Humanities Approaches to Graphical Display." *Digital Humanities Quarterly* 5(1), 1-21 (2011).
68. Gibson, James. "The Theory of Affordances." *Perceiving, Acting, and Knowing: Toward an Ecological Psychology*. 1st edn. University of Michigan, Michigan (1977): 67-82.
69. Velho, Luiz, Djalma Lucio, and Leo Carvalho. "Situating Participatory Virtual Reality." In *Proceedings of XVI Simposio Brasileiro de Jogos e Entretenimento Digital*. Curitiba, Brazil (2017).