How Close Are We to the Holodeck?

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In 1997 I used Shakespeare's most revered play and a Star Trek's fanciful holographic entertainment environment as cultural reference points for thinking about the convergence of profoundly meaningful storytelling and powerfully immersive computation. *Hamlet on the Holodeck: The Future of Narrative in Cyberspace* (Murray 1997, Murray 2016) asked whether we could expect to see digital storytelling reach the level of human expressivity that we recognize and collectively reverence in Shakespeare's *Hamlet*. The title was meant to challenge the perceived disjunction between high culture and digital media and to provide a conceptual framework for thinking about how new narrative platforms and genres might evolve over a long period of time. I did so in part by examining specific late 20th century artifacts that seemed to show the direction of innovation for the coming medium. Two decades later, the assumptions and predictions of the book have been validated, and a new set of artifacts are available for considering how close we are to the appearance of a cyberbard.

The holodeck has proven to be a useful cultural touchstone. It was conceptualized by Gene Rodenberry as part of his transmedia Star Trek world, appearing first in a 1974 animated series, and becoming a major part of the 1987 relaunch of the franchise, with the *Star Trek: The Next Generation* TV series. The idea for a room filled with illusory three dimensional, seemingly material beings and objects was based on the technological speculations of Gene Dolgoff, the inventor of the digital projector. Dolgoff was inspired to work with holography in the 1960s because he saw 3D light projections as "the ultimate way of reproducing reality" (Dolgoff 2016). In 1973 he spent a day showing Rodenberry holograms and arguing that a vision of the future should include "a room … where people could be transported – not really transported – but believe they were in a new place. " It was Rodenberry who came up with the name and established the story patterns for how holograms would

entertain, serve, and menace the crew of the Enterprise through multiple *Star Trek* series. The conceit was so compelling that by the turn of the 21st century the holodeck was routinely referred to as the "holy grail" of artificial intelligence researchers and game designers:

> Richard Lindheim (Television Producer and then Director of USC's Institute for Creative Technology) "The ICT is on a quest to envision and prepare for the future', and, says Lindheim, 'Our Holy Grail is the Holodeck'." Quoted p.71 in (Derian 2002)
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> Gamasutra 2003: "If placing your body in a fully-immersive virtual world is the game developer's ultimate goal, then the holodeck is the holy grail." (Graft 2013)

And with the arrival of consumer VR devices in 2015, PC Games Magazine announced the sacred quest was at an end: "The holodeck is here." (Edwards 2015). Such claims overlook the many still magical technologies implicit in Rodenberry's imaginary invention, which assumes spontaneously responding characters in a palpable world of solid objects. The holodeck as metaphorical holy grail is not so much a technical goal, as an aesthetic one: the pursuit of deep immersion combined with powerful interactivity. In fact the impossibility of actually creating Roddenberry's imaginary environment may be part of its appeal. Just as Dolgoff dreamed of "reproducing reality," the audience for the Star Trek holodeck is seduced by the prospect of a fantasy life so detailed and concrete that it substitutes for the real world.

The years since *Hamlet on the Holodeck* was first published have confirmed my predictions of a sustained collective effort of narrative invention, drawing on diverse communities of practice. There is a rich tradition of narrative videogames, both mass market and independent, engaging diverse player communities. At the same time, traditional narrative forms like television and live theater, have embraced game structures, creating worlds that invite multiple forms of interactivity. Computer science explorations of artificial intelligence in storytelling, which formed a key part of the argument of *Hamlet on the Holodeck,* have expanded.

And most recently, virtual reality devices have come onto the consumer market, receiving considerable attention and corporate funding, and creating a lively new community of practice. This essay looks at some representative examples from these diverse traditions in the light of the question posed in 1997 and still open to exploration: Are we moving toward an expressive interactive digital form of storytelling that can someday provide the kind of deep vision of what it means to be a human being that we cherish in great art in traditional forms?

This is a different question from the technical issues of whether we yet have holographic characters we can talk to and holographic chairs we can sit on, as portrayed in the *Star Trek* episodes. In fact, I would argue that concern with reproducing the real world, Dolgoff's target, is often an obstacle to creating belief in a fictional world that we can interact with. The importance of designing virtual characters with a few exaggerated qualities that create belief (a large duck bill) rather than with the detail of literal reproduction (every feather in a duck's wing) is a well-known insight of AI researcher Joseph Bates, one of the early pioneers of computational narrative (Bates 1992) (Bates 1994) who was in turn influenced by the great Hollywood animators (Johnston and Thomas 1981, 1995), but it is a lesson that has to be learned over and over again.

In fact, the confusion between the real and the imaginary world is one of the recurring themes of holodeck plotlines on *Star Trek: The Next Generation* and *Star Trek: Voyager*. In its positive form it is a wish-fulfillment dream of a world of immediate gratification in which the things that we imagine are effortlessly realized for us to enjoy – we talk with Leonardo da Vinci or get to play Sherlock Holmes in a simulated London. But the other side of the holodeck fantasy is the fear of an inescapable fantasy. *Star Trek* plots offers multiple versions of this nightmare. A real person may be trapped in a simulated world and unable to escape back to reality, or fantasy villains may escape and wreak irreversible harm to real flesh and blood. Sometimes, the horror derives from our vulnerability to deception, the ease with

which we could mistake a simulated reality for the actual world, or our temptation to preserve the fantasy at the expense of real life.

Commercial claims for Virtual Reality platforms play on both the longing and the fear. They promise to transport us to beautiful alternate worlds where we can soar like an eagle or pilot a spaceship, and they scare us by threatening an invasion of horror movie monsters in our familiar spaces, literally in our faces. And the thrill of the holodeck immersion is also invoked by contemporary analog experimentations such as new forms of theater that obliterate the distance between audience and actors.

Looking at some ambitious projects, virtual and physical, that aim at creating the experience of inhabiting an alternate space and sharing it with fictional characters, we can gauge our distance from the "holy grail" of the holodeck aesthetic experiences and identify the strategies that support or undermine more interactive and immersive storytelling. We can also test the assumption that digital technologies can "reproduce reality" and create an experience that is indistinguishable from being there.

The Gunslinger Project of USC ICT

As we saw in Lindheim's comment above, the *Star Trek* holodeck was identified early on as the "holy grail" for researchers at USC's Institute for Creative Technologies, which works at the intersection of computer science, military simulation, and Hollywood entertainment. The Gunslinger project (see https://www.youtube.com/watch?v=OsXyCjKbzu8), which I visited in February 2011, involves a physical mock-up of a western-movie-style saloon fitted with large-screen displays of computer-generated characters who respond to gestures and speech. You are given a cowboy hat fitted with electronic tracking equipment and a holster and six gun that functions like the ones in a videogame arcade. Having grown

up avidly watching old Hollywood western movies and the many cowboy shows of the 1950s and 1960s, I was as eager to step into the world of my childhood fantasies, as *Star Trek's* Captain Janeway was to enter her Victorian governess holodeck fantasy world. The details of the set, starting with the swinging saloon doors through which you enter the make-believe world, were well chosen to script the interactor with genre-based story expectations.

But as a narratively motivated interactor on the Gunslinger set, I could not engage in meaningful interactions to put these story expectations into effect. For example, if I thought of looking for an ace up the sleeve of one the poker players – a common trope of western saloon poker games – there was no way to induce one of the virtual characters to do it, and the characters themselves were out of reach as screen-based characters rather than 3D projections. With less ambitious natural language processing they might have turned to me and asked a simple question that furthered the plot. For example, one character might have asked me if I thought the other was cheating, But the interaction design lagged behind the charm of the set design and the computational virtuosity of the back-end language processing. The lack of a cues for meaningful interaction – a reason to say something in particular to the poker players or the barman and to receive a particular, dramatically satisfying response within a clear dramatic scenario-- made the life-size, speech-generating characters less present.

I have described the touchstone of design in interactive narrative as "dramatic agency" which I define like this:

> The experience of **agency** within a procedural and participatory environment that makes use of compelling story elements, such as an adventure game or a interactive narrative. To create dramatic agency the designer must create transparent interaction conventions (like clicking on the image of a garment to put it on the player's avatar) and map them onto actions which suggest rich story possibilities (like donning a magic cloak and suddenly becoming invisible) within clear stories with dramatically focused episodes (such as, an opportunity to spy on enemy conspirators in a fantasy role playing game). (Murray 2011)

The gunfight portion of the installation produced an appropriately story-motivated action based on the genre: a clearly defined action mapped to a physical object -- drawing the six gun from the iconic western holster and shooting the bad guy before he could draw and shoot at you -- leading to highly readable results in the form of projected blood splatter on the screen that separated me from the virtual character.

In fact, I used a similar arcade experience as a key example in 1997, describing the self-consciousness I felt when my children witnessed me raptly shooting at Mad Dog McCree, despite having banned guns from our own house. I posited a kind of game that has since been realized by members of the mainstream and indie games community, in which you are asked to perform acts that may feel fine at the time but become morally uncomfortable as the consequences are revealed. In the Gunslinger set up I felt self-conscious, but it was from the failure of the fantasy to engage my belief. Like the actors in *Rosencrantz and Guildenstern Are Dead (Stoppard 1968),* who are shamed to find out that their audience has slipped away and they have been acting into the void, I felt exposed in my cowboy hat and holster by my inability to find a place in the desired but incompletely realized make-believe world.

When computer scientists concentrate on backend artificial intelligence to understand natural language, they are on Dolgoff's quest of *Reproducing Reality,* which is different from Joe Bates' and Disney's goal of believability, which we might call *Representing Stories.* Mass market games like *Grand Theft Auto* or *World of Warcraft* provide a palette for representing story elements as simple interactive game mechanics by drawing on formulaic elements of genre fiction like gangster movies and fantasy quests.

The creation of spaces that reflect strong genre storytelling traditions (a western saloon, a haunted house, a tavern in a quest fantasy world) go a long way toward creating immersion by motivating the interactor to take actions to elicit plot events

associated with the genre. For VR designers the ability to create immersive theatrical spaces for an interactor to walk through presents an opportunity to seed the physical space with well-chosen props that invite exploration and whose manipulation will somehow advance the story. A good model for this is the mechanic of items in an adventure game which appear at specific places throughout a game world and which are available for inspection or acquisition, usually with some trade-off in resources like time, cost, capacity for carrying, or risk of physical danger. Interactive objects should invite engagement, suggesting outcomes that leverage the genre expectations of the interactor. A murder scene should be full of clues, a haunted house full of dark places to explore and doors that may lead to spooky encounters. Engagement with these abstract representations of the story elements should be appropriately rewarded – in ways that are dramatically appropriate though not overly predictable, leading to the experience of the "active creation of belief" in which immersion in a detailed, consistent digital environment leads to the desire to interact, which, when it provides the experience of dramatic agency, increases the sense of immersion creating a reinforcing cycle of deepening involvement (Murray 2011) (Murray 1997, Murray 2016). But such an experience of enhanced belief does not come automatically from putting on a VR headset, or from the designer's photographing the actual world in 360° degree fidelity. Like all deep narrative engagement effects, it is the result of deploying carefully crafted medium-specific conventions of representation.

Punchdrunk Promenade Theatre

Sharing space with virtual characters calls for new conventions of story representation, and new ways of sustaining our belief in the imaginary world. When multiple interactors cohabit a virtual space, there is a possibility of creating an experience that I call the "collective creation of belief" in which other people's enacted or expressed belief in a shared fantasy environment reinforces one's own immersion (see chapter 4 in (Murray 1997, Murray 2016)). This is what happens

when children play "make believe" together and when fans of *Lost* speculate on the secrets of that purposely puzzling TV's show's magic island. But the presence of other people can just as easily disrupt the illusion, as when we see people in present-day dress in an historical theme park, making us feel embarrassed for the play-acting informants pretending to inhabit another century.

This is a design problem that has been explored in live performance environments. For example, the Punchdrunk theater (http://punchdrunk.com/) has been successfully mounting productions in London and New York with sustained runs that invite theatergoers to wander around multiple stage sets in a multi-floor performance space arranged to represent places within a fictional world. *Sleep No More* (2011–16) turns an abandoned New York hotel into Macbeth's castle (see http://sleepnomore.com), and the London production of *The Drowned Man* (2013) (see trailer: https://www.youtube.com/watch?v=DZKNNMombV8) turns a cavernous former postal sorting station into an abandoned movie studio. The plays are called "promenade theater " because the audience members follow actors from one fictional location to another, or sometimes just poke around examining the elaborately dressed actorless sets. Scenes are performed simultaneously, making for many choice points and for considerable divergence in the experience of individual theatergoers. Comparing experiences after the performance is a particularly pleasurable part of the experience, making theatergoers aware of the depth and variety with which the storyworld has been instantiated. As with the *Lost* viewers on the internet, the attempt to make sense of disjointed experience can serve as an intensification of the immersion, an after-the-fact exercise in the collective creation of belief.

During the experience, the physical space creates a sense of enclosure in another world, as in a visit to a well-designed theme park that covers a lot of space and obstructs the view outside the boundaries. The Punchdrunk productions include detailed set designs that suggest the interactive spaces of mystery-themed adventure games in which objects are meant to be examined and evaluated as

potential solutions to game puzzles, often involving revelations of backstory. These spaces encourage solitary exploration which sometimes leads to sexually titillating encounters that play with the separation between audience and player.

We can think of the Punchdrunk productions as a kind of holodeck experience, then, in real space, but with limited ability to interact. Audience members can examine documents and props and move around spontaneously according to their own curiosity. This provides a novel sense of being inside the fictional world. At the same time they are kept behind the fourth wall with a strategy discussed in Chapter 4 of *Hamlet on the Holodeck* – the wearing of a mask. The audience members wear identical, neutral, but highly theatrical looking masks that hide emotional reactions, inhibit action within the fictional world, and direct attention away from fellow viewers and toward the performers. The masks also provide a kind of mythic gravitas to the actions portrayed.

The Punchdrunk plays are related to experiences I instanced in 1997 as harbingers of immersive, interactive genres: dinner and weekend resort experiences in which actors mix with audience members who are cast in the role of vacationers or wedding guests at an event that turns dramatic through a murder or comic family quarrels. Usually the audience members are observers, but they can be participants in the ritualized elements of the event such as dancing at the wedding. In some variations, which are closer to live action role playing, the participants may share a meal, in which each is given a pre-scripted role and scene-by-scene cues for revealing plot points or furthering individual aims. In all of these formats, there is a tension between the role of observer and participant, scripting and improvising.

Professional immersive live theater takes these strategies to the next level, illustrating the power of detailed set design and the efficacy of audience masks to create and reward dramatic expectations and to avoid disruption by establishing a fourth wall within a 3D space. Here, the range of activity is limited to navigating the fictional space and choosing which characters to follow. In more closely scripted

interactive stories, the choice of whom to follow could be dramatically significant and provide a strong experience of dramatic agency. In my experience of the *Drowning Man,* the plot was never made clear enough to motivate me to move one way or another. *Sleep No More* is more successful, by all accounts, because it is based on the familiar, highly melodramatic story of *Macbeth,* and produced in a more compressed space leaving less room for the audience to wander in limbo between significant scenes. Both plays rely more on expressive dance vignettes than on spoken dialog, and they succeed as elaborate dramatic spectacles rather than as coherent presentations of character and plot, as in a traditional play or a more story-driven interactive fiction. VR may turn out to foster similar experiences in which the pleasure desires from wandering around a spectacular space, or even sitting in a rich 360 degree soundscape, perhaps seeing oneself and others reflected in costume and maybe a few ritual gestures as in the inventive videogame *Journey*. The confusion of such an environment may be a feature rather than a bug, creating the experience that play theorist Roger Callois called Ilinx (dizziness as from a whirlpool) by enclosing the interactor within a highly evocative spectacle where disorientation and lack of control is experienced as a pleasurable escape from the mundane world.

Henry the Hedgehog (Oculus Story Studio)

When Saschka Unseld, became head of Oculus Story Studio, he brought to high production budget VR projects a set of storytelling techniques from traditional filmmaking, but he soon discovered that they did not work. He set out to make a comedy about a Hedgehog who could not hug people because he was so prickly, but he was surprised to note that mishaps he expected to work as comedy seemed oddly sad in VR. Unseld attributes this to the absence of the fourth wall that tells you in a movie that what is happening on the screen is not real. Unseld offers the insight that to have a close-up view of a character who is about to cry feels “uncomfortable” in VR, so pathos has to be staged at a distance to leave the VR viewer free to empathize without being confused by a need to respond (Unseld 2015). Unseld’s observations reflect the wider process by which filmmakers are discovering that storytelling in

virtual reality requires more than adding another spatial dimension to the same narrative structures.

In the case of *Henry the Hedgehog*, which I viewed at an Oculus lab in San Francisco, the interactor sits on a rug that puts you on the verge of action in the fanciful home of the main character. The space seems continuous with your position and you can turn around and see things behind you. This responsiveness of presentation rewards your head movement, which reinforces the sense of actually being there in a physical sense. The scene in front of you has height and depth and some cartoon characters fly around it, motivating more head movement. There are a few moments in which Henry looks at the interactor to acknowledge their presence. But dramatically we are kept at a distance by the lack of interactivity. You cannot have a piece of the birthday cake that is being eaten so close to you, of course, but neither can you get up and walk around in the richly detailed and therefore enticing space. As Unseld found out when the jokes fell flat and the pathos became uncomfortable, the situation of ambiguous presence is a poor fit for the dramatic problem of the film, which is Henry's loneliness, increasing our self-consciousness, and eroding immersion.

Often we can see the future of a medium by attending to our frustrations with the skillful experiments that lead the way by making the necessary mistakes. The frustration I felt in not being able to further examine the enticing detail of the cartoon set suggests some design possibilities that future projects could exploit, such as rewarding closer inspection of details with revelation of secrets. It would also be wise to actively attract attention to the space to the side or behind the interactor by using spatialized sound or the movement of characters as attractors for visual exploration. As interactors stand rather than sit to participate in these spaces, ducking from approaching objects and tip-toeing to see things just beyond eyeline would provide dramatic satisfactions from natural embodied gestures.

Of course, more extensive interactions are possible using the emerging VR platforms

that track walking through the space and, most importantly, using one's hands (with controllers or gesture capture) to manipulate objects. A cartoon environment like Henry's with an elaborately detailed, multi-plane, multi-level, and whimsically enticing story world would be an appropriate framework for manipulable objects that would allow a greater degree of interactivity.

Skammerkrogen (The Doghouse) 2015

Another ambitious approach to scripted events in three dimensions is Skammerkrogen (The Doghouse) made for the Oculus Rift by Danish artists Johan Knattrup Jensen and Mads Damsbo, and presented as a multi-viewer installation art experience in which five people are seated at a physical dinner table, which is set for a family meal. Each player has their own headset and sees the action from their own point of view with the ability to experience 180° freedom of head movement.

Those seated at the table see the same events through different characters point of view. But the physical and represented worlds diverge -- the character moves independently of the viewer including leaving the table for another room, which can induce dizziness. Looking down, the interactor sees the character's body, with the character's hands in their lap or on the table, with no control by the inhabiting viewer. The desired effect, as one of the creators puts it, is to watch a movie but from inside the head of one of the characters, and to be able to look around the movie while it continues. The experiences of the characters are mostly the same, but they diverge in dramatically significant ways that reinforce the theme that the world is composed of many subjective realities rather than just the individual ones we may take for granted. As with the Punchdrunk Theatre presentations, much of the pleasure of the story is in comparing versions afterwards, which the creators consider an intrinsic part of the dramatic experience.

Jensen and Damsbo want the experience to allow the visitor to "jump easily and blithely" from one "perspective and truth" to another, but they found that hard to achieve. Like Unseld, the Doghouse team discovered that the absence of a fourth

wall confused their audience. Watching a film from the head of someone seated at a table while you are physically also seated at a table creates confusions between the actual objects and the virtual representations, so that interactors may try to pick up actual (but empty) wine glasses only to find the headsets in the way. They are cued to act in the virtual space, but the interaction design does not support it (Jensen and Damsbo 2014). The dinner party physical set works well as a provocative art piece for gallery visitors who are not taking part in the installation since they see five people at dinner, not eating or talking to one another, with odd VR headsets on (see figure), but it is less appropriate for the interaction design. This is another good illustration of the fallacy of literally *Reproducing Reality*, instead of creating a stage set for believable storytelling with representational story objects , that afford interaction.

Defining the physical limits of the virtual world is a persistent problem with VR gear, not just for filmmakers who are new to interactivity like the Doghouse team, but even for experienced game designers. For example, there is a bow and arrow in the demo program for the 2016 release of the VIVE headset one of the first to include hand controllers. Interactors particular enjoy a satisfying simulation of a bow and arrow in which both hands are needed and the action is well synchronized, especially in the moment when the bowstring is caught by the notch of the arrow. But the very success of the illusion creates confusion (or it did for more than one tester in my lab) by leading players to position the arrow hand next to their cheek as in real world archery, which then breaks the illusion by making them aware of the hand controller and headset. To make this kind of embodied interaction in virtual space successful, designers will have to create a new gestural language and new set of digital signposts to mark the boundary between physical and the virtual objects.

Setting aside the awkwardness in handling physical point of view, the Doghouse's basic structure of five subjective points of view on the same event is dramatically promising for the new medium. A related and equally promising approach is reported as a focus of exploration of *Blackout* a forthcoming VR project that takes

place on a New York City subway train and allows you to live out the common fantasy of entering the minds of the people around you (see preview at http://www.fastcodesign.com/3053634/blackout-takes-you-inside-the-minds-of-nyc-subway-commuters). The use of VR for exploring multiple points of view, and for "easily and blithely" moving from one perspective to another, as the Doghouse artists wished to achieve, is particularly appealing to me as a path to realizing my most ambitious hopes for the medium – the creation of kaleidoscopic structures (Murray 1997, Murray 2016).

When a technology of representation is first introduced, novelty creates a feeling of magical transportation. This can lead some to claim that VR is an automatic "empathy machine" and others to look to it as a way of jumping into the frame of a cinematic reality and inhabiting another character. But the deeper experience of empathetically participating in other points of view will depend, as it always has, upon the medium-specific craft of storytelling, and specifically upon the pioneering storytellers who will collectively invent a new set of media conventions to create coherent and expressive new interactive genres.

Nonny de la Peña's Immersive Journalism

One such pioneer is Nonny de la Peña whose goal is "immersive journalism," achieved through the painstaking recreation of scenarios drawn from actual events, presented in real time but with skillful dramatic compression. Using documentary audio and recreated 3D images, de la Peña distills politically charged events into actions that are character-based and compelling.

For example, de la Peña's first VR film, "Hunger in LA" presents us with a 3D graphic recreation of a long line for a food bank. We are there as an embodied observer, a witness who can move around in the scene which is realized with actual recorded audio. Like all of de la Peña's work, it is focused on a particular dramatic incident. We are given just enough time to experience impatience with the slow-

moving line, when a man standing near us collapses in a diabetic seizure. We can choose to kneel down next to him as we all wait with him for the ambulance (Peña 2013). De la Peña is journalistically meticulous in her reconstructions but she is not trying to reproduce reality, but to document it through selective representation. She has the journalist's commitment to focusing attention on the salient detail, to finding the story. This elevates her work beyond most other examples of documentary journalism which are content to point a 360° camera at something that has gone largely unseen, and that often use techniques from conventional filmmaking like voice overs and jump cuts to capture information. By contrast de la Peña abstracts reality into a compressed experience that puts the viewer in control of the camera, creating greater verisimilitude with strong dramatic focus.

These representative examples from diverse media traditions reflect a collective effort to invent more immersive and interactive formats for storytelling, to take us closer to something like the active engagement in a responsive storyworld like the fictional Star Trek holodeck. They are all struggling with the boundary between the real and the virtual and with establishing immersion in a medium that lacks clear conventions for a fourth wall. They each offer lessons in what does and does not work in creating satisfying interactivity in virtual environments, lessons that will continue to be built on by a diverse community of storytellers. It is always easier identify the direction of change than to predict the pace of change. Taking the short view, it is hard to predict when we will see VR interactive stories that are likely to outlast the fragile platforms currently on the market. Taking the long view, it seems likely that the promising strategies being explored today will be elaborated on in the coming decades, inventing the conventions of powerfully interactive and immersive virtual worlds, moving us in a dispersed yet collective craft practice step by step closer toward the moment of unmistakable bardic achievement.

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