

Rei Toei lives!:

Hatsune Miku and the Design of the Virtual Pop Star

BY

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THESIS

Submitted as partial fulfillment of the requirements
for the degree of Master of Arts in Communication
in the Graduate College of the
University of Illinois at Chicago, 2013

Chicago, Illinois

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This thesis would still be a virtual experience in my head without the consistent encouragement support of my partner, Daniel, whose stern but loving tone when calling me by an honorific I've not yet earned has pushed me on toward that ultimate goal.

ACKNOWLEDGMENTS

All hail my cool and calm thesis advisor, Steve Jones, ever the font of enlightenment and a refreshingly chill guide through the academic labyrinth. Deep thanks also to my ace thesis committee, Adrienne Massanari and Jason Leigh, for their considerable advice, wisdom, and patience.

Simply landing in the graduate communication program at the Univ. of Illinois-Chicago was one of life's greatest strokes of fortune thus far. Zizi Papacharissi leads a department as intellectually vibrant as her own personality, and the energy crackling through my feisty cohort powered the kind of nurturing, mind-expanding, and fun environment every scholar dreams of. I never would have plugged into it without Kevin Barnhurst's boundless encouragement, and his graceful example of maintaining the strength of one's heart while working out one's head will remain a valuable life lesson.

Additional thanks to the following: all sources contacted for interviews (my research on this topic will continue, so those who didn't get back to me still can!); UCSD professor Tara Knight; Jamie Murnane, for killing an afternoon with Miku and me; all those who kept brave faces while I perfected my elevator explanation of this phenomenon; my mother and her beau, who dutifully sent me newspaper clippings about robots and holograms, some of which were indeed instrumental; and the supportive community that is the annual VisCom conference on visual communication — all my conference experiences since have paled in comparison.

For this writer, background music is essential to reining in my limbic system and achieving something like Csikszentmihalyi's "flow" state, and I simply must acknowledge and thank several such sources that aided in that transition into long and, due to their input, productive stretches of writing: a Spotify user named Keats Handwriting, who created a fantastic playlist titled "Instrumental Music to Work To" that, at completion of this thesis, contains 2,864 tracks of just that; plus the highly recommended web sites Coffitivity (coffitivity.com, streaming ambient recordings of coffee shops and similar environments in which mobile workers like me have gotten used to producing) and especially Focus@Will (focusatwill.com, a superb streaming music service that's basically the Pandora of background music, with actual flow science behind it; see www.focusatwill.com/science/science-primer).

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SUMMARY

Cyberspace is everting, and some of the first digital figures to recolonize physical space are virtual pop stars — non-corporeal characters presented as singular musical performers with the appearance of agency — projected as three-dimensional performance simulations within existing concert venues. In America, these figures thus far have been actualized as resurrections of rappers, from the Tupac “hologram” in 2012 to lifelike new performances by the late Eazy-E and ODB in 2013. In Japan, these actualized figures are primarily stylized animations of characters created around a vocal-synthesis computer application, the most popular being digital software agent Hatsune Miku.

This study examines the creation and design of virtual pop star presentations, determining what theories from visual communication, robotics design, performance studies, and augmented/mixed realities are at play and connecting them within this new phenomenon. Current virtual pop star presentations remain mere simulations of actual holography, though their performances and reception have framed them as such; thus, this study begins with a history of holography and the relation of that technique to the emerging performance technologies, as well as a relational history of previous virtual pop stars, from Alvin & the Chipmunks to Gorillaz. Qualitative interviews with technicians, artists, and executives illustrate designers’ creative motives, theoretical negotiations, and the presentations’ performance outcomes.

Findings indicate that these current virtual pop stars — whether presented as stylized animation in Asia or photo-realistic images in America, each situated on either

SUMMARY (continued)

side of the uncanny valley — are transitional figures, bridging our experience with the normative behavior of human performers (who thus far remain as the characters' digitally translated antecedents) toward a future co-starring more vivid, interactive, and possibly even intrusive digital agents and avatars. The continuing development of digital projection technology in this performance field heralds particular doom for the hegemony of the screen in mediating human-computer interaction. As digital presentations step off a 2D plane and into the 3D world, communication presence is complicated, the very concept of virtuality begins to dissolve, and traditional performative tasks are distributed across a wider network of non-performers.

I. INTRODUCTION

*She's not there
But let me tell you 'bout the way she looked
The way she'd act and the colour of her hair ...
— The Zombies, "She's Not There"*

A. Virtual pop stars

On April 15, 2012, the rapper Tupac Shakur (2Pac) appeared on stage at the Coachella Valley Music and Arts Annual Festival in Indio, Calif. Shirtless but wearing his usual jewelry and Timberland boots, and sporting his signature tattoos, Shakur shouted, “What’s up, Coachella?!” before launching into two of his classic hip-hop singles, “Hail Mary” and “2 of Amerikaz Most Wanted” (Kaufman, 2012). Shakur’s performance, accompanied by a recorded backing track before a crowd of nearly 100,000 (Kaufman, 2012) and sharing the headlining slot by fellow rappers Dr. Dre and Snoop Dogg, was a surprise for most festivalgoers (Goodale, 2012) for many reasons — not least of which was the fact that Shakur had been shot and killed in 1996.

This resurrection was the result of new media technologies replicating a 150-year-old theater illusion. The new, animated Shakur had been created and designed by digital visual effects specialists and implemented at the festival by collaborating production companies. From the point of view of the crowd, the projected two-dimensional animated image appeared to be a three-dimensional person standing between Dr. Dre and Snoop Dogg.

News and video of the “hologram” performance became an Internet sensation immediately following its first presentation (the Coachella festival repeats its programming during the following weekend, and the Shakur illusion was presented a

second time on April 22, 2012). Within 24 hours, the digitally animated figure of Shakur had been christened 2.0Pac¹ and given its own parody Twitter account (@HologramTupac) with more than 3,300 followers (Kaufman, 2012) (today the followers number more than 20,000). The official video of the performance, uploaded to Snoop Dogg's YouTube channel, has been viewed more than 18 million times (westfesttv, 2012) (more than 25 million as of Oct. 1, 2013). The week following the first performance, Shakur's 1998 "Greatest Hits" returned to the Billboard 200 albums chart for the first time since 2000, making a sales gain of 571 percent over the previous week (Caulfield, 2012).

"This is just the beginning," promised Ed Ulbrich, chief creative officer for the company that had designed the display (Smith, 2012). Dr. Dre, whose original idea it was to create the digital performance, began discussing plans to tour the 2.0Pac presentation, as well as using the same technology to resurrect other dead pop stars, including Jimi Hendrix and Marvin Gaye (Smith, 2012), and officials at Mursion Systems, the London company that created the projection technology, voiced hopes in the press to create "hologram" versions of Kurt Cobain, Michael Jackson and Whitney Houston (who had just passed away two months prior to the 2.0Pac premiere), even pairing a digital Elvis Presley with the real Justin Bieber ("Tupac hologram maker: 'I'd like to bring Elvis back to sing alongside Justin Bieber'," 2012). The next month, in May 2012, an animated digital image of the late singer Freddie Mercury appeared for an instant on stage alongside two of his former Queen bandmates at the end of the 10th anniversary

¹ Alas, the precise origin of that nickname has been difficult to suss out of the online mists.

performance of the musical “We Will Rock You” in London’s West End (Conner, 2012b). By summer’s end, the idea of “hologram” resurrections had created enough of a media frenzy that a planned digital re-creation of President Ronald Reagan, to be presented in a separate auditorium during the Republican National Convention in Tampa, Fla., in August 2012, was scrapped “out of concern it would overshadow [Republican presidential nominee] Mitt Romney’s acceptance speech” (Pfeiffer, 2012).

This nationwide flurry of interest and activity in virtual performer simulations fueled my own scholarly interest in the subject, which had been piqued months earlier by a chance outing in my professional work as the pop music critic for the Chicago Sun-Times newspaper. In that capacity, I received a press release dated Oct. 25, 2011, heralding the opportunity to “MEET THE WORLD’S FIRST VIRTUAL POP DIVA.” The promoted event, produced by Live Viewing Japan (a distribution company broadcasting Japanese entertainment products to international audiences), was a simulcast of a concert performance by digital idol singer Hatsune Miku, broadcast live on Nov. 10, 2011, from Sapporo, Japan, to select movie theaters in nine U.S. cities (Charney, 2011). As a pop music critic, one sees and hears a lot of music and performance that is, frankly, not dramatically distinguishable from one to the next, so when a press release comes along citing a performer as “a major national phenomenon,” ascribing numerous markers of popular success (e.g., “the most popular of the Vocaloid Character Series software,” a concert that sold out with remarkable speed) and utilizing tantalizing quotation marks in an attempt to summarize what was clearly an emerging phenomenon (“She’s also played several enthusiastic ‘concerts,’ where she performs on stage projected as a 3D hologram

and backed by a live band”), I was intrigued. I attended the simulcast at the AMC River East 21 movie theater in Chicago, Ill.

I went on a lark, intending to watch a short segment and satisfy a professional curiosity before moving on to a dinner date with friends, but I quickly had to text my regrets to the dinner party. Hatsune Miku in concert was immediately mystifying and enthralling — a challenging but alluring display that confounded much of what I thought I understood about pop music, its performance and consumption. I happened to be carrying with me a novel that, thankfully, contained a generous supply of blank flyleaf pages in the back, which I immediately set about filling with notes about the concert. Admittedly, my final and underlined impression was, “This would make an awesome thesis.”

The broadcast opened with an image of the theater in Sapporo, from a camera in the rear center of the theater. The perspective lined up nearly perfectly on screen with the Chicago movie theater, giving the slight illusion that the slope of the movie theater and its audience continued right into the screen showing the slope of the Sapporo theater half a world away. The Chicago theater was nearly sold out — an audience of mostly young people, diverse of gender and race, plus a handful of older men — and the Sapporo theater was full, each seat holding a silhouetted human figure and each of those bearing a pair of glow sticks, which would be waved aloft at various points throughout the performance. On the stage were two wide, mostly transparent scrims, one perhaps human height and 30 feet long in the center on the surface of the stage and another slightly narrower hanging perhaps 20 feet above the stage. These were the screens on which the

three-dimensional simulation of Hatsune Miku would be projected throughout the concert. On stage, on either side of the bottom screen, were several human musicians.

Hatsune Miku first appeared on the suspended screen, a pixie-like creature drawn without much photorealism, like a Japanese anime character — white skin, doe eyes, bangs and long cerulean pigtails, a kind of schoolgirl outfit with a white sleeveless blouse, black short skirt and a tie matching her hair, seemingly hovering in the darkness. She sang with little musical accompaniment in these first seconds, then vanished in a poof of fairy dust. Other than a few in-the-blink-of-an-eye costume changes, this was the only moment of magical realism depicted in the performance. She reappeared on the screen below (two bright lights, the projection beams, shone from the rear of the stage throughout the performance), where she spent the vast majority of the remainder of the concert. She sang (or, at least, her depiction mimed moving lips synchronous to the music we heard), she danced, she even took one moment to speak directly to the crowd. Our view in Chicago changed via approximately six different camera angles directed from the Sapporo theater, showing different views and close-ups of both Miku and her human support players. The viewing experience was similar to nearly every filmed concert I have witnessed in the last 30-plus years as a fan and a professional critic — except that the star performer was not human.

My scrawled notes include some initial, hasty thoughts and a few research questions:

— “She herself is a mediated form, expressing but not her own communication, she’s a puppet, communicating what others put through her.”

— “They look like they’re trying not to go over that [uncanny valley] bell curve... she’s the only digital creation, the audience is live, more importantly the band is live.”

— “questions of art, is this collective art?”

— “Critical point: aren’t most pop stars today (or always) this programmed anyway? Doing exactly what they’re told to have the maximum emotional and commercial impact?”

— “Can she ever be sad, uncertain, all the things that make for an authentic performer?”

— “Alan Arkin in ‘Grosse Pointe Blank’: ‘that’s a terrible dream (about the Energizer bunny) — that creature has no anima! no soul!’”

So by the time America and I became captivated by the idea and appearance of virtual pop singers via 2.0Pac, the phenomenon already was well established as a major part of Asia’s entertainment industry. The crucial difference is that in Asia the virtual stars are not avatars based on existing human beings; instead, they are crafted software agents — individual “fictional” characters created and digitally rendered in “reality” for the purpose of performance. SeeU in Korea, Luo Tianyi in China, and numerous figures in Japan — including Kaito, Kamui Gakupo, twins Rin Kagamine and Len Kagamine, Megurine Luka and, most notably, Hatsune Miku — are each digitally animated characters who sing and dance via computer software, on television programs and now, thanks to the same technology that presented 2.0Pac, projected as live concert performers in theaters, arenas, even stadiums.



Figure 1: Hatsune Miku (Crypton Future Media)

Hatsune Miku (her name translates as “first sound of the future”) is the biggest star among the digital virtual idols. She was created in 2007 by Japanese company Crypton Future Media as the embodiment of a line of software applications called Vocaloids. Users compose music and write lyrics through the software, which then sings the composition back to them in the guise of Hatsune Miku (see Figure 1). Miku’s Vocaloid voice is the product of an actress, with sampled syllables called up and strung together based on the lyrics input by the user and pitched according to the user’s control. Miku’s versions of the software have sold more than 70,000 copies (Wappler, 2012). The popularity of the series led Crypton to apply Miku’s image to television marketing — as an animated spokesperson. Miku has appeared in commercials for the Toyota Corolla, and early in 2012 she was the face of Google’s promotional blitz for its Chrome web

browser. (For context, in the United States that honor went to Lady Gaga and Justin Bieber.) Digital singles and albums featuring her voice and visual image have topped the music charts in Japan.

But Miku took her boldest step on Aug. 22, 2009, when she performed her first live concert during the Animelo Summer Live event at the Saitama Super Arena, before a crowd of 25,000. Projected with a setup slightly different from 2.0Pac, Miku has performed numerous other concerts throughout Japan, in Singapore, Hong Kong, Taiwan, and, on Sept. 18, 2010 (World, 2010), her first American concert at a Japanese pop festival in San Francisco (Sciortino, 2011). Early in 2012, Miku performed four solo concerts in Tokyo; the shows' 10,000 tickets sold out in a few hours (Meyers, 2012).

In addition to the technological intrigue, there are social and creative phenomena, too: Each song that Miku performs, on record and in concert, is written by fans using the Vocaloid software. There is no Svengali behind her, no cadre of professional songwriters, no Brill Building production house churning out carefully crafted pop songs for a particular market. Instead, fans compose songs — and create animations, and direct short films, and write fan fiction, you name it — and upload them to web sites such as Nico Nico Douga (“Smile Smile Video,” Japan’s YouTube equivalent) and Piapro, the official community center for fans of Crypton’s digital idols. Officials at Crypton then cherry-pick the good stuff, making deals with the creators — many of whom (e.g., a collective called Supercell, a producer named WhiteFlame) have become stars in their own right by virtue of repeated selection — and releasing the music through Crypton’s record label, KarenT (Wappler, 2012). More than 100,000 Hatsune Miku songs and videos have been created, uploaded and shared online.

My notes from the Nov. 10, 2011, Miku concert simulcast also include, “It’s Rei Toei!!” This is likely not the first thesis to cite novelist William Gibson — the man who coined the word “cyberspace” early in the 1980s — as the prescience behind a particularly futuristic cultural artifact, but Miku’s resemblance to one of his characters is striking. Gibson’s 1995 speculative fiction novel *Idoru* introduced Rei Toei, a digital software agent appearing as a human woman (and as a legitimate, fully three-dimensional hologram, not a simulation) both as performer on stage and a celebrity about town. The novel’s plots are driven by the desire of Rez, a famous human pop star, to legally marry Rei Toei. In the process, Gibson defines the concept of a virtual pop star and explores it in detail. The novel’s title, *Idoru*, is a word meaning “idol singer,” a term applied to wildly popular human singers in Japan for decades. One computer-savvy character, Yamazaki, explains how Rei Toei expands the concept: “She is a personality-construct, a congeries of software agents, the creation of information-designers. She is akin to what I believe they call a ‘synthespian,’ in Hollywood” (W. Gibson, 1996, p. 121). Such performers are “software agents — *eigen-heads*, their features algorithmically derived from some human mean of proven popularity” (W. Gibson, 1996, pp. 229-230).² Yamazaki uses poignant quotation marks when he discusses “a ‘live’ performance” by Rei (W. Gibson, 1996, p. 250), and he’s equally ironic in describing her Crypton

² Such a derivation has been realized by another Japanese pop idol group, AKB48 — five young women who in 2011 announced that they’d added a sixth member. Her name was Eguchi Aimi. The new member began appearing in promotional photos. Fans were surprised, excited, then confused, then suspicious. Turns out, she was really a digital collage crafted from the eyes, mouths, noses, etc. of the other five members. The ruse was revealed, but not after media outlets in Japan had fallen for the story, reporting numerous accounts and accolades of this “perfect” new beauty. No word yet on whether she’ll “sing.”

equivalent: “Mr. Kuwayama is Rei Toei’s creator, in a sense. He is the founder and chief executive officer of Famous Aspect, her corporate identity” (W. Gibson, 1996, p. 310).

Rei, however, is several steps beyond today’s virtual idol-singers. She is a complete artificial intelligence, with the ability to engage in conversation and make independent decisions. Rei seeks to break free of her corporate handlers. Miku — thus far — has not achieved such self-realization, much less rebellion.

Gibson, curiously, is not much of a Miku fan. In 2011, he tweeted, “Hatsune Miku doesn’t really rock me. I want higher rez, less anime.” Fans took to the same social media platform to excoriate and harass him. He later followed up with this tweet: “Hatsune Miku is clearly a more complex phenomenon than I initially assumed. Requires further study” (Sciortino, 2011).

This study advances that requirement. I have sought to determine what factors contribute to a successful presentation of a digital entertainer and how these are being negotiated in the design of each aspiring virtual pop star. This study examines the foundational histories of holography and pseudonymous pop music, as well as the development and debut of the world’s biggest virtual pop star thus far, Hatsune Miku. Performing agents are discussed in the context of communication theory, artificial lifeform design, performance studies and augmented reality technology. Interviews with designers of digital performing agents, as well as relevant researchers in related projects and fields, further elucidate the manner in which virtual pop stars herald a new era of human-computer communication, interface and entertainment.

B. Relevance and scope of study

Much of the existing research in visual communication is focused predominately on two-dimensional, fixed media — depictions transferred onto paper or a flat screen, from graphic design to film/video criticism — rather than actual three-dimensional presentations or, in the case of this first round of virtual pop stars, aspiring ones. The literature of virtual reality, across disciplines, addresses it strictly as a constructed environment one enters in order to encounter the virtual by means of electronic headgear, goggles and haptic gloves. But these virtual pop stars exist within a new modality. The technology of digital idols brings the virtual out of the box and into physical reality, requiring nothing to be worn by the user in order to experience the performance. They are a harbinger of the disappearance of the screen, an idea just beginning to appear in the literature of computer-mediated communication. But even studies looking into augmented and mixed realities still concentrate on the effect as experienced via screens. The name Hatsune Miku and the concept of the virtual pop star still have only supporting roles in Western scholarship.

In October 2012, two Hatsune Miku performances in Asia were marketed as a celebration of her fifth birthday. Thus, there are at least five years of the phenomenon to study in Japan. After the 2.0Pac performance in the United States, as mentioned, commercial interest in the creation of new virtual performers was piqued. More significantly, Crypton Future Media, in partnership with Sega, is preparing to launch Hatsune Miku in the United States. An English-language version of her software was unveiled and demonstrated in October 2012 at New York Comic Con.

Virtual pop stars provide an opportunity to bring together theory from communication, cultural criticism and performance studies, uniting several related topics previously examined in isolation. Given the technology looming in the marketplace, the time is right to cross these streams.

Additionally, a virtual pop star performs for two usually distinct audiences. One witnesses the performance as they would any human performer — as passive recipients of the singer's various messages and low-level participants in the spectacle. Another audience engages with the performance on a more intimate level, as active participants in the idol's creative culture, perhaps as a contributor of content or a member of the fan base's online social network. The meaning of the performance is specific to each of these audiences.

Future research of mine will explore the second audience — the direct effects and far-reaching implications of crowd-sourced content and new shades of fandom — but this study looks at these artifacts from the perspective of the first audience. This is a production-focused investigation of the creation, design and development of virtual pop stars specific to aspects of their ability to successfully communicate with a general audience based on theories of live performance, computer-mediated presence, and the context of human-computer communication and screenology.

II. LITERATURE REVIEW

A. Histories, context and connections

1. Dimensions of virtuality

Much of the history of art and entertainment centers on an ongoing effort to raise imagery from flatness and planes into perspective and form — to grasp the two-dimensional depiction, unfasten it from its purgatorial plain and expand it into the same third dimension as its creators. We acclaim writing and painting when it “leaps off” the page or canvas, and we praise artists for “bringing the work to life.” Ancient sculptors first mastered the skill of creating realistic three-dimensional doubles, and Renaissance painters developed the technique of perspective in order to depict a 3D space within a bi-dimensional one. Working by hand, and occasionally skewing that perspective for dramatic effect, these artists were never perfect in their techniques, but their goal was the same: to erase, where possible, any signs of mediation. The idea is to make the interface — the canvas, the photograph paper, the display screen, even audio speakers — transparent, “one that erases itself, so that the user would no longer be aware of confronting a medium, but instead would stand in an immediate relationship to the contents of the medium” (Bolter & Grusin, 1996, p. 318).

Each art form strives for this diverting illusion, and as more temporal, narrative forms developed — the novel, radio, motion pictures, television, video games, virtual reality — each of these employed various strategies to induce that user-content relationship by transporting him or her into a virtual world, a separate place where that

content theoretically existed. Literary techniques in novels, sound effects in early radio dramas, camera point-of-view and editing styles in film, stereo in recorded music, surround-sound home entertainment systems and ever-larger television screens, certainly the cave-like set-ups of virtual reality projection — the goal of each medium is conducive, to transport the listener and/or viewer and declare, as did the announcer boldly at the beginning of the 1950s historical re-enactment television series on CBS bearing this title, “You Are There!” (Horowitz, 1983).

This study looks at an emerging concept of virtual reality technologies from the other side of presence and its theoretical cousin, immersion, within the context of visual communication, intelligence design and performance studies. We’re not going through the looking glass into a virtual wonderland. Instead, the virtual wonders are doing the traveling. 2.0Pac, Hatsune Miku and others want you to stay right where you are. They’re coming out of the box to perform for you, in real time and, ideally, in real space. Virtual pop star presentations are not about transporting viewers into an imaginary or illusory narrative space; they’re about creating digital characters that act within our own reality. Your sense of presence isn’t on the move — theirs is. This particular usage of augmented reality tech seeks to bring the virtual into this reality, to actualize virtual figures within real space, not only lifting the entertainment off the screen but erasing (possibly eliminating) the screen altogether.

This study examines the current state of the technology and the presentations of virtual pop singers, as well as considers its future potential and implications. Both 2.0Pac and Hatsune Miku have been referred to widely in the news media as “holograms.” While this is not accurate, the misuse of the term speaks to both our cultural understanding of

this kind of virtual, projected art form (and one inherently emblematic of futuristic ideals) and the form's ultimate goal for its presentations. As mentioned, like all art forms, the creators seek to lift the presentation from the flat screen and present it within our own three-dimensional world. It's a desire that found its first expression through scientific means in the hologram.

2. A history of holography

Before true holography, artists attempted to raise images from flat surfaces by means of simple optical science. By the 1800s, stereographs were displaying depth in still images — stereo daguerreotypes were exhibited in London in 1851 to enthusiastic reaction — and by the 1950s this binocular technique was adapted into 3D movies, which added movement to the stereoscopic display (Speer, 1989). Stereoscopic techniques, however, fail to depict real three-dimensional space, only its depth (Capucci, 2012). Something like parallax was presented in the lenticular images of the 1960s, but only the development of holography in the 20th century suggested a “last hope for visual and artistic content” (Speer, 1989, p. 304) enveloping all three dimensions — hope that the image could be resurrected from flat surfaces and screens to a new (and possibly more interactive) life in our 3D reality.

As defined by its inventor, Hungarian physicist and Nobel Prize winner Dennis Gabor, holography (Greek, “written in full” (Capucci, 2012, p. 248)) is “the art of freezing a light wave into a photographic plate by means of another (reference) beam, and reviving it by laser or white-light illumination” (Gabor, Kock, & Stroke, 1971, p. 11). A reconstruction of the light waves from the original object, a hologram thus projects the

same size, shape and position of the object, the only difference being that the resulting image is semi-transparent and not always true to color (F. A. Jenkins & White, 1976; Nelson & Horowitz, 1983). Importantly, unlike previous stereoscopic effects — which required adjusted lenses, View Masters, 3D movie glasses, etc. — a hologram’s dimensional effect can be seen without special eyewear (Blanche et al., 2010). Gabor conceived of holography in 1947 and articulated the idea the following year in his article “A New Microscopic Principle” (Gabor, 1948), but at the time no light source existed strong enough to generate the effect; with a mercury-vapor lamp, Gabor himself could only produce a hologram one-millimeter square (Capucci, 2012). Thus, the idea cooled on the back burner, pursued only by a handful of scientists (Yuri Denisyuk’s “wave photographs,” Emmett Leith’s extension of Gabor’s concepts (Johnston, 2008)), until the invention of the Light Amplification by Stimulated Emission of Radiation (LASER) in 1960 by Theodore H. Maiman (Capucci, 2012).

Various forms of holograms evolved swiftly thereafter: transmission holograms, lit from behind, the first kind of holograms to be exhibited in the 1960s; reflection holograms, lit from the front and monochromatic; white light transmission holograms, commonly referred to as rainbow holograms, illuminated with natural light and displaying brilliant color (Benyon, 1982; Johnston, 2008). Just as 3D movies added movement to stereoscopic images, the integral hologram, also called a multiplex hologram or holographic movie, did the same for three-dimensional viewing, allowing for limited animation (Benyon, 1982; Thomsen, 1969). Developments continued across disciplines, with advances from artist Harriet Casdin-Silver, commercial photographic researcher Stephen Benton, optical engineer George W. Stroke, and physicist Lloyd

Cross, all of these in America (Johnston, 2004, 2008), as well as throughout Japan (Kodera, 1992), into the 1970s and '80s. One of the first crossovers between high art and popular culture was Salvador Dali's three-dimensional hologram titled "First Cylindric Chromo-Hologram Portrait of Alice Cooper's Brain" in 1973 (Carlson, 2012). The Museum of Holography was founded in 1976 in New York (Jung, 1989). That same year, Russian scientist Victor Kumar presented the first monochromatic holographic movie, and in 1984 he exhibited some in color (Capucci, 2012; Jung, 1989). As "group after group was seduced by holography" (Johnston, 2006, p. 2), science and art (including those behind the scenes, such as museums seeking to preserve statuary and sculpture (Asmus, Guattari, Lazzarini, Musumeci, & Wuerker, 1973; Dyens, 1989)) were joined by business. In the 1980s, holography was exploited for commercial uses, such as holographic foils on packaging and badges for credit card security (Johnston, 2008).

With each successive wave of wavefront technology, forecasts of holography's success predicted transformative effects, each one "underpinned by implicit confidence in philosophical positivism and faith in technological progressivism" (Johnston, 2005, p. 367). Holography was hailed as accomplishing the artistic goal described earlier, appearing "to graft itself onto conventional photography and to pull it into a third dimension" (Johnston, 2008, p. 223). This close cultural connection to photography was instrumental in remediating the idea of holography to the public. That connection was presented to the public in a stream of press releases issued by the American Institute of Physics touting the development of holography by Leith and others and labeling the technique as "lensless photography" (Johnston, 2008), even though holography, unlike

the more instantaneous and documentarian aspects of photography, requires considerable forethought, planning and manipulation to produce a finished form (Speer, 1989).

At the same time, holography began appearing within commercial and urban environments already saturated with “duplicates, imitations, pretenses, copies, reproductions and the like” and amid an art culture “engulfed ... with a type of art that values and develops the fake, the simulated, inspirations and ‘neo’-isms of all kinds” (Boissonet, 1989, p. 375). Holograms are there, but not there. In his exploration of “the *trompe l’oeil* of all holograms” (Boissonet, 1989, p. 376), Boissonet observes that “one of the principal qualities of holography is the ambiguity between presence and absence” (Boissonet, 1989, p. 375). He goes on:

The presence-absence of the hologram, which essentially is an unsubstantial image, gives it a kinship with hallucination and mirage. ... The figure is always there, even if one cannot touch it; but at the same time, it is never there, because there is no tactile certainty of its presence. Therefore the tension is alternately created and dissolved according to the position of the spectator. ... If the realism of the holographic illusion nevertheless fascinates us, it is less because of its *trompe-l’oeil* quality than because it makes us see that it is something without materiality, something that alternately appears and disappears, projecting us into an imaginary world of auras and beings of ghostly appearance. The holographic image, therefore, produces a dimension other than this third dimension, of which it recreates the illusion (Boissonet, 1989, pp. 376, 378).

We’re well beyond mere Renaissance perspective; now we’re discussing “dimension” in the realm of the spiritual. Art critic Edward Lucie-Smith viewed an exhibit of holograms and declared the images “were disturbingly there but not there. They hovered like ectoplasm” (Lucie-Smith, 1996, p. 57).

Lucie-Smith’s critique, importantly, was titled, “A 3D Triumph for the Future.” In most popular appraisals of holographic science, art, even its commercial applications,

“holography evinced the future” (Johnston, 2008, p. 223). Holography began to carry a “futurist mantle” (Bryson, 1998) and “connote futurity” (Schröter, 2011, p. 31); the first depiction of laser holography in regular cinema was as a special effect in a futuristic science-fiction film, “Logan’s Run” (Schröter, 2011). From there, holograms “became a staple of science fiction plots, alongside time travel, robots, black holes and interplanetary travel” (Johnston, 2008, p. 228). The narrative of the first “Star Wars” film hinged on a message delivered by Princess Leia Organa via holographic projection by the robot R2-D2; a holographic character was featured regularly in the British TV space-comedy series “Red Dwarf”; the American TV series “Star Trek: The Next Generation” (1987-1994) expanded the idea in its “holodeck,” a room in which the starship’s computer could construct holographic characters in virtual environments; its spin-off, “Star Trek: Voyager” (1995-2001), went a step further by bringing holography out of the holodeck and using it to fashion a sentient holographic doctor existing among the human characters (Johnston, 2008). “Star Trek” has trained us well in the communication tech of the real future. The show’s “data pads” appeared later as iPads. Lt. Uhura’s ship-to-shore communicative earpiece showed up as Bluetooth headsets. It’s not too surprising then that virtual pop stars like 2.0Pac and Hatsune Miku appear as efforts to realize, say, Vic Fontaine, the holographic lounge singer inside the holodeck of “Star Trek: Deep Space Nine” — just a little more hip.

This exposure within popular culture did not, interestingly, boost holography’s reception in the public; instead, the concept of holography as a futuristic medium trivialized the form “as kitsch or simply as technical game-playing and thus as something to be rejected” (Zec, 1989, p. 425). Holography historian Sean Johnston observes:

Impact was traded for ubiquity. While science fiction has sustained the early themes of optimism and expansion, popular engagement with real-world holograms has been diffident and fickle. No longer seen as the display medium of the immediate future, the trajectory of the first 50 years of the hologram suggests a cultural evolution distinctly unlike that of the photograph. (Johnston, 2008, p. 228)

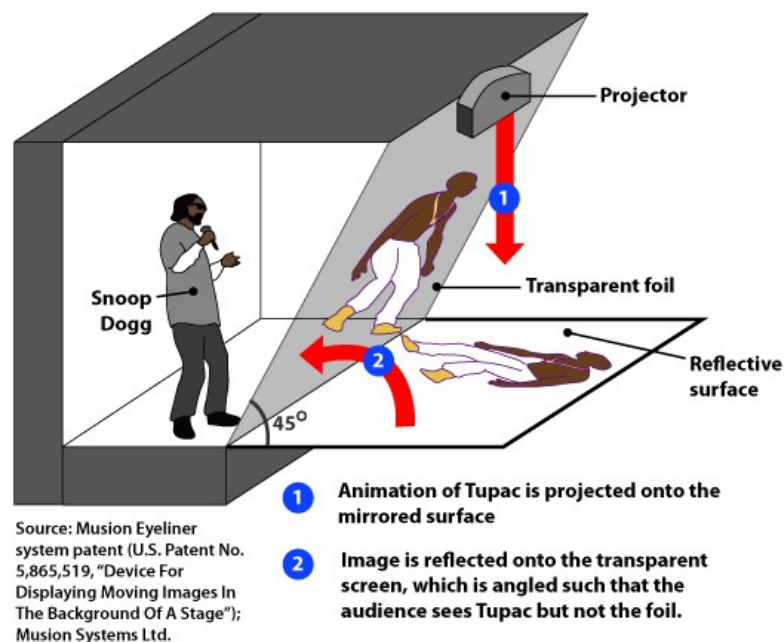
Thus, near the turn of the '90s, scholars began calling for a defined aesthetics of holography (Benyon, 1992) and increased education of “visual literacy” (Speer, 1989, p. 299) in order to raise holography above its base perception as “the sparkling reflective patterns on toothpaste packages, as computer-generated individuals in science-fiction tales, or even more uncritically as any three-dimensional image” (Johnston, 2008).

The ubiquity Johnston describes only muddled the matter. We see “holograms” frequently, but many of these images are not holography at all. Princess Leia was mere movie magic, and the spectral sights inside Disneyland’s Haunted Mansion are simple optical illusions (Overton, 2005). The “hologram” reporter interviews used by CNN on election night 2008 were a technique called digital image fusion, while the latest round of 3D movies and the new lines of 3D televisions employ merely updated forms of old stereoscopic techniques (Blanche et al., 2010). The chief subjects of this study, virtual pop stars like 2.0Pac and Hatsune Miku, are not actual holograms, either. But we read them as holograms, as best we understand holography, and we think of them in terms of the futurism depicted in popular science fiction.

3. Simulated holography and robot actors

Although widely reported in news media as a hologram, the 2.0Pac performance at the Coachella festival utilized an updated version of a 19th-century stage illusion. The

animation of 2.0Pac was created and designed by visual production specialists Digital Domain Media Group Inc. (an Oscar-winning visual effects studio that crafted digital effects for films such as “The Curious Case of Benjamin Button,” “TRON: Legacy,” “X-Men: First Class” and “The Girl with the Dragon Tattoo” (Kaufman, 2012)) and then implemented by AV Concepts (San Diego, Calif.) using a system designed by Musion Systems (London). Musion’s system, called Eyeliner, projected the Digital Domain creation from above onto a transparent screen on the stage (Palmer, 2012). The resulting animated image appears to exist on the stage, in this case standing next to two other performers, the rappers Dr. Dre and Snoop Dogg (see Figure 2A).



Graphic by Roxanne Palmer for the International Business Times

Figure 2A: Design of the 2.0Pac illusion, 2012. (International Business Times)

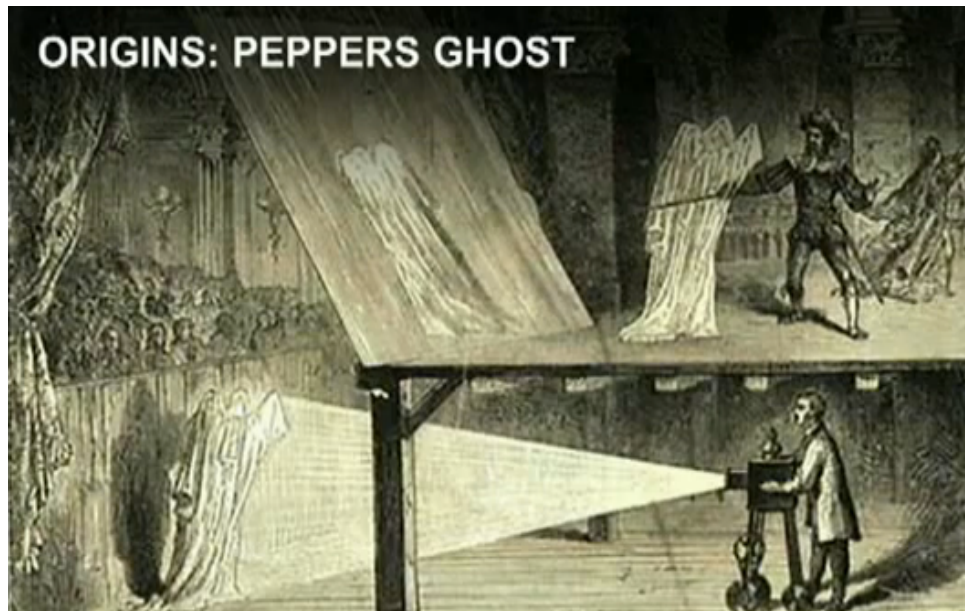


Figure 2B: Depiction of the original set-up for the Pepper’s ghost illusion on stage in the 19th century. (Rock, 2012)

Musion’s Eyeliner system is based on a conjurer’s trick called “Pepper’s ghost” (see Figure 2B) invented by engineer Henry Dircks (Dircks, 1863) and improved upon by chemist John Pepper (“The Patent Ghost,” 1863), who debuted the illusion in an 1862 dramatization of Charles Dickens’ “The Haunted Man and the Ghost’s Bargain” at the Royal Polytechnic Institute in London (Smith, 2012), where Pepper was a professor. In the Victorian-era version of the illusion, a piece of glass (a substance that can be both transparent and reflective) was angled over the stage. An actor, positioned in a recessed area below the stage or in the orchestra pit, faced a mirror angled toward the on-stage glass; lighting in the hidden area caused the actor to “appear” reflected in the on-stage glass (Palmer, 2012; Smith, 2012). The new Eyeliner technique projects the image from

above — a computer animation instead of a real actor — onto a reflective surface which itself reflects onto a similarly angled piece of polyester or Mylar (a transparent/reflective lightweight plastic) on the stage (Smith, 2012). Modern technology stabilizes and solidifies the projected image, the result of higher lumens (brightness) in the projectors and edge-blending in the animation software. Digital Domain’s Ulbrich points out that “the projection techniques and technologies that we’ve used are not unique. There are many vendors that can provide the required equipment, whether it’s rented or licensed” (DigitalDomain, 2012). Similar techniques and technology have been used to create the ghosts inside Disneyland’s Haunted Mansion amusement ride, to make Frank Sinatra (who died in 1998) appear at a 2003 concert, and to project the animated rock band Gorillaz on stage during a performance by Madonna at the 2006 Grammy Awards ceremony (Smith, 2012).³

Musion co-founder James Rock has explained that, while Pepper patented his own technique back in the 19th century, Musion’s patents are “process patents” based on their method of sizing, arranging, and rigging the projection system (Rock, 2012). “The foil is one of the keys to the technique,” Rock says. “Suffice to say, it is supplied on a large roll — 16’ or 32’ high and hundreds of feet long from our supply source — and has a high-gain reflective treatment that’s applied to it during production. The foil is also very thin

³ Then there’s this anecdote, reported post-2.0Pac: “Across the pond, the East London firm [the Musion system] responsible for resurrecting Frank Sinatra to sing for Simon Cowell’s 50th birthday party also brought a legendary, deceased ad-man, Paul Ardin, to life in Cannes, where his company Saatchi & Saatchi held its annual New Directors’ Showcase. He walked onstage, squinted at the lights, then said, ‘Well, I’m glad to see Saatchi’s New Directors’ Showcase is still alive and well. Unlike me.’ After a short speech, he evaporated in a poof of smoke, leaving his microphone to drop to the ground, according to London’s Daily Telegraph” (Goodale, 2012).

but quite durable to work with. This means that we can do very big images where glass isn't a practical option" (D. Johnson, 2006).

Hatsune Miku is projected onto stages using a different technique. Both systems project the performing image onto invisible onstage screens, but instead of capturing a reflection projected from above Crypton's Miku system projects the performing image from the rear of the stage onto a Dilad screen, a clear film which contains tiny imperfections that scatter the light, letting most of it through but capturing enough to "generate an image on the screen with high contrast and brightness" (Kimoto).

The idea of virtual performers on stage with live human actors connects back to the creation of puppetry near 3000 B.C. (Blumenthal, 2005). Mechanical actors mixing with humans on stage probably began with inventor Jacques de Vaucanson's gear-driven duck in 1738, continued with various automatons of the 19th century and pierced the zeitgeist with Czech writer Karel Capek's 1921 science-fiction play "R.U.R. (Rossum's Universal Robots)," which introduced the word "robot" into the English language (Wright, 2012). Disney amusement parks also have pioneered the performance capabilities of robots and animatronics. Digital technology returned to the theater boldly in the early '90s via the cleverly titled "Invisible Site," a "high-tech 'happening'" produced by George Coates Performance Works in 1992; the performance mixed singers and actors with computer-generated stereoscopic images — created in real time by offstage engineers, and thus at least partially responsive to actors' movements on stage — viewed by an audience wearing polarized 3D glasses (Breslauer, 1992). Coates described the set-up for the show in a radio interview:

We had to link two SGI/VGX computers together, write some software, and have an operator behind the audience follow the actor with a joystick so that those birds would go wherever the actor went. And it was a real-time stereographic 3-D animation that was in real time with the actor. So the operator was really a performer. The operator of the computer was performing with the actor. It was astonishing. We'd never seen that occur in live theater. (Coates, 1996)

In 2006, New York's Les Freres Corbusier premiered Elizabeth Meriwether's "Heddatron," a reimagining of Ibsen's "Hedda Gabler" featuring five onstage robots, and in 2011 the American Repertory Theater presented onstage robots in "Death and the Powers: The Robots' Opera," a collaboration between composer Tod Machover and the Media Lab at the Massachusetts Institute of Technology (Wright, 2012). In music, robots have participated in performances both classical (Honda's ASIMO conducted the Detroit Symphony Orchestra in 2008) and popular (from frequent suggestions or implications of robot replacements for live performers, such as the themes of Kraftwerk's 1978 album "Die Mensch-Maschine," to, as recently as January 2013, a viral online video of Compressorhead, a trio of German-made robots performing "Ace of Spades" by Motörhead). Via audio and/or visual effects, several musicians have participated in posthumous collaborations with singers who were not actually "there," including Natalie Cole's Grammy-winning 1991 duet with her late father on "Unforgettable," two 1995 singles by the Beatles ("Free as a Bird," "Real Love") featuring the three living members adding new vocals to late-'70s recordings by the late John Lennon, and a 2007 duet on the TV talent show "American Idol" by Celine Dion and, via similar projection technology, the late Elvis Presley. Virtuality, though, is a two-way cable: on Aug. 3, 2006, singer-songwriter Suzanne Vega appeared as a digital avatar in the Second Life

online virtual community and performed two songs to christen the virtual world's new live performance venue.⁴

4. A history of virtual pop stars

A virtual pop star is defined here as a non-corporeal image presented as a singular musical performer, whether an individual or group, with the appearance of agency. A virtual band, in this respect, does not include human actors presenting themselves as fictional music performers, even if the actors perform off-screen as those fictional characters (e.g., the Blues Brothers, Spinal Tap, Flight of the Conchords), or human actors presenting their characters as music performers within the context of their acting performance, even if those characters' music performances crossover into real commercial product (e.g., the Partridge Family, the Brady Bunch, the Heights from TV's "The Heights," the Oneders from the film "That Thing You Do"). Nor am I dealing with recording artists who record under a persona but remain anonymous (e.g., the Residents, Jandek, Dvar). I am discussing characters created, voiced and/or visualized by collective labor and presented in reality and in the market for commercial and artistic purposes.⁵

Virtual pop stars have been present throughout pop culture with some regularity since the 1950s, and most previous virtual performers largely have been successful because of a strict adherence to performer narratives. Performer narratives, as defined by

⁴ For an amusing and enlightening peek into the challenges of avatar performance through the experiences of Second Life's troupe of avatar actors, the Avatar Repertory Theater, see Ilinca Tamara Todorut's "Virtual Theater for Beginners" (*Theater 42*, 2, pp. 3-5, 2012).

⁵ For a taste of how the definition of "virtual band" has been and continues to inspire neological debate and general fussiness, see the record of relevant page edits for that term on Wikipedia at http://en.wikipedia.org/wiki/Talk%3AVirtual_band.

Aaron Calbreath-Frasieur's lively study of the Muppets, are those involving "performer characters, engaged in acts of performance as well as non-performance character development" (2012, p. 178). Performer narratives, in other words, are stories about performers who, in between putting on shows, get mixed up in madcap misadventures. All the virtual figures described in this section are performer characters and as such — according to Calbreath-Frasieur's theory, which stands on the shoulders of Henry Jenkins' concept of transmedia storytelling (H. Jenkins, 2006) — their narratives are exempted from certain expected complexities and can exist across a variety of media. These narratives, which often slip into seemingly self-aware meta-narratives, navigate more easily around questions of identity and authorship, allowing fans to accept the presentations of the characters as if unmediated. But as showfolk, complete with that subculture's historic connotations of looser morals and social boundary-pushing, virtual performers from the Archies and Josie & the Pussycats to Kermit the Frog and Hatsune Miku are allowed to exist in a cultural zone where it's safe to be different, digital — a little more or less than human. The human performer (particularly the actor) is a cultural archetype pre-packaged with certain assumptions — a person already straddling the boundary between reality and fantasy, able to permeate the liminal space where virtual performers ultimately are actualized. If animated characters first claim to be performers, then they've already taken a step toward a shade of virtuality humanity is comfortable with.

The first virtual pop star most Americans encountered was a squeaky-voiced, animated rodent trio — an audio gimmick that, coupled with some cartoon imagery on a

series of record covers and a resulting prime-time television show, evolved into a worldwide and long-lasting animated music brand: Alvin & the Chipmunks.

Struggling to pay his mortgage in 1958, singer-songwriter Ross Bagdasarian (recording as David Seville) experimented with a vocal effect while recording his song “Witch Doctor.” Using a \$190 tape recorder to record certain portions of his vocals sung slowly and recorded at half tape speed, then played back at regular speed, Bagdasarian created the effect of a duet between himself in regular voice and his sped-up, high-pitched voice as the gibberish-spouting (“Oo-ee, oo-ah-ah, ting-tang, walla-walla bing-bang”), romantic advice-dispensing witch doctor (Setoodeh, 2008). The success of the single (three weeks at No. 1 (Crouse, 2000)) led him to try it again, which he did on another David Seville novelty recording (“The Bird on My Head”) and, later that same year, “The Chipmunk Song,” credited this time to the fictional Alvin & the Chipmunks (Childs, 2004). “The Chipmunk Song” was a huge hit, earning a Grammy Award, reaching No. 1 on Dec. 8, 1958, and selling 2.5 million copies that month alone (Crouse, 2000), leading to an animated television series, a series of recordings featuring the chirpy vocal effect applied to numerous popular hits, a recent film franchise combining computer animation and live action, and retail sales of more than \$1 billion (Setoodeh, 2008).

The requisite visual imagery created for the first three Chipmunks LP covers at first depicted the trio in a semi-realistic, painterly style quite different from what became the group’s standard image. The debut, “Let’s All Sing With the Chipmunks” (Bagdasarian, 1959), for instance, shows three chipmunks with pointy heads, realistic hind legs and dark-brown fur highlighted with black streaks. The animals are

anthropomorphized with collegiate letter vests, seersucker blazers and straw boaters in hand; without the wardrobe, however — and given their rendered positions, particularly with lead singer Alvin kneeling down with arms outstretched, perhaps an attempt to mimic Al Jolson — their animalistic faces and apparent lunging stance also could appear to be a slightly snarling preparation for an attack on the hapless tuxedoed human music conductor frowning at them in the background (see Figure 3A). The following two albums, “Sing Again With the Chipmunks” and “Around the World with The Chipmunks,” both released in 1960, featured cover artwork in this same style. All three images are credited to Pate/Francis & Associates, an art studio that produced numerous album covers for the Liberty label around the turn of the 1960s, including exotica records such as “Quiet Village — The Exotic Sounds Of Martin Denny” and compilations like “Fantastic Percussion.”

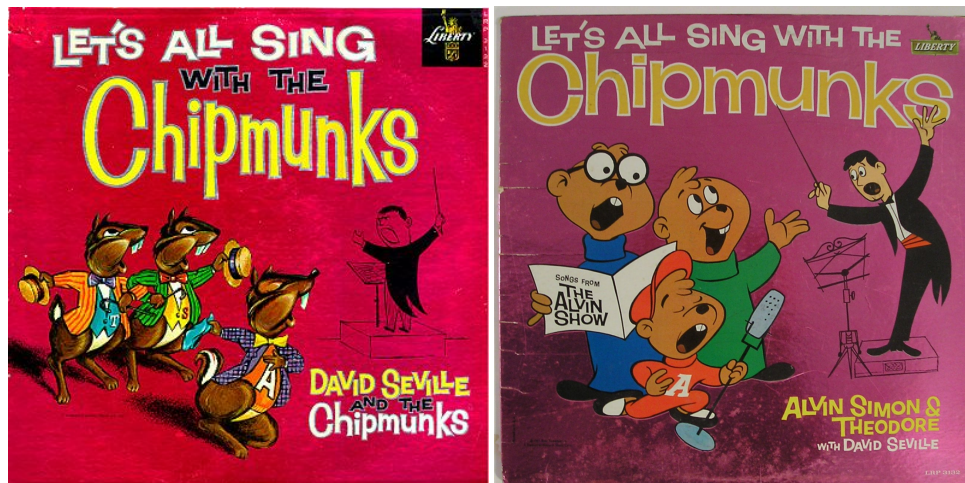


Figure 3A (left): Album cover for “Let’s All Sing With the Chipmunks” (1959).

Figure 3B (right): Album cover for “Let’s All Sing With the Chipmunks” (1961).

In 1961, however, all three albums were reissued with new cover art (see Figure 3B). The basic illustrations were the same, but the Chipmunks trio and their human counterpart were now depicted with animation cels in the style of the new CBS prime-time television program in which they starred, “The Alvin Show” (CBS, 1961-1962). Here we see the Chipmunks as we still recognize them today: in a line-drawn, stylized 2D animation, with softer edges, more rounded figures and, more importantly, happy human-like faces (one character even now wears eyeglasses). The new album covers are credited to Studio Five, another design house catering to the entertainment industry and producing numerous album cover artworks throughout the ’60s (Discogs), but the style of the art squares with the new TV venture produced by Herbert Klynn’s Format Films. Klynn had been a longtime illustrator with animation studio United Productions of America (the “Mr. Magoo” cartoons and numerous theatrical shorts) before forming his own Format house in 1959 with fellow UPA defector Jules Engel. For some significant years at UPA, Klynn and Engel had run the backgrounds department, where they were renowned for blurring the distinction between foreground and background. In contrast to the dominant, dichotomous style of television animation, Engel explained, UPA’s characters were “never in front of the background. The character was always *in* the background” (Abraham, 2012, p. 82). That style continued into Format’s productions, including “The Alvin Show,” carrying forth a “UPA spirit” of “breezy” animation built with “simplified graphics” (Abraham, 2012, pp. 235-236).

The input of this collective creative labor is part of the Chipmunks' foundational template for the virtual pop star. The Chipmunks began as the idea and product of one man in a studio, but once seized by the market they became the product of a multitude of recorded voices, sound engineers and visual animators in both television and film, all working (often across many national borders) to produce the illusion of a performance narrative involving four cheeky cartoon rodents. Created first as an engineered vocal technique and only later crafted into visual entertainment — like Hatsune Miku later — the Chipmunks also set a visual standard that would be adhered to for decades: virtual music performers designed as 2D cartoons for television and thus appearing in that style throughout other media, from album covers to merchandising. Unlike Miku, whose anime-like image (originally developed by an artist for use on the packaging for Vocaloid, the synthesized voice software she's made famous) has never been photo-realistic and has always kept to this side of the uncanny valley, the Chipmunks and the numerous cartoon bands to follow honed to a safe, stylized template of visual production.⁶

The next significant animated virtual band appeared as a result of one man's desire to not only emulate the commercial success of the Chipmunks' transmedia performer narrative but to seize upon their familiar animation form as a means of eliminating the troublesome human celebrity from creative and performative participation. Consider a segment in the career trajectory of music and television

⁶ Alvin, Simon and Theodore were updated for the digital age in a trio of family films — “Alvin and the Chipmunks” (Fox, 2007), “Alvin and the Chipmunks: The Squeakquel” (Fox, 2009) and “Alvin and the Chipmunks: Chipwrecked” (Fox, 2011) — in which they appeared as digitally animated characters, slightly less stylized but still well shy of any uncanny creepiness, within the live-action films featuring human actors.

executive Don Kirshner, the music supervisor for “The Monkees” (NBC, 1966-68), a popular live-action television comedy about a fictional (not virtual) pop band. Kirshner oversaw the songwriting and recording for the music presented on that show — music that was, at least at first, performed and recorded by other musicians and presented on screen while the actors lip-synced and mimed their performances. His work with “The Monkees” was successful, and several songs marketed as the Monkees were real commercial hits. But as the show developed, the actors chafed against their roles merely mimicking the performances of session musicians and insisted on contributing to the creation and production of the show’s music. Kirshner refused and was fired. Matt Stahl’s analysis of this situation speculates on the thinking that led Kirshner to a Brobdingnagian, Bagdasarian idea:

But a question must have consumed him: where, in a pop music world increasingly populated by performers who, like the Monkees, had been infected by the Romantic-countercultural rock ethic of individualism and authenticity ascendant at the time, would he find a commercially viable group who would add value to his constant capital in a satisfactory way and whom he could treat as calculative actors for whom alienation and powerlessness could easily be compensated? (Stahl, 2010, p. 12)

He even told Rolling Stone that he “wanted to do the same thing with a cartoon series that Ross Bagdasarian had done with the Chipmunks. ... I wanted my own Alvin, Simon and Theodore, I figured the country was ready for it” (as quoted in Stahl, 2010, p. 13). Joining forces with Filmation Associates, a studio then enjoying great success by turning superhero comic-book characters into cheap children’s television programming, Kirshner did the same for the Archies, a popular, long-in-print comics series about a clique of wholesome teens. Despite the characters in the comic books having never previously mentioned interest in forming a band, “The Archie Show” (CBS, 1968-69) debuted on

Saturday mornings with the four main characters following the same narrative and production arc as “The Monkees”: “wacky adventures, zany humor and three minutes of pure bubblegum pop” (Childs, 2004, p. 4).

Kirschner’s move paid off: the virtual Archies were a huge hit in the real world. The No. 1 song in 1969 — a year commonly viewed as the apex of the anti-Vietnam, topical protest-song movement — was the Archies’ bubblegum-defining single “Sugar, Sugar.” In the last year of the decade, despite the ascendancy of the previously mentioned “individualism and authenticity,” that song was not the product of a particular artist or group of artists but of a burgeoning commercial content-generating machine. Stahl defines virtual labor as “performative labor that appears to be performed by an individual but that is actually the result of a division of labor incorporating creative and technical workers, intellectual property, and high-tech equipment” (Stahl, 2010, p. 4). “Sugar, Sugar” was presented and marketed as performed by the cartoon Archies, but the song was written by producer Jeff Barry and singer-songwriter Andy Kim, and sung by musician Ron Dante (Childs, 2004), all hired by Kirshner (Gold, 2004), and presented in the TV show thanks to the virtual labor of writers, animators and background artists at both the Archie Company and Filmation, plus sound effects firm Einfeld-Mahana.

“Sugar, Sugar” sold 10 million copies, but the buying public and even some in the music industry remained slightly confused by the reality/virtuality of the Archies. Numerous promoters requested Kirshner and Filmation to — somehow — tour the cartoon band (Stahl, 2010). Dante says he never made public appearances in the guise of his virtual persona: “I never toured or made TV appearances as the Archies. The comic

book people owned the rights to the Archies and wanted the group to stay as an animated group” (Gold, 2004). The band’s virtuality was thus never compromised.

In the years that followed the success of the Archies formula, it seemed as if every Saturday morning cartoon started a band. The marriage of music production and animated video imagery showcased on (and sold through) “The Archies” and “The Alvin Show” became a new strain of pop music performance, inspiring numerous music-related animated copycats, particularly from animation outlets such as Hanna-Barbera, including fictional groups “The Impossibles” (CBS, 1966), “The Beagles” (CBS, 1966-67), “The Banana Splits” (NBC, 1968-70), “The Cattanooga Cats” (ABC, 1969-71), “Groovie Goolies” (CBS, 1970-1971), “Josie & the Pussycats” (CBS, 1970-71) and “Josie & the Pussycats in Outer Space” (CBS, 1972), “Amazing Chan & the Chan Clan” (CBS, 1972), “Butch Cassidy & the Sundance Kids” (NBC, 1973), “Jabberjaw” (ABC, 1976-78) and a reboot of “Alvin & the Chipmunks” (NBC, 1983-90), as well as the interstitial animated music videos of “Schoolhouse Rock” (ABC, 1973-1985), plus virtual representations of real-life stars like “The Jackson Five” (ABC, 1971-73) and even “The Beatles” (ABC, 1965-69). Most of those only lasted a season or two but still managed to burrow into popular culture via consistent rerun programming. Several also attempted to expand the transmedia virtuality of the characters by marketing the music — albums such as “Here Come the Beagles” (Columbia, 1967) and “We’re the Banana Splits” (Decca, 1968) — and by almost bridging the animated personas with live concert presentations. “The Banana Splits” show, for instance, was a mix of animated characters and live-action costumed performers; producers actually “toured” the band, saving travel costs by hiring actors in each city to don the costumes and mime to the prerecorded soundtrack, even

handing out autographed photos (Rutherford, 2008). “Josie & the Pussycats” featured music created by a band (including Cheryl Ladd, later one of “Charlie’s Angels”) that recorded six singles (four of which were available only through mail-order offers on cereal boxes) and an album, “Josie and the Pussycats: From the Hanna-Barbera TV Show,” which showed the real, leotarded human singers on the cover. A planned concert tour, however, was scrapped because the album stiffed (Charles, 2009). The tour, though, was part of the plan from the genesis of the show — “Hanna-Barbera wanted to get three girls who could really sing and do their own performing,” reports Dan Janssen, the album’s producer (Janssen, 2001) — and there were even “plans for the gals to perform the songs live at the end of each [animated] episode” (Fields, 2012). The Pussycats’ creators apparently sought to actualize the music in the real world in a way not achieved by the Archies, from which the Pussycats were spun off — a kind of animation-human hybrid of performance prefiguring the Gorillaz.

At the dawn of the 1980s, an increased use of synthesized sounds in popular recordings correlated with a pattern of artists attempting to establish legitimacy of new styles or with new tools by remediating the new forms through old material. In 1979, for instance, the pop charts saw two Top 10 hits from synthesizer-based groups the Flying Lizards and the Buggles, first with a cover of the 1959 chestnut “Money (That’s What I Want)” and then a paean to the 20th century’s golden age of wireless in “Video Killed the Radio Star,” respectively. Another group applied this same remediating model — upping the performer narrative ante and using televised appearances to bypass altogether concerns about uncanniness.

The Silicon Teens released a short series of singles and one album, “Music for Parties” (Mute, 1980), comprised of nearly all rock classics from the 1950s and ’60s (“Memphis, Tennessee,” “You Really Got Me,” “Sweet Little Sixteen,” etc.) played on chirpy synths. (One review of the “Music for Parties” LP noted that “the science of electronics has come a long way and perhaps there’s no better way of discovering just how far it has come than by hearing familiar things dismantled and reconstructed” (McGrath, 1980).) However, despite the plural moniker — liner notes listed band personnel as Darryl, Jacki, Paul and Diane — the music and production was the work of one Daniel Miller, head of the emerging, innovative synth-pop label Mute Records. Produced as a lark (under a pseudonym as producer Larry Least), the debut single, “Memphis, Tennessee,” threatened to become a minor hit. Miller, often described as “not a conventional musician” (Nobahkt, 2005) and a person who sought others to fill in the limelight instead of himself, hired friends and actors to construct and support the illusion of the project being an actual group. Frank Tovey, a new Mute acquisition who was performing under the pseudonym Fad Gadget, was called upon to appear as the Silicon Teens’ singer in both promotional photographs and a promotional video for the single, with hired actors filling out three other roles in the band. This mediatized, virtual version of the band even sat for interviews, including a surprise appearance on the BBC’s popular “Roundtable” music show (Strasse, 2011). Other labels approached Miller about signing the band, believing them to be a foursome. Miller recalled recently: “We managed to perpetuate the myth for about a month” (Pato, 2012).

That’s a blip on the pop cultural timeline — but a significant one after years of forward-thinking pop artists in the ’70s had been extolling the virtues of machines taking

over music-making, from Kraftwerk's explicit "The Man-Machine" (EMI, 1978) and Lou Reed's implied "Metal Machine Music" (RCA, 1975) to aborted plans by the Human League to tour with an "automatic orchestra" (Collins, 2011) and commissioned performances of Charles Dodge's "Any Resemblance Is Purely Coincidental," a "work for tape and solo piano" featuring a dislocated, digitally manipulated recording of a 1907 performance by opera singer Enrico Caruso, which Dodge began composing in 1978 (Dodge, 1980). A post-2.0Pac report on the New York City news and culture blog Gothamist reported that Frank Zappa considered a holo-tour in the early '80s: "While we can't find any further documentation of this, we once talked to Ike Willis (a guitarist who frequently played in Frank Zappa's touring bands from 1978 on) in Providence, RI, after one of his shows there, and he told us that Frank had talked about touring a hologram of himself. This would have been a hologram based off of a live show he would be playing, which would be transmitted to other stages throughout the world. The details were never really hammered out, but Zappa did have an interest in holograms" (Carlson, 2012). Alas, I haven't been able to find further documentation of this, either. After the success of "The Robots," a single from "The Man-Machine," the German synth pioneers in Kraftwerk mentioned a desire to stage a groundbreaking concert: performing in several cities on a single night by staging multiple teams of robots to simultaneously perform (or appear to perform) their music instead of themselves.⁷ Gerald Casale, of synth-pop group

⁷ They're still inching toward this goal. In 1981, Kraftwerk began performing "The Robots" in concert alongside four robot-like dummies; by 1991, the human players managed at least to leave the stage altogether while new robot figures appeared to play the song.

Devo, envied that plan for reasons of both creative control and the bottom line, telling an interviewer in 1979:

... We have a similar idea. We'd like to use holograms in the major venues. I think it would be better; if I was in the audience I'd actually prefer hologram projections of the performer than the performer. I think it would be a more valuable experience. I think it's more human all the way round. The artist can contemplate what he will show you more thoroughly, show you something in fact better, more intense, imaginative, and not burn himself out doing so. So that his energy is conserved to give you more. When you think of it, the physical act of touring is really a punishment, it's not even twentieth century. I mean it's just so crude, to go around 40 cities in 45 days, the amount of money and crew and equipment, the logistics involved. All the things that can go wrong. It's just archaic (Morley, 1979).

Holograms began to saturate pop culture as a special visual effect — not only in movies but now in television, too, such as the 1984 introduction of Max Headroom, “the world’s first computer-generated TV host” portrayed by Matt Frewer in a variety of TV projects and advertisements. The next virtual pop star drew on this, as well as the emerging impact of MTV music-video presentation style. “Jem & the Holograms” (Hasbro/Marvel, 1985-88) was a successful syndicated cartoon, which followed the basic TV model of virtual bands from the '60s and '70s (a performer narrative interspersed with song performances, each of which was presented within the narrative as its own meta set piece, beginning with MTV-style titles in the lower-left corner of the screen) and chronicled the career of Jem, the rock star alter-ego of young Jerrica Benton — an alternate identity made possible by Synergy, a supercomputer “designed to be the ultimate audio-visual entertainment synthesizer” and one that “can generate completely realistic holograms” (Marx, 1985). Via a pair of earrings containing tiny holo-projectors, Jerrica commands Synergy to project transformative clothing, hairstyles and makeup over

herself and her three bandmates in order that they may assume their pop-music identities, as well as various special effects used in onstage visualizations and within the series' adventure plotlines. The idea of holography in this case was the creation of an original Hatsune Miku-like performing agent, but instead of presenting it by itself these characters "wore" it like a costume on stage — or, as contemporary performance-capture techniques in cinema have been pejoratively referred to, digital makeup.

The virtuality of *Jem & the Holograms* remained onscreen, and in a very '80s twist the characters were not agents for fictional characters (such as the Chipmunks and the Archies) or promoted as avatars for real celebrity performers (the identities of those voicing the characters remained submerged in the show's end credits); rather, "*Jem & the Holograms*" was produced as a marketing vehicle for a line of toys — dolls bearing the characters' likenesses. The show's animation studio, Sunbow Productions, was an arm of an advertising agency, Griffin-Bacal Advertising, hired by toy-maker Hasbro specifically to create the series. This is the same team that previously had produced the "G.I. Joe" and "Transformers" cartoons for TV with the same priority of marketing over entertainment. So firm was this mission to market action figures that — in stark contrast to the ready availability of Miku recordings — despite a total of 151 full-production pop songs being written and recorded for use in the 65 "Jem" episodes, none of that music ever saw independent commercial release, though several dozen of the songs were issued on cassettes that were included in the packaging of certain Jem dolls and playsets (Pranceatron).

The 1980s initiated virtual pop stars into other marketing schemes, as well, beginning with an advertising spectacle called the California Raisins. This Emmy-

winning group of claymation, anthropomorphized sun-dried fruits danced while singing rhythm-and-blues standards in television commercials produced for an agricultural advocacy group, the California Raisin Advisory Board. But in addition to selling awareness of the real-life, edible version of themselves, the California Raisins were presented as viable pop stars within the music market. Four full-length albums were released under the California Raisins name in 1987-1988, and their cover of Marvin Gaye's "I Heard It Through the Grapevine" charted on the Billboard Hot 100 singles tally, followed by a primetime television special ("Meet the Raisins!" CBS, Nov. 4, 1988) and a short-lived Saturday-morning animated series, "The California Raisin Show" (CBS, 1989).

Much later, in 2004, a boy's sound effect-turned-viral computer animation was adapted into Crazy Frog, a digitally animated character in an advertising campaign for cellular ringtone provider Jamba! The popularity of the online videos and their accompanying music transformed Crazy Frog into a virtual pop star, scoring a No. 1 hit across Europe with a single, "Axel F" (a remix of the theme song from the 1984 movie "Beverly Hills Cop" containing the Crazy Frog ringtone sound) and three subsequent, best-selling albums (Wikipedia, 2013a)⁸. Seizing on the viral nature of the Internet and its

⁸ A cluster of Wikipedia citations begins here. Trained as both a journalist and scholar, I attempt to otherwise verify any information found via this crowd-sourced database. However, when even other sources seem thin by comparison, I invoke Matthew G. Kirschenbaum's "A Note on Wikipedia as a Scholarly Source of Record," from the preface to his book *Mechanisms: New Media and the Forensic Imagination* (MIT Press, Cambridge, 2008): "Information technology is among the most reliable content domains on Wikipedia, given the high interest of such topics among Wikipedia's readership and the consequent scrutiny they tend to attract. Moreover, the ability to examine page histories on Wikipedia allows a user to recover the editorial record of a particular entry

expanding ease in sharing music content, several animated, anthropomorphized animals followed in Europe using this same model, including a hit rework of the “Ghostbusters” movie theme by France’s Mickael Turtle in 2006 (Discogs, 2013; Wikipedia, 2013d), France and Germany’s chart-topping Pigloo (despite its name, an animated penguin) (Dudley, 2006; Wikipedia, 2013e) and Finland’s popular, Chipmunks-aping Pikku Orava (Little Squirrel) boasting five albums and platinum sales (Wikipedia, 2013f).

As the Internet era dawned, virtual pop performers appeared with some regularity, though rarely with much notoriety. Perhaps the first group to refer to itself as a “virtual band” (Adder, 2006; “Virtual Band,”) was the Bot Brothers in 1996, two computer-generated human images named Paul and Fred Bot — one of the first artists to distribute music solely via the Internet. That year they released two songs, “Fuck You” and “Stupid Human,” in SoundFont, a pre-mp3 file format for MIDI music players. Notoriety was limited to computer music enthusiasts possessing the technology required to play back the songs (thebots.net). In 2002, the project resurfaced as the Bots, this time as a quintet depicted as computer-generated human figures, and they continue releasing occasional comedy songs via a website (thebots.net), which features the tagline: “Where entertainment meets reality.”

Faring much better a couple of years later was Prozzäk, a virtual Canadian duo — a real-life project between musicians Jay Levine and James Bryan McCollum, members of the successful jazzy pop band the Philosopher Kings, and presented virtually as two cartoon characters named Simon and Milo. The project began when Levine and

...” This also has held, in my professional experience, for entertainment products such as these.

McCollum, during a Philosopher Kings tour of Europe, jokingly performed a song (“Europa”) in faux English accents for bandmates while on the tour bus. The song was too pop-oriented for the band, but officials at Sony Canada, the band’s record label, liked it enough to release it, and Levine and McCollum created the animated alter-egos that became Prozzäk in marketing materials and videos (N. Strauss, 1999). An apocryphal, futuristic backstory was created for the two characters: Simon and Milo are more than 200 years old, former mortal enemies (Levine and McCollum initially did not get on well in the Philosopher Kings (O’Rourke)) who had been “transported to the 21st century with a mission, to find true love through music” (Lamb, 2001). Extra voices, male and female, were created occasionally by applying studio effects to vocals by either member of the duo (O’Rourke). Prozzäk released four albums from 1998 to 2005; the first, “Hot Show,” sold more than 300,000 copies by 2000 and was nominated for four Juno Awards (Canada’s Grammys) (Reaney, 2000). The two considered touring the project (N. Strauss, 1999) by showing Simon and Milo performing on screens (O’Rourke), though a newspaper report from 2000 describes a Prozzäk performance (billed as “Canada’s ‘first animated group’”) as a live-action event with Levin and McCollum appearing “standing inside the giant heads of their cartoon creations” and simply playing the cartoon duo’s songs as their human selves (Reaney, 2000).

Other notable virtual music projects from around the world:

— One-T, a French electronic duo of Eddy Gronfier and Thomas Pieds, was presented as a large multiethnic group of animated characters (a sullen teen lead singer, a large Latino MC, a Japanese hacker, a neutered bulldog, etc.) created by Pieds. The group

released a string of singles and two albums in Europe between 2001 and 2007. One-T was visualized only in music videos (Wikipedia, 2012b).

— Strawberry Flower, a short-lived virtual trio that created advertising music for “Pikmin,” a Nintendo video game, which aired only in Japan. Their first song, “Ai No Uta,” became an unexpected hit in Japan in 2001. In the video, the music is performed by Strawberry Flower, depicted as three musicians based on the tiny, primary-colored plant-animal hybrid creatures from the video game (Wikipedia, 2012c).

— Vbirds were a very Jem-like virtual female quartet (intergalactic cartoon dancer-singers Boom, Wow, Bling and D:Lin) created for a television pilot at Cartoon Network UK in 2002. The original series was not optioned; however, a mini-series aired called “Vbirds: Perfect,” which instructed viewers how to perform dance routines along with the characters (VBirds). A Vbirds single, “Virtuality” (featuring the refrain, “Out of this world is where we want to be!”), was released in April 2003. A preview article that year states that “although Vbirds are virtual, their voices are provided by Birmingham session singers who will remain behind the scenes” (“Virtual band of sisters created by real talent,” 2003), one of whom (voicing Bling) was actress Sophie Okonedo, later Oscar-nominated for her role in “Hotel Rwanda” (2004) (VBirds).

— Eternal Descent is a transmedia project, a fantasy comic-book series by that title — in which numerous real-life heavy-metal performers were depicted as characters in the narrative, including guitarist Joe Satriani and the band Shadows Fall (Vandervliet, 2012) — and a collaborative music recording project by the same name launched in 2004 by one of the comic’s writers, British writer and musician Llexi Leon, resulting in one album release and one EP (Wikipedia, 2013b). In 2012, an attempt was made to raise

money via a crowd-sourced funding site toward production of an animated television pilot; the funding goal was not reached, and the pilot appears not to have been produced (Leon, Halawani, Davies, & Sizemore, 2012).

— Deathmøle is “a fictional band that makes actual music” (Deathmøle), formed by three characters (Marten Reed, Amir Afridi, Hannelore Ellicott-Chatham) in a comic-book series, *Questionable Content* by American writer Jeph Jacques (Wikipedia, 2013c). Since writing and creating the virtual band in 2004, Jacques has released seven albums under the Deathmøle moniker, using images of the comic characters to market the music.

— Studio Killers are a Danish-Finnish virtual band, featuring four animated cartoon characters (Cherry, Goldie Foxx, Dyna Mink, and Bipolar Bear), an “electronic audio visual collective” (“Studio Killers,”) marketed via animated videos and futuristic imagery. “No one knows where they came from,” reads one bio, “one day they were just here staring back at us through our high definition flat screens” (“Studio Killers,” 2013). A single made the rounds online in 2011, an album in 2013 (“Music: Studio Killers,”).

Virtual pop stars can exist as three-dimensional physical objects, too, not only as visual artwork, animation cels and televisual veils. These creations also fit into the rubric of virtual performance, when crafted specifically for presentation within a performance space or through an electronic medium. The Chipmunks may have been the first virtual pop stars via recordings and animated television, but the first virtual performers to present themselves in the physical world likely were the audio-animatronic attractions created by Walt Disney designers as theme park performers, beginning with the singing birds in Disneyland’s Enchanted Tiki Room, which opened in 1963, and including the Country Bear Jamboree. Disney’s singing bears opened in 1971 and remained a popular

Disneyland attraction until 2001, a year before “The Country Bears,” a feature film based on the characters and utilizing puppetry to depict the characters, was released.⁹

Disney also now owns the most internationally prominent example of physicalized virtual pop stars: the Muppets, the popular puppet franchise created by Jim Henson in the 1950s and whose characters (Kermit the Frog, Miss Piggy, etc.) have starred in three television series, nine movies and numerous online videos, as well as releasing albums, comic books and video games and more. The Muppets perfected the virtuality of music performance in two distinct ways. First, as performing characters appearing throughout that variety of media, the Muppets blazed Jenkins’ transmedia trail by seamlessly threading their performer narrative through each of the aforementioned media, infiltrating well beyond the standard lunchbox fare of the Hanna-Barbera era. For example, the narrative of a Muppets video on YouTube is related to or extends that of the Muppets movies, television show and more, with each expression being interconnected yet understandable by itself — a precursor to Hatsune Miku’s overall narrative running through online video, onstage performance, opera, even television commercials. Embedded within that transmedia fluidity is the Muppets’ particular performer narrative, which has the Muppets performing for us as performers for others, chiefly by singing and staging musical theater and frequently backed by a band, Dr. Teeth & the Electric Mayhem. The locality of their performance is key to our discussion, though; the Muppets

⁹ Also, in 1977, a San Jose restaurant opened called Chuck E. Cheese’s Pizza Time Theatre, which integrated a pizza establishment with arcade games and regular performances by several animatronic characters. The restaurant expanded to a national chain.

have physical bodies but are only presented on screen and in audio recordings. They are non-corporeal in that — well, have you ever *seen* an actual Muppet?

In addition, Henson made a couple of significant innovations in his field. He framed each mediated Muppet performance so that the puppeteer was completely invisible, hidden within a stage set and/or positioned outside the camera frame, but — the second way the Muppets expand pop virtuality — Henson also wrote the characters as if they were self-aware and acted with agency yet had no knowledge of being puppets. The Muppets “believe” they are independent, autonomous creatures (Finch, 1993). On an episode of “The Muppet Show” featuring a rare guest puppeteer, Kermit made the introduction with a self-reflexive humor typical of nearly all Muppet appearances:

“Ladies and gentlemen, it’s very seldom that we have a guest puppeteer on the show. In fact, between you and me, it’s rare that we have *any* puppeteer on the show” (quoted in Stoessner, 2009, p. 74). The easy conflation of the Muppets’ world and ours is part of the exposition justifying the characters’ general lack of hesitation about mixing with humans and pursuing their own desires within the real world. The Muppets exist in a mixed reality, and they helped fertilize new media for the very kind of hybrid narrative and performance that figures like Miku now exploit. “When dealing with a completely fictional world,” writes Calbreath-Frasieur, “it is usually obvious when a text is allowing audiences to explore that world. With the Muppets it is hard to tell where our world ends and theirs begins” (2012, p. 179).

Another virtual group existing also as physical objects (though with a public profile that looks up to see the bottom of the Muppets’ fuzzy soles) is the band Mistula. A performance-art project in south Asia, Mistula is a representation of a virtual band via a

high-end line of ball-jointed dolls, which are popular collectors items throughout Asia. The brainchildren of two Filipino artists, Joey David and her musician husband, Rey Tiempo, *Mistula* — a Filipino word meaning “in the likeness of” or “similar to” (“*Mistula in the Valley of the Dolls*,” 2004) — is comprised of four dolls commercially manufactured by popular Japanese doll maker Volks, Inc. (Wikipedia, 2012a) that the couple purchased in 2004 and re-styled as iconographic figurines (named *Bella Lugosi*, *Manx Minuet*, *Uno* and *Lobo*) representing the topical, hard rock music made by Tiempo and his band (*mistulavisions*, 2008). Mediatized via online videos and photos on an official website (*mistula.com*) and through numerous single releases and a graphic novel from 2004 to 2006 (Wikipedia, 2012a), *Mistula*’s songs have charted in Europe, and the dolls have been featured as a rock band on music magazine covers. ““Why did they even form a band if they don’t want to show themselves?”” David said in a television interview, repeating a frequently asked question in the media about her project. “For me to be able to trigger that reaction, I already feel fulfilled. ... Can you imagine? Before, dolls are just toys. Now they perform!”” (*mistulavisions*, 2008).

But it’s within the last several years that the presentation of this kind of virtuality within real space has been actualized less with physical materials and more with digital projection — a shift from physical items created for presentation within media and toward media created for presentation within real space. Before *Miku* stepped off a software box and onto a concert stage, two pop bands in the West began experimenting with tweaking and evolving the previous virtual music models. *Gorillaz* and *Dethklok* both have enjoyed significant commercial success in the process, and both projects are significant for successfully crafting new hybrid forms of live concerts featuring

performances of both their human personnel and their animated avatars — performances that, notably, each began as purely virtual presentations but eventually evolved to include sight of the flesh-and-blood musicians.

Gorillaz are a virtual quartet consisting of two-dimensional animated members named 2D, Murdoc Niccals, Noodle and Russel Hobbs, plus numerous human guest appearances on recordings and in concerts. The group was created in 1998 by Blur singer Damon Albarn and “Tank Girl” creator-illustrator Jamie Hewlett as a means to comment on the nature and power of celebrity in popular culture. “With Gorillaz,” Hewlett said in a 2010 interview, “we wanted to show that imaginary characters could be bigger than actual celebrities, who are really imaginary characters, anyway. Tough battle that one” (Conner, 2010). Gorillaz were successful out of the gate: the self-titled debut album in 2001 sold more than 7 million copies; the band was named Most Successful Virtual Band by the Guinness Book of World Records, a category that had not existed prior to the existence of Gorillaz. The second Gorillaz album, “Demon Days” (2005), won a Grammy Award.

From the outset, too, Albarn and Hewlett presented Gorillaz in live concert settings. The first outing was almost purely virtual. For the Gorillaz Live world tour, March 2001 to July 2002, Gorillaz concerts featured a large screen obscuring the entire stage. On the screen were shown various two-dimensional and digitally animated videos in sync with the music — more abstract visuals than just images of the Gorillaz characters appearing to sing and play the songs. Behind the screen was the live human band performing the music in real time. Occasionally, a strong white light shone from behind the screen, casting the human performers in silhouette for the audience to see. The

Gorillaz characters also spoke to the audience, sometimes via actors present for the performance and sometimes via prerecorded dialogue. As the tour progressed, the stage setup changed so that a semi-transparent scrim covered the bottom of the stage and the screen showing animated visuals filled the upper portion of the proscenium; the literal spotlighting of the human performers occurred first for longer periods of time, then almost permanently throughout the concerts (2-J, 2013). This pattern of steadily increasing the sight of the human performers and decreasing the focus on the animated visuals continued, until on the 2010 Gorillaz tour the human musicians were no longer hidden at all, just merely cast occasionally in subdued lighting while the videos played above them. Albarn ascribed this to the increased presence of special guest stars on the tour (“I couldn’t entertain the idea of putting Lou Reed or Bobby Womack behind a screen,” Albarn said. “I’m not that daft” (Conner, 2010)) — a move that utterly surrenders the duo’s original subversion of human celebrity status. That reversal indeed may have been inevitable. As John Richardson points out in his study of one of Gorillaz’ songs, “Hinging on the notion of the virtual as a conduit for parodic artistic expression, the subversive intent of the band’s evasive strategies was predestined to be compromised by [Albarn’s] iconic status within British popular culture” (Richardson, 2005, p. 3).

However, Albarn and Hewlett initially announced that they would present the group’s second tour in 2005 depicting the characters as three-dimensional simulations using the same two-dimensional technology as 2.0Pac and Hatsune Miku presentations. The Gorillaz “holograms” were to appear on stage with the human guest stars from the group’s “Demon Days” album. “Holograms and humans on the same stage is where it gets spooky,” band spokesman Chris Morrison told the Guardian newspaper, again citing

the simulations as a “way to rebel against celebrity culture” (Simpson, 2005). But the tour never happened. Hewlett later explained that the technology was too expensive to tour, and too glitchy: “Live, it’s impossible to do, it turns out. You can’t turn your bass up, you can’t turn anything up, because it vibrates the invisible expensive holo-screen stretched between the band and the audience. The holograms go to pieces” (Conner, 2010). Albarn added:

If it were at all possible, we’d be doing it. You just can’t do it yet. It belongs to the brave new world, really. ... So the cartoons are back. It’s a complete animated narrative above me now. Watching it as we’re playing, it feels really strong. I think it’s more satisfying, easier for people to watch us and the screen. They’re a very strong presence in the ether above us, looking down on us from some kind of digital pantheon. (Conner, 2010)

But Gorillaz did pull off one simulated-hologram performance the following year — with the technical difficulty Hewlett mentioned accounted for in the production. At the start of the Feb. 8, 2006, Grammy Awards telecast, the Gorillaz characters appeared in simulated 3D form on the stage of the Staples Center in Los Angeles performing the song “Feel Good Inc.” Midway through, two human rappers from the hip-hop group De La Soul, who appear on the recorded single, joined the virtual band on stage, standing in front of the invisible projection screen and contributing their rapped verse. “Feel Good Inc.” then segued into “Hung Up” by Madonna, who appeared first also in projected virtual form — a photo-real video projection as opposed to the less-realistic stylized animation forms of the Gorillaz — cavorting with 2D and Noodle before the projection screen vanished and the human Madonna appeared on stage with her live band to complete the song, with the members of Gorillaz thereafter relegated to smaller video screens positioned throughout the stage. Hewlett, however, said that the audio of the

Gorillaz during the first segment of this set piece was a prerecorded track heard only on the television broadcast and in the earpieces of the De La Soul rappers. Because of the vibration issue cited above, “there was not really any sound in the actual theater,” he said, adding during the 2010 interview, “The [technicians] we did that with, since then, have fixed the problem.”¹⁰ Indeed, in 2007, the year following the Gorillaz’ Grammys performance, Hatsune Miku made her stage debut.

That was also the year another virtual band debuted on stage: Dethklok. This current virtual band combines elements of the traditional television-based model for virtual performers and the Gorillaz live concert model. “Metalocalypse” (Cartoon Network, 2006-present) is a stylized animated comedy series on the Cartoon Network cable channel in its late-night Adult Swim block of programming; the show premiered in August 2006 and completed its fourth season in July 2012, following the misadventures of Dethklok, a group of brutish death-metal musicians who are so famous they constitute the world’s seventh largest economy. Members include Nathan “Tonto” Explosion, Skwisgar Skwigelf, Toki Wartooth, William Murderface, and Pickles the Drummer. The music the animated Dethklok performs on the show is performed largely by the show’s creator, animator and musician Brendon Small. The first of three Dethklok albums was released in 2007, the same year the virtual band first performed on stage. Dethklok

¹⁰ In video footage of the Gorillaz/Madonna performance (see <http://www.youtube.com/watch?v=lwxccVA15A8>), you can hear an unusually high level of chatter from the audience during the Gorillaz portion of the performance. Because they could see the visuals but not hear the music, the crowd received fewer of the usual performance cues instructing them to pipe down. Only when Madonna appears, performing live for all to hear, does the crowd react loudly to her arrival and then settle for the remainder of the performance. In his Gorillaz study, Richardson cites three music magazine reviews with “reports of unrest in audiences” at Gorillaz performances (Richardson, 2005, p. 6).

concerts feature loud metal music thrashed out live by Small and an assembled band.

While the players are visible, they're not the main visual attraction. The job of delivering the eye candy falls, like the TV show, to a screen showing Dethklok in animated performances and, also like the TV show, some comedy bits. Small explained in an interview the reasoning behind the meta-narrative of a Dethklok concert:

I'd watched that Gorillaz DVD ["Demon Days Live"] where they play behind the scrim and all you see is their shadows, and I lost interest very quickly. There was no connection between me and the performer. So I thought, what if I did this? We're not supposed to be the band, but we make the sounds for the records. We don't look like a metal band. We look like a bunch of fatsos on stage. The show can't be about us. People would come and go, "Hey, they're not Dethklok. That's disappointing." So we wound up doing what Gorillaz eventually did, which was hang the giant screen above us for the animation of the band, but we're still [seen] onstage making a connection with the superfans and hypernerds who know who we are and want to see us play. I'm a guitar player. When I see a show, I want to get close. I want to see the fingers, the guy's tricks. Others might want to see the drummer when he goes crazy. This way we can satisfy both audiences. But really, our job is to be largely unseen. We're the pit band like in a Broadway show. We're the Metalocalypse Players. (Conner, 2012a)

Like Gorillaz, too, Small mentions that the impetus for the creation of the Dethklok characters was to make a critique on celebrity: "It's about a group of celebrities that happen to be a metal band. It's about celebrities going through their stupid day. ... The jokes are not exclusive to metal. It's comedy about inept billionaires — would they be able to find their car in a parking lot, they don't understand the value of a dollar, etc." (Conner, 2012a).

The evolution from purely virtual presentation on 2D screens to a mixed reality of human performers with screens emulating 3D may be a response to the previously cited unrest at the Gorillaz' pure-virtual performances and an inevitable progression "which

could be interpreted as evidence of the power of conventional modes of representation over the popular imagination” (Richardson, 2005, p. 6). The most commercially successful of these virtual pop stars, namely the Chipmunks and the Muppets, achieved their crossover appeal because they were presented within the context of the real world instead of as characters within a virtual world that the spectator had to make an effort to enter. The Chipmunks sang recognizable pop hits often as accompaniment to or with cameos by human performers. The Muppets “believe” they are performers alongside any human performer, throngs of which populate their TV shows and movies. Gorillaz and Dethklok both had initial commercial success as an electronic entity, on records and videos, but as a live act they had to evolve to include more prominent showcasing of the human contributors/collaborators in order for audiences to accept them.

5. Vocaloid software

Attempts to synthesize human vocals date at least back to 1961 (Kelly & Lochbaum, 1962) and several projects since (Carlsson & Neovius, 1990; Cook, 1993). Technical exploration of what would give voice to Hatsune Miku began at the turn of this century at Spain’s Pompeu Fabra University, where researchers financed by the Yamaha Corporation began developing what would become the Vocaloid software (Werde, 2003). By 2003, Vocaloid coding was centered at Yamaha’s Advanced System Development Center in Hamamatsu, Japan, and that year Yamaha demonstrated the software at music technology conferences in Germany and the Netherlands (Wilkinson, 2003). Vocaloid was introduced to the American market in January 2004 at the tradeshow for the National Association of Music Marketers in Anaheim, Calif. (Eidsheim, 2009).

A basic explanation of Vocaloid software is that it “sings” whatever combination of notes and words the user feeds into it. Yamaha’s product description of Vocaloid describes it as software that “allows users to input melody and lyrics in order to synthesize singing. In other words, with this technology, singing can be produced without a singer” (<http://www.vocaloid.com/en/about/>). After decades of synthesizers replicating nearly every musical instrument sound, Vocaloid finally tackles the last unsynthesized instrument: the human voice. “As anyone familiar with speech synthesis will know, it is virtually impossible to artificially synthesize phonemic transitions, particularly voiced ones,” Frode Holm wrote in reviewing the Vocaloid debut at NAMM in 2004. “The solution seems to be to capture this information from an actual human voice and transform the data into some form of parameter-based model for later resynthesis” (Holm, 2004, p. 80).

Vocaloid users select among several synthesized voices from the program’s Singer Library — which now includes 20 voices, including Hatsune Miku — which are generated from the app’s Synthesis Engine and combined with music and lyrics input in the app’s Score Editor. These synthesized voices are often described as “vocal fonts” (styled sounds used to build words in audio, like styled letters used to build words in print), and include options for timing, dynamics, vibrato, breaths, and vocal stops (the punctuation) “in order to have songs with a realistic human’s vocals” (<http://www.vocaloid.com/en/about/>). A user of the software

enters pitches and durations on conventional staff paper in one application setting, or by playing the piano interface (or a connected MIDI piano) in another setting. Lyrics are added as the user types them in, in correspondence with the notes; melody and words are then sung back by the voice the user selects. This process is roughly comparable to typing

words into a text document and having them read back by text reader software; however, unlike a conventional text file reader, Vocaloid assigns pitch and duration to each word based on user input. Also, each pitch-duration-word compound may be treated with added vibrato, envelope, attack, dynamics, and so on (Eidsheim, 2009).

Each vocal font is crafted from a single human voice. To create the font's database of phonemes — in English, samples are required to represent approximately 3,800 possible vowel and consonant combinations — sound engineers record a singer performing up to 60 pages of scripted articulations (e.g., “epp,” “pep,” “lep,” etc.) at three different pitches. Variety is key, as these various transitional sounds

are a big part of how we understand words and why a vocal track sounds natural or artificial. For example, the phoneme *p* sounds slightly different at the beginning of a word than it does at the end, and it affects the vowels next to it differently than, say, the phoneme *t* (Wilkinson, 2003, p. 28).

The recording process usually involves eight hours of recording each day for five days. These samples are compressed and trimmed into precise phonemes and loaded into the software's vocal font database for recall by the user (Eidsheim, 2009; Werde, 2003).

Here's what occurs next:

To sing the word *part*, for example, the software combines four elements from the phentic database: *p* (as it sounds at the beginning of a word), *p-ar* (the transition from *p* to *ar*), *ar-t* (the transition from *ar* to *t*), and *t* (as it sounds at the end of a word). The two *ar* elements are blended together, and the resulting vowel *a* is lengthened to accommodate the melodic line (Wilkinson, 2003, p. 28).

A process called spectral analysis allows the sample library to be transposed or time-shifted in ways limited only by the user's imagination; one could even unlock the default settings, re-order the phoneme maps and create songs in, say, Elvish, Esperanto or a language made up by the user (Miller, 2004).

This was a significant advancement in the difficult endeavor of synthesizing human speech, much less singing. For years prior to Vocaloid's debut, various software allowed non-musicians to create music — from GarageBand's song-building sets of musical and rhythmic loops to vocal- and pitch-correction apps such as Melodyne and Auto-Tune — and before that a history of mechanical and electronic attempts to synthesize human speech stretches back to the 18th century (Miller, 2004).¹¹ The first song performed with computer-synthesized speech was “Daisy Bell” in 1961 at Bell Labs (Sasso, 2004). That event alone didn't ingrain itself into our collective cultural memory, but when a computer with a distinct personality repeated the same act at the white-knuckle climax of Stanley Kubrick's film adaptation of Arthur C. Clarke's “2001: A Space Odyssey,” it became a synthespian performance few can forget.

Yamaha's Vocaloid software has made a particular splash in at least a few world markets with a similar (and cheerier) application of identity — a specific marketing tactic employed by British audio software company Zero-G, the first company to work with Yamaha in grooming Vocaloid for commercial development. Zero-G introduced each font not simply as a fun or utilitarian computer app but as a personality — a *singer* — identified with unique package designs and a Christian name (Eidsheim, 2009). The NAMM debut in 2004 showcased three Vocaloid fonts in English: Lola (a “virtual female vocalist,” packaged with the “O” in Lola designed as a female symbol), Leon (a “virtual male vocalist,” packaged with the “O” in Leon designed as a male symbol) and Miriam (a “virtual vocalist,” packaged with a photograph of the real Miriam). Lola and Leon were

¹¹ For a thorough account of pre-Vocaloid speech-synthesis history, see Len Sasso's “Voices From the Machine,” *Electronic Musician*, 20, 3, pp. 29-38, 2004.

released first and together, their voices sampled from what Zero-G managing director Ed Stratton called “generic soul-singing voices,” thinking that the Vocaloid’s first fertile market would be in service as background singers (Werde, 2003). Miriam is an aberration among Vocaloids in that it is named after its human sample source, popular New Age vocalist Miriam Stockley. “At first I was quite horrified by the idea” of sampling herself for the software, Stockley told *The New York Times*. “People tend to pay a lot of money to get my sound, and here I am putting it on a font.” In the end, however, “You can’t fight progress, no matter how strange it sounds” (Werde, 2003).

Early reviews of Vocaloid software clustered around this basic theme: “The samples I’ve heard have a not-unpleasant hybrid quality to them: somewhere between a real vocal track and the automated voice you get when dialing information” (S. Johnson, 2005). Holm’s review of the Anaheim debut concluded:

The synthesized voice does give a convincing illusion of someone singing, with intelligible lyrics, natural vibratos, spot-on inflections, and more. Still, it is quite some distance away from replacing a singer in a lead position, but for background vocals and other subsidiary vocal tasks, it might very well do an adequate job in many situations. However, my guess is that this package will not initially be known for its natural singing capability at all. By the time this sees print, there will no doubt be “How did they do that?” Vocaloid-generated effects on several hit records (Holm, 2004, p. 81).

The distance wasn’t as great as he thought.

On Nov. 5, 2004, another of Yamaha’s vocal fonts was released, this time in cooperation with Crypton Future Media, an audio technology company based in Sapporo, Japan. Crypton CEO Hiroyuki Ito reflected on the transition of the software from studio utility to performing character: “It was supposed to be a kind of ‘virtual instrument’ for projects that didn’t have the budget to hire a singer. An amateur songwriter, for example,

could insert a synthetic voice in his home studio to create a demo recording of a song. But since there's such a rich [a]nime culture in Japan, we thought maybe by adding some kind of animated character, we could figure out a whole new way of utilizing Vocaloid technology" (Ashby, 2011). The first such character was named Meiko, a female font in Japanese that utilized the same sampling methods as the Zero-G voice libraries and operating on version 1.0 of the Vocaloid software. Kaito, a male font released by Crypton on Feb. 17, 2006, operated on version 1.1.

The release of Vocaloid 2.0 generated the software's greatest commercial and cultural transformative impacts in Japan. Hatsune Miku bowed as the first Vocaloid 2 character on Aug. 31, 2007. A few months later, the Vocaloid 2 family began expanding: Kagamine Len and Kagamine Rin, a dual-voice package — male and female twin characters — came in December, and Megurine Luka — the first bilingual Vocaloid, a female font with Japanese and English options — came in 2009. To date, 14 different Vocaloid 2 fonts have been released, including character representation ranging from Hiyama Kiyoteru (an older male voice, depicted as a hip, young urbanite in a slim black suit) to Kaai Yuki (a very young female voice recorded from "an actual elementary school student" (http://vocaloid.wikia.com/wiki/Kaai_Yuki), depicted as a cute little girl with pigtails); two of these, VY1 and VY2, are marketed as generic male and female vocals, respectively, without any anthropomorphic, characterized representations. Updates to the software have included adding different tones and timbres to the various voices; for instance, the Hatsune Miku Append software patch, released April 30, 2010, added six different tonal options to Miku's voice: Soft, Sweet, Dark, Vivid, Solid and Light. Vocaloid 3 characters — of which there are now 10, all of them female — began

showing up in October 2011 with SeeU (another bilingual voicebank, in Japanese and Korean, and depicted as a blonde teen). Non-Cryton Vocaloid characters now exist, too, such as Megpoid (vocally sampled from voice actor Megumi Nakajima and visually modeled after Ranka Lee, a character on the anime series “Macross Frontier”) and Gackpoid (vocally sampled from J-rock superstar Gackt). An open-source software app called Utauoid has resulted in the brief rise of Vocaloid-like star Kasane Teto.¹²

The most recognized Vocaloid, however, is Hatsune Miku, largely because Cryton stationed her at the vanguard of two significant advancements upon the release of Vocaloid 2. First, on Dec. 3, 2007, Cryton launched a web site called Piapro (piapro.jp) to act as a hub for Vocaloid fans to share and display their own creations with the software. Users upload audio files to Piapro (the name is a twist on the phrase “peer production”) featuring music and vocalized lyrics made using Vocaloid, but music is just one of four content sections on the site. The other three are tabs for images, text files and 3D renderings, where users share their homemade visual art (drawings, paintings, computer-generated art, but no photos), fan fiction and three-dimensional images and animations, respectively. In order to upload content to the site, users must agree to a terms-of-use agreement, in which they declare that the material is for “unofficial, noncommercial use only,” similar to the rules for photo-sharing web site Flickr (Wappler, 2012). Cryton created the image of Hatsune Miku, but the company places hardly any

¹² It should be noted that Vocaloid faced at least one commercial competitor, a singing synthesis program called Cantor from a German company, VirSyn. Cantor hit the market shortly after the first Vocaloids, and though it offered musical voice synthesis comparable to the Yamaha software it was more expensive and required more difficult commercial licensing than Vocaloid. A final version of Cantor was released in 2007, and it has not since been updated.

limits on how users may use that image. It's a loose approach to corporate branding that's more common in Asia than in the West. Michael Bourdaghs, an associate professor of modern Japanese literature at the University of Chicago and author of *Sayonara Amerika, Sayonara Nippon: A Geopolitical Prehistory of J-Pop*, explains: "Japanese pop-culture image brands have always been willing to allow fans, artists and others to play around with their characters. Hollywood studios tend to see this as an infringement on their properties, but I think Japanese firms see it as a way of increasing the value of their brands, which ultimately leads to higher profits" (Wappler, 2012). Kurousa-P, a Japanese music producer also known as WhiteFlame, has written and shared many songs using the Miku Vocaloid. "There are thousands of creators," he says, "but all of them have their own unique Mikus" (as quoted in Wappler, 2012). Fan-made videos featuring Hatsune Miku and other Vocaloid personalities also fill the servers at Nico Nico Douga (translation: "Smile Smile Video"), Japan's equivalent to YouTube. In fact, it was on Nico Nico Douga that Hatsune Miku first went viral.

The semiotics within much of this content has powerful cross-cultural effects. Today, for instance, Hatsune Miku is frequently portrayed in images and videos brandishing bunches of leeks. One of the first Hatsune Miku videos to go viral on Nico Nico Douga was a cover of "Ievan Polkka." The roots of this connection are deep and tangled. "Ievan Polkka" is a centuries-old Finnish folk song that was revived in pop culture via an *a cappella* performance by a Finnish quartet, Loituma, in 1995. In 2006, a Flash animation of this song was an online meme for several months, showing a particular Japanese anime character dancing and twirling a leek in the air. The song itself — a bouncy, staccato melody — makes for a fine choice to experiment with and test

Vocaloid software, so it's no surprise an early user, junichirokoizumi, uploaded his simple video in September 2007 featuring the Miku Vocaloid singing the tune and showing a rudimentary, 2D animation of a tiny Miku waving a leek up and down with one arm, as a nod to the earlier animated meme. This imagery was among the first encountered by many fans of the new software, and the symbolic vegetable continues to appear in fan-made art and video.

The popularity has transferred to YouTube, as well; Miku's megahit song, "World Is Mine," has been viewed more than 18 million times (as of January 2013). Likewise, this popularity has transferred to commercial interests, too, including a popular video game series, Project DIVA, which sold more than a million units in Japan, as well as Miku's image used in advertisements for Toyota cars and Google's web browser (Wappler, 2012). Another gauge of her popularity: Early in 2012 the web site Top Tens polled readers who they'd most like to see perform at the upcoming Olympic Games in London. Hatsune Miku quickly topped the poll but then was removed from the list. As reported in *The Los Angeles Times*: "The Top Tens administrators, based in the U.S., didn't fully understand that the pixilated princess was a legitimate performer. After receiving angry missives from Miku fans ... Top Tens reinstated Miku, and she won the vote" (Wappler, 2012). The poll was unofficial, of course, and Miku did not perform at the games.

Secondly, Hatsune Miku is the first Vocaloid character to step off of boxes and screens and onto a real concert stage. On Aug. 22, 2009, Hatsune Miku performed her first concert at the Saitama Super Arena in Saitama, Japan (Osborne, 2010). She has since performed several concerts around Japan and in Singapore, Hong Kong and Taiwan. Her

first performance in America was in September 2010 at the J-Pop Summit Festival in San Francisco (Sciortino, 2011) (where a footnote appeared with her billing in the program, advising attendees, “This is not an actual live concert. It is a recorded cinema experience” (World, 2010)). In March 2012, 10,000 tickets for four solo Miku performances in Tokyo sold out within hours at a price of 6,300 yen (\$76) each (Meyers, 2012). Some of Miku’s concerts have been simulcast to movie theaters, including the Nov. 10, 2011, performance described earlier.

But what music does a digitally animated projection perform in concert? Here’s where Hatsune Miku and her creators break new ground in the fields of entertainment, social media and copyright. Unlike many of the virtual pop stars previously discussed, there is no single creative artist or easily definable cadre of professional songwriters providing the content for this virtual performer. Hatsune Miku performs only songs written by fans, as selected from the Piapro database by officials at Crypton Future Media. While the aforementioned Piapro user agreement specifies “noncommercial use” for the purposes of displaying, sharing and archiving users’ content on the site, Crypton sifts the material, selects the most compelling songs and promotes them via its own record label. After creating the Piapro web site, where most of the Vocaloid-related content gathers, Crypton launched its own record label, Karen T (named, improbably, for the daughter of *Future Shock* author Alvin Toffler), through which they market and sell Vocaloid songs. Crypton cherry-picks the good stuff and offers its creators a new agreement with profit-sharing potential. Approximately 20 amateur songwriters have provided the most popular Hatsune Miku songs, and in so doing they have become celebrities in their own right. Crypton created the image of Hatsune based on the

synthesized voice created for the Yamaha software, but the content is crowd-sourced — providing Miku another kind of voice (see Figure 4).

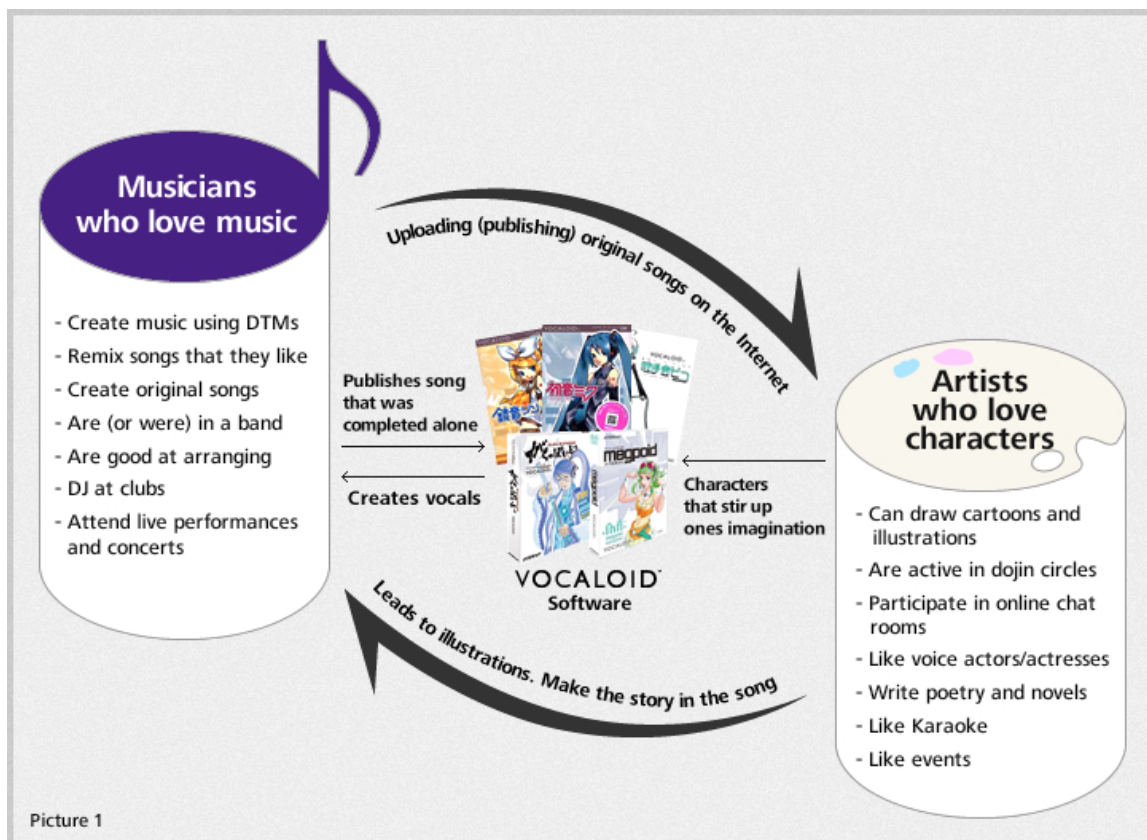


Figure 4: The Vocaloid circle of life, showing the creative cycle of music production using Vocaloid software. (Yamaha)

In October 2012, at a panel during NY Comic Con, Crypton announced the planned 2013 release of an English font for Hatsune Miku, demonstrating the new Vocaloid with an audio song snippet (Scaldothepartymaster, 2012). Awareness in America is growing via an early wave of golly-gee media coverage, albeit mostly in

fringe and techie outlets, and a U.S. release of Miku gaming software also is expected in 2013, along with more corresponding concerts on these shores. Even in Japan, Miku's audience has grown in diversity as well as size. "At first, there were mainly 'otaku' [geek] male fans," says Abe Jun, a keyboard player in Miku's concert band, "but gradually the females increased, and now we have a wide range" (Wappler, 2012). As this new communication technology increases its presence in commercial markets and as a tool in the entertainment industry, we must consider and examine its implications for culture production and participation.

The power not only of the Vocaloid software itself but especially of its personification into signifying characters such as Hatsune Miku stands out as "an example of something that combines several technologies — projection technologies, music-making software, and Web 2.0 user-generated content — to create something fundamentally new," says Tara Knight, assistant professor of digital media at UC-San Diego, who's making a documentary series about Miku (Wappler, 2012). Crypton CEO Hiroyuki Itoh adds to *The Los Angeles Times*, speaking of Hatsune Miku, "She is the symbol for the freedom of creation" (Wappler, 2012). But one artist's freedom and creation, especially when a transformative technological tool is concerned, is another's outsourcing and unemployment. Does the arrival of Hatsune Miku on the international concert schedule give human artists reason to fear what industrial workers have feared for centuries: that they're being replaced by machines? Just as the Internet transformed journalism but doesn't necessarily spell the end of the printed newspaper, virtual pop stars likely won't silence the human singer. However, they add an intriguing and viable option to the marketplace — both for producers and consumers.

The software was designed with producers in mind. Zero-G, for instance, did not hide its intentions to market the first Vocaloids as a means for recording artists and producers to replace human backup singers with the software. Humans are difficult to schedule, require occasional rest, aren't always at their best and might (as Don Kirshner discovered) resist creative control. A "virtual vocalist" like Lola or Leon has none of these issues. A digital diva might be digital, but she isn't a demanding diva. If a producer can add vocals 24/7 within his or her studio schedule and tweak their performance without blowback, time and money are saved.

Virtual pop star software also buttresses the bridge between producer and consumer, allowing the latter to travel to the former's side with fewer restrictions. Even more than certain voice-enhancement software that preceded it — e.g., Auto-Tune and its enhancement of talented vocalists like Cher ("Believe") and less talented singers like T-Pain (the majority of his catalog) — Vocaloid gives voice to aspiring artists whether they can carry a tune or not.

In terms of presenting celebrity, a virtual pop star is free of drama for both producer and consumer. A programmed software agent is on a taut publicity leash. Until artificial intelligence arrives within the form, like Gibson's unruly and restless Rei Toei, Hatsune Miku won't threaten Crypton's investments by going to the club after a recording session and showing up in tabloids drunk, sick, or breaking the law. Expensive and reputation-damaging drug and alcohol rehabilitation is not a factor. Only the loose branding of Crypton's Piapro policy leaves an opening to publicity threats. If a fan abuses the access to a Vocaloid's image and, say, creates a video of Lily, a Vocaloid 2 based on the voice of a real singer, Yuri Masuda of the Japanese band m.o.v.e, delivering a vicious

and racist rant about a foreign politician that goes viral online, despite the company's best efforts to stamp it out on the web sites where they have control, considerable real-world damage control would still be required, and reputations both human and digital would be threatened. The reduced likelihood of this kind of trouble, though, may be one factor attracting fans to virtual pop stars. One American fan, Ritsu Namine, told *Clash* magazine, "I like [Hatsune Miku] a lot more than the other musicians nowadays, because she's not a part of the latest gossip or addicted to drugs or having her 54th baby. But I'm sure that if she was a real person, she would. So I guess I like her more just because she's not real" (Sciortino, 2011).

The collective nature of a Vocaloid's content creation also expands the entire concept of celebrity, moving it away from an individual bestowal and diffusing it within a wider sphere. This study hasn't yet mentioned much about Hatsune Miku's biographical narrative — because there's not much of one. Crypton created Miku's image, but little backstory was created for her or any of the Vocaloid characters. According to Crypton, Miku is 16 years old, 158 centimeters tall and weighs 42 kilograms. (True, she has no corporeal existence; nonetheless, they have stated her weight.) As of yet, Miku has not given an interview. Thus, fans fill in their own story. Miku on stage is herself a projection, but she is also a target onto which each fan can project his or her psychological fantasies, desires and dreams. Her celebrity then is both individualized in each fan and collectivized among the whole group. "Many fans I've talked to believe Miku doesn't have one fixed, single self — she's not just one pop icon like Lady Gaga — but that she can take on the characteristics of the person making her at that moment," says Knight, the documentarian. "Somehow, she is everyone, and thus

becomes an icon of the self-expressive qualities of her fans. I think it is her very ephemerality, her lack of a physical existence, that allows for a different relationship between audience and performer, between user and creator” (Wappler, 2012). In so doing, William Gibson says, she realizes the already shared nature of celebrity: “I think Miku is more about the fundamentally virtual nature of all celebrity, the way in which celebrity has always existed apart from the individual possessing it. One’s celebrity actually lives in others. It’s a profoundly mysterious thing” (Wappler, 2012).

The future of digitized voices and virtual pop stars is a mysterious thing in many ways, and Bill Werde’s 2003 New York Times report on emerging Vocaloid software tried to consider as many paths into that future as possible. “In an era when our most popular singers are marketed in every conceivable way — dolls, T-shirts, notebooks, make-up lines — the voice may become one more extension of a pop-star brand,” he wrote (2003). Miriam Stockley, for instance, was compensated for lending her voice to the third Vocaloid app bearing her name and likeness, but she doesn’t have much control over how others will now use her voice. Users of the Miriam font can apply it to any project within the scope of the software, even for commercial work; users are only forbidden to market the results as Stockley’s own work (Werde, 2003). Similarly, consider the digital animation data of 2.0Pac. How will this data be used in the future, and who has control over the image? To create the visual effects in the 2008 film “The Curious Case of Benjamin Button,” filmmakers collected complete three-dimensional digital data of Brad Pitt’s likeness. That data exists — who controls it, and who will want to acquire its rights? Brad Pitt could be digitized into a commercial for microwave popcorn. 2.0Pac could appear in a television commercial endorsing a political candidate.

Werde's examination is riddled with such possibilities and questions. "What's to stop dilettantes from creating their own fonts?" he writes. "Could it be long before falsified but entirely convincing clips of Britney Spears begging for Justin's forgiveness circulate on the Web — to say nothing of George Bush conspiring with Tony Blair about weapons of mass destruction? ... How much would an advertiser pay to have Elvis sing a new jingle? How easily would a new 'Elvis' song climb the pop charts — if only for the novelty value?" (Werde, 2003). He closes his piece with some final hail-mary hypotheticals:

Once a full palette of vocal fonts is available (or once Yamaha allows users to create their own), the possibilities become mind-boggling: a chorus of Billie Holiday, Louis Armstrong and Frank Sinatra; Marilyn Manson singing show tunes and Barbra Streisand covering Iron Maiden. And how long before a band takes the stage with no human at the mike, but boasting an amazing voice, regardless?

In fact, in today's world of computer-produced music, who needs humans at all? Vocaloid could be used as part of an integrated music-generating machine. Start with any number of existing programs that randomly generate music. Run those files through Hit Song Science, the software that has analyzed 3.5 million songs to determine mathematic patterns in hit music. (Major labels are already taking suggestions from it — "Slower tempo, please, and a little more melody at the bridge.") Throw in a lyric-generating program, several of which can be found free online, and then route the notes and lyrics through Vocaloid to give the song a voice (Werde, 2003).

This isn't mere sci-fi imagination; it's happening. The American company Zenph Sound Innovations brings musicians back to life, not visually *a la* 2.0Pac but aurally by re-creating the style of their performance. Zenph's complex software analyzes the recordings of deceased musicians, studies their particular style on their instrument, then uses that data to re-create a performance that sounds like the way that human player would present it. The software generates high-resolution MIDI files and delivers them to

Zenph's specially designed robotic pianos, which depress the instrument's keys based on up to 24 MIDI attributes. Using this technique and technology, Zenph has released albums of new compositions played in the style of Art Tatum, Sergei Rachmaninoff, and Oscar Peterson. Zenph's next goal is to adapt the software to allow users to jam with virtual musicians. In other words, you play a guitar solo, and the Zenph plug-in reinterprets it to sound as if Eric Clapton played it (Van Buskirk, 2010). Now it's not just human vocals available for use in the market possibly without the singer's consent, it's instrumental performance, as well. Paul and Ringo could sing again with John and George, without having to splice together old recordings, or the next One Direction album could feature a scorching guitar solo by Jimi Hendrix.

B. Applicable theory

How is it that people marvel at such simulations? Hatsune Miku fans fill concert venues for her performances and stuff online forums with content generated for her to perform. How do these reproductions avoid the creepiness factor sometimes associated with an artificial life form? Beyond the standard criticisms that accompany the introduction of any new technology (Davis, 1976), neither 2.0Pac nor Hatsune Miku has met much serious resistance within popular culture. Japanese digital idols, in particular, have found emotional purchase among casual spectators and hardcore fans. In this section, I will discuss reasons for these successes, drawing from a variety of theories. First, I will discuss virtual pop stars within the context of communication theory as it has been applied to previous virtual reality research, including telepresence and immersion. Second, I will explain how the theory of the uncanny valley, from the field of robotics,

applies to visual presentations such as virtual pop stars, how these simulations differ from recent attempts at photorealistic presentations in entertainment, and how various cultural factors have cemented a foundation of support for this kind of entertainment simulation. Third, I will discuss virtual pop stars within the realm of performance studies, focusing on previous research specific to pop music performance and how technology has impacted the liveness of a music concert in a way that makes a singing hologram less foreign to modern ears (and eyes). Finally, I will conclude with evidence that virtual pop stars such as Hatsune Miku represent an opening salvo in the overall eversion of cyberspace and the disappearance of screens in ubiquitous computing.

1. Communication theory

This is not “The Matrix.” Hatsune Miku is not a virtual reality character existing solely within a constructed, contained realm of cyberspace. We do not go to her; she comes to us. She augments our physical reality. The design of such an agent or avatar, however, draws upon theory and skill applied in the creation of virtual reality simulations.

First, some definitions. This study deals with agents more than avatars. Per the delineation set by Blascovich & Bailenson, avatars are digital representations driven by the actions of actual people, typically in real time, while agents are digital representations driven by computer programs (Blascovich & Bailenson, 2011, p. 60), which can function either in real time or “played back.” Both representations are tracked and rendered by computers. In the Second Life online virtual community, for instance, users move through the simulation via an avatar, the digital stand-in for their corporeal self at that

moment. If a Second Life user were to re-create the appearance of their avatar for recall or display later, say, dancing on their computer's screen saver or in a video posted online, that representation would then be an agent of the software that creates and generates it. Agents, in a sense, are avatars once removed. Hatsune Miku, representing a fictional character, is an agent of the Crypton software.¹³ 2.0Pac represents an actual person, but because that person is deceased the representation is an agent of its software. The term "avatar" incorrectly describes virtual pop stars; however, it remains in widespread use in this context (along with, as discussed earlier, "hologram"), particularly in emerging media reports about the phenomenon, because of the term's prevalent usage throughout popular culture and science fiction, now reaching near-saturation levels in the wake of the successful 2009 film "Avatar."

Agents and avatars act within contexts and realities that are *virtual* — and here we have a slippery term. The everyday application of the word "virtual" has two meanings: either "imaginary" or "depending on computers" (Ryan, 2001, p. 12). Speaking to the former, virtuality is a cognitive construct, a concept that "begins in the mind and requires no equipment whatsoever" (Blascovich & Bailenson, 2011, p. 18). Virtuality as a state of mind pre-dates the contemporary technology-centered understanding of virtual reality, describing the effect of perspective painting and even certain literary ideas stretching back through the work of authors such as Gilles Deleuze and Marcel Proust. In Proust's literature, memories are virtual, "real without being actual, ideal without being abstract,

¹³ I could see, though, how further study of Miku's crowd-sourced content phenomenon might promote an argument that she is more avatar than agent — the software generates her appearance, but the character's agency belongs to the collective providing her the content that, in a sense, gives her anime appearance its anima. Can a single avatar have a plural antecedent?

and immediately the permanent and habitually concealed essence of things” and a particular “species of optical illusion” (Proust, 1996, p. 57). Deleuze’s work extends and emphasizes the concept: “the virtual is opposed not to the real but to the actual. *The virtual is fully real in so far as it is virtual*” (Deleuze, 2000, p. 108, original emphasis). Both authors discuss virtuality as an integral and possibly inextricable part of reality (van Doorn, 2011).¹⁴ Likewise, well before the digital age, virtuality existed in television, movies, photographs, paintings, even back to the simple mirror (Friedberg, 2009; van Doorn, 2011). Anne Friedberg names a “virtual register” in which “images have a materiality and a reality but of a different kind, a second-order materiality, liminally immaterial” (Friedberg, 2009, p. 11). It is this liminal space this study is concerned with, in which a virtual object is *actualized*.

As to the “depending on computers” side of this equation, the term *virtual* first was applied within a technological context in the mid-20th century to describe something that appeared to exist without actually existing (e.g., virtual computer memory) (Ebersole, 1997). Since then, communication literature has been dominated by discussion of “virtual reality” (VR) as little more than the technological experience Jaron Lanier first described with the phrase in 1989. Head-mounted displays, haptic gloves and room-size projection spaces or CAVEs — these have been the province of VR ever since, instead of

¹⁴ For extra rich and innovative perspectives on virtuality in literature, look to Jonathan Farina’s “‘Dickens’s As If’: Analogy and Victorian Virtual Reality” (Farina, 2011) and, especially recommended, John Beusterien’s “Reading Cervantes: A New Virtual Reality.” The latter draws a parallel between CAVEs and the Cave of Montesinos episode in *Don Quixote* that, frankly, would blow Plato’s mind.

a broader cognitive and artistic experience.¹⁵ Technocentric definitions range from the simple — “virtual reality refers to an immersive, interactive experience generated by a computer” (Pimentel & Texeira, 1993, p. 11) — to the more complex:

Virtual reality denotes the use of three-dimensional computer graphics technology to generate artificial environments that afford real-time interaction and exploration. These are intended to give the user an impression of being present or immersed in a computer-generated world. While virtual environments can be presented on desktop computer displays, a sense of immersion is often promoted through the use of head-mounted displays (HMDs). (Murray & Sixsmith, 1999, pp. 316-317)

A focus on goggles-and-gloves hardware persists throughout multiple studies — “environments experienced via head mounted eye goggles and wired clothing” (George Coates as quoted in Steuer, 1993, p. 5), “realities implemented with stereo viewing goggles and reality gloves” (Krueger, 1991, p. xiii), etc. Steuer, however, argues that it’s possible to define VR “without reference to particular hardware” (Steuer, 1993, p. 5), and while the simulations discussed in this study are technologically dependent, I claim it is necessary to think of them beyond the tech. For the mixed reality I’ll be discussing below, we need to mix the VR concepts, as well.

¹⁵ Throughout communication literature Lanier is credited with the genesis of VR’s technological terminology, though this endnote from Samuel Ebersole’s “A Brief History of Virtual Reality and Its Social Applications” is worth including here: “According to a posting by Julian Dibbell on the CYHIST listserv (October 9, 1996), the term ‘virtual reality’ first appeared in the 1956 Grove Press translation of ‘The Theatre of Alchemy’ by theorist/playwright Antonin Artaud. According to Dibbell, when he informed Jaron Lanier of the discovery, ‘He was tickled. He insisted he hadn’t been consciously aware of the reference at the time he (re)invented ‘virtual reality,’ but he did allow as how he’d read a lot of Artaud in college, so that who knows, you know? He added, too, that he liked the connection a lot, that he was always trying to convince his more antitechnological friends of the organic relationship between technology and the arts (or something like that — I have it all on tape somewhere, as I was interviewing him about something else at the time), and that this might help do the job.”

Because, really, the technology-based definitions of virtuality depend on the broader artistic concepts, which the computers are simply actualizing on screen or, in the case of virtual pop stars, projecting and simulating within the physical environment. To understand virtual pop stars, however — and especially to design them — we must secure the tech-centered notions of virtuality to the larger artistic concept. In discussing virtual design and implementation, Joseph Bates buttresses this idea, suggesting that “the primary task in building a world is to transfer artistic knowledge, of both general and specific kinds, into the machine” (Bates, 1991, p. 3). The machine is not the experience; it is the tool with which we build the experience. That said, we need to uncouple the connection between VR experience and the technological concept of “cyberspace” — that illusory place originally conceived in Gibson’s *Neuromancer* as the mentally enveloping “space” a human “enters” by connecting directly to the machine via a “Matrix”-like jack or a VR headset. *The digitally virtual need not be isolated from the material world*. While many new media studies of online virtual life have moved away from this kind of disembodiment (Bakardjieva, 2005; Hayles, 1999; H. Jenkins, 2006; Munster, 2006), and others support the notion that the ultimate goal of VR tech is the amplification of virtuality within human perception and cognition (Lanier & Biocca, 1992; Rheingold, 1991), still “the idea of the digitally virtual as somehow separate from the material conditions of everyday reality has nevertheless persisted in much of the literature” (van Doorn, 2011, p. 532).

Most examinations of VR discuss it in the context of another loaded term: presence (sometimes, particularly in older literature, referred to as telepresence). Jonathan Steuer’s oft-quoted definition of VR is founded on the concept: VR is “a real or

simulated environment in which a perceiver experiences telepresence” (Steuer, 1993, p. 7). Explanations of tele/presence are many and varied (see Biocca, 1992; Lombard & Ditton, 1997; Nash, Edwards, Thompson, & Barfield, 2000; Nass & Moon, 2000; Giuseppe Riva, 2009; Schloerb, 1995; Sheridan, 1992), and the most comprehensive summation of the concept has been Kwan Min Lee’s exhaustive explication of the theory, concluding that presence is “a psychological state in which virtual objects are experienced as actual objects in either sensory or nonsensory ways” (Lee, 2004, p. 27). Simply, presence deals with an individual’s relationship to the external, the awareness and experience of one’s physical environment (J. J. Gibson, 1979; Steuer, 1993) (as opposed to absence, which is absorption in our own internal thoughts (Waterworth, Waterworth, Mantovani, & Riva, 2010)). It’s the feeling of “being there,” even if “there” isn’t “here” but rather a distant environment experienced via technological mediation. Steuer splits the difference between the older, prefixed term and the shortened newer usage: “‘presence’ refers to the natural perception of an environment, and ‘telepresence’ refers to the mediated perception of an environment” (Steuer, 1993, p. 6). Indeed, the term “telepresence” was coined in 1980 by Marvin Minsky to refer to the distant awareness experienced by workers manipulating physical objects remotely via teleoperation systems (Minsky, 1980). Thomas Sheridan’s parsing of the terms — the other frequently cited definition of presence — similarly assigns “presence” to the overall perception of awareness and environment, mediated or not, and “telepresence” to specific cases involving teleoperation (Sheridan, 1992). This study follows that lead.

Presence is a key factor in the analysis of virtual pop stars, but as a social experience more than a psychological one. In the case of virtual pop stars performing for

crowds, we must look beyond the individual to define the sense of presence, the definition and experience of which also is socially and culturally constructed (see Fontaine, 1992; Heeter, 2003; G. Riva et al., 2007; Villani, Repetto, Cipresso, & Riva, 2012). Previously cited examinations of presence have studied it within the contexts of mediated systems in which the user looks *through* the system to feel the presence of objects and/or environments *elsewhere*. The assumption, particularly in certain self-locative studies (Slater & Wilbur, 1997; Wirth et al., 2007), has been that the user's self-awareness does the "traveling" through the system to experience and be present in the distant environment. "The term *presence* proposes not a goal but a destination," writes Biocca, "a psychological place, a virtual location" (Biocca, 1992, p. 27). But in the case of virtual performer presentations, the objects and/or environments do the "traveling" through the mediated system; the user remains in his or her physical environment and is aware of the presence of the virtual performer *within that physical environment*. This squares with Endsley's model of situation awareness (Endsley, 2000), social-psychology's transportation theory (Green, Brock, & Kaufman, 2004), the strategy of "emotional immersion" in narrative fiction (the ability of multiple readers to respond to characters in the prose as if they were real people) (Ryan, 2001) and especially the one-way interaction and illusory face-to-face relationships of para-social communication as examined within entertainment, particularly television (Handelman, 2003; Horton & Wohl, 1956) (indeed, Lee refers to virtual objects as "para-authentic" (Lee, 2004)), as well as emerging theories of augmented and mixed realities discussed below.

The largely one-sided interactivity of existing virtual pop stars' performances suffers one of two important aspects of virtuality. While Sheridan breaks down five

variables that facilitate a sense of presence (only three of which are technologically determined), Steuer reiterates that presence “is a function of both technology and perceiver” (Steuer, 1993, p. 10) and names two determinants of presence representative of the mediating technology: *vividness* (“the ability of a technology to produce a sensorially rich mediated environment”) and *interactivity* (“the degree to which users of a medium can influence the form or content of the mediated environment”) (Steuer, 1993, pp. 10-11). While the presentations of 2.0Pac and Hatsune Miku have been fairly vivid — engaging the senses of sight and sound, with reasonable depth in each — their opportunities for real-time interaction are limited. An audience interacts with a human performer by shouting, cheering, singing along and dancing; this still happens in the presence of a virtual performer. But a performer interacts with the audience, too, greeting the crowd, engaging in banter between songs, reacting emotionally to the audience’s reactions, etc.; existing virtual performers, however, are pre-programmed well in advance of the performance and cannot be adjusted on the fly to interact with the audience. In addition, to further the previous thought, it’s conceivable that further research of Hatsune Miku’s crowd-sourced content suppliers could support an argument that the very creation of that content — which thus far has included stage banter, localized greetings and even expressions of emotion in response to crowd reactions — constitutes an interactive engagement with the performer, however asynchronous it might now be in this situation. Steuer later specifies that interactivity, as a determinant of presence, is distinct from two other common communication research terms, engagement and involvement (Steuer, 1993, p. 14). We are left with virtual pop stars as vivid, engaging characters, with whom interaction is thus far limited. The indirect and more one-sided avenues for interaction,

however, should place virtual pop stars onto Steuer's graph depicting Various Media Technologies Classified by Vividness and Interactivity into the blank space near the top center of the graph (see Figure 5).

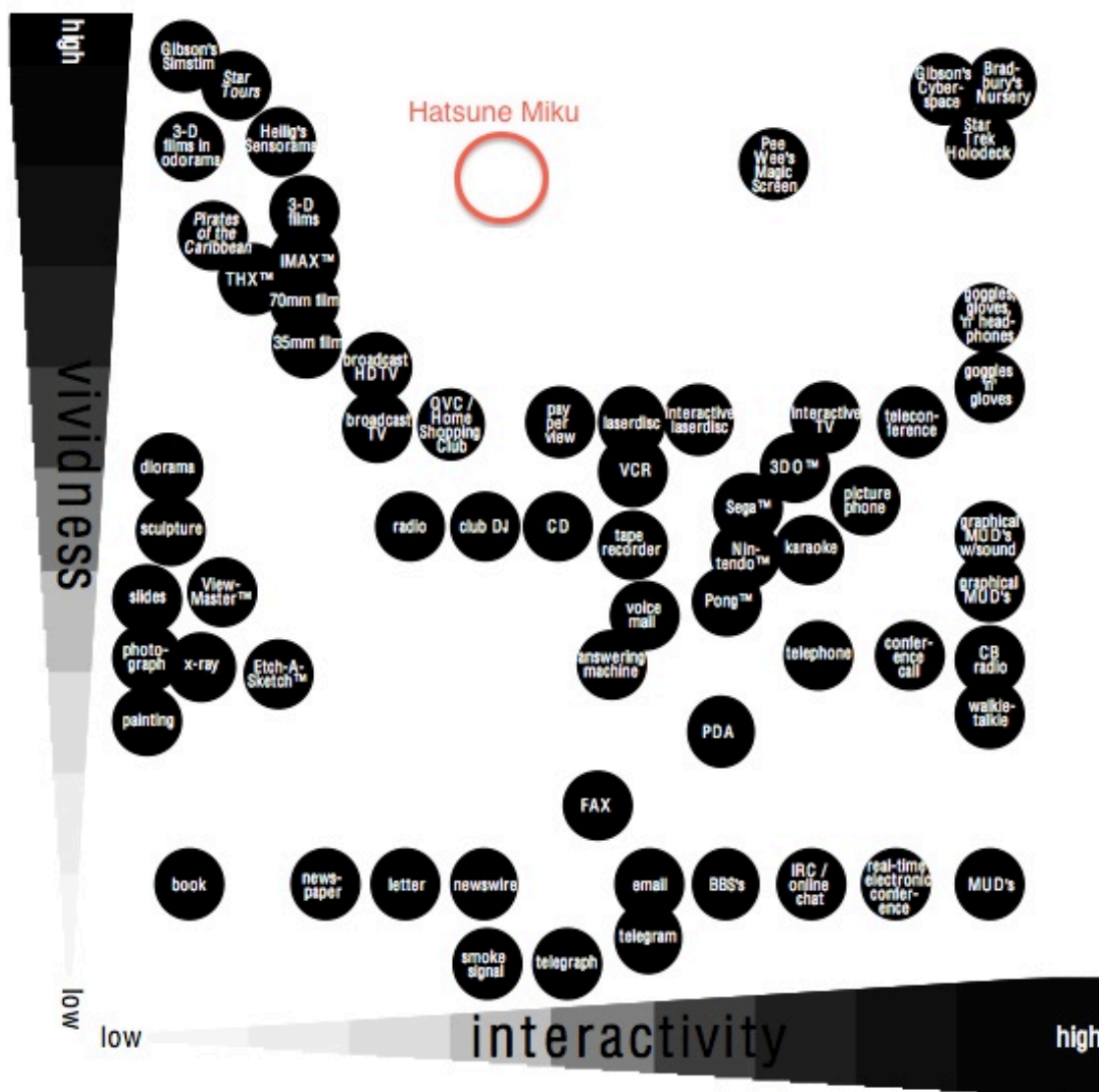


Figure 5: Steuer's graph of Various Media Technologies Classified by Vividness and Interactivity, with my addition showing where virtual pop star Hatsune Miku might fall (Steuer, 1993)

Also associated with presence, particularly in VR studies, is immersion, which Biocca describes as “the blocking out of the physical world” (Biocca, 1992, p. 8). Immersion is a level of involvement with an experience that reduces a sense of self, induces an intense concentration, and distorts time (Draper, Kaber, & Usher, 1998; Fontaine, 1992; Varney, 2006); that is, the user is so *present* in the *virtual* environment that he or she is not or at least is less aware of the *real* world. Given the previous delineation of presence vs. absence above, immersion, in a sense, turns presence (awareness of the external world) into absence (awareness of internal thoughts).¹⁶ Immersion requires a full sensory surround, particularly a 360-degree horizontal and vertical view of the experience (Grau, 2003), which includes a concert in a concert venue regardless of the humanity or virtuality of the performer.

This technological aspect of immersion is important to note. A defining element of presence, intertwined with immersion, is a lack of medium-awareness, a “perceptual illusion of non-mediation” (Lombard & Ditton, 1997). The International Society of Presence Research defines presence as “a psychological state or subjective perception in which even though part or all of an individual’s current experience is generated by and/or filtered through human-made technology, *part or all of the individual’s perception fails to accurately acknowledge the role of the technology in the experience*” (“The Concept of

¹⁶ A related notion is Mihaly Csikszentmihalyi’s concept of flow (Csikszentmihalyi, 1990), in which one is “completely involved in an activity for its own sake. The ego falls away. Time flies” (Geirland, 1996). Flow is essentially an intense but positive and creative feeling of presence (Heeter, 2003).

Presence: Explication Statement," 2000 my emphasis). Immersed in the experience, the user not only experiences a virtual world or object as immediate and present, he or she experiences it as if its presence is unmediated. This is a component of the richest explanations of presence and immersion. "With a VR system you don't see the computer anymore — it's gone," write Lanier and Biocca. "All that's there is you" (1992, p. 166). Murray & Sixsmith claim "the hardware of virtual reality must recede and become transparent for this sense of presence (or 'telepresence') to occur" (1999, p. 324). Speaking of direct human-computer interaction, via screens and VR head displays, Mark Lajoie notes, "To the extent that the terminal, as an interface, acts as an object, it is a constant reminder to users of their inability to become fully subject in the virtual space. In effect, it marks their lack of presence as subject within the virtual reality" (1996, p. 163). VR technology stands at "the current limit of the effort to create a communication/communion medium that is both phenomenologically engulfing and yet all but invisible" (Benedickt, 1991, p. 11). The advantage of virtual performer systems over previous VR headgear and even the everyday computer screen is that the projection technology is relatively easy to conceal. What better way to make the simulation technology recede out of sight, and thus out of mind, than by using it to project the simulation into real space, venues in which users are not normally accustomed to directly mediated experiences? In my own experience of a Hatsune Miku performance, this was the ultimate end of the presentation. I began viewing the concert present but unimmersed, overly aware of the technology and in fact searching for it within my field of view, second-guessing the performance and attempting to answer questions: Where are the projectors? Where is the clear projection surface? What is her range of motion along the

stage? etc. Within a few songs, though, immersion occurred and the technology was forgotten.

This end goal of a “perceptual illusion of non-mediation” is merely VR’s expression of the same transparency strived for in most art forms, from the “invisible style” of Hollywood filmmaking to the “fourth wall” in the theater. In fact, a 2001 study of VR immersion found parallels between the transparency of movies and that of VR experience, using Csikszentmihalyi’s term in concluding that “transparency keeps users in the ‘flow’ of their activities and consequently enhances experience in users” (Marsh, Wright, & Smith, 2001, p. 225). The extra element provided by VR, though, is inclusion, the ability to be surrounded by a new environment rather than merely looking at one through the keyhole of a screen — the ability to evolve beyond merely using the tech to inhabiting it (Bricken, 1990). But as the VR inverts and mixes with our own reality, we inhabit an augmented version of our own reality. Experiencing this in groups via staged music concerts, again we have to apply a social layer to this immersive experience and “the sense of community developed by interaction” (G. Riva, 1999).

In the end, it is the duty of VR designers to use their technology in a way that veils that very technology from view — from subtle projection of digital pop stars to selected framing of Muppets on back to the great and powerful Oz (keep the curtain closed!) — while keeping in mind that the technology is the direct provider of the immersive experience. A final summation for designers:

What does presence have to do with technology? Nothing. What does technology have to do with presence? Technology can be used to design and deliver experiences. Establishing explicit presence goals should help designers make design decisions and test prototypes to be sure that the intended effects are being achieved. Designers should consider the nature

of presence they intend to be experienced. Ideally, what should participants feel present to: a task, one or a few particular stimuli, or perhaps a gestalt impression? Is the participant provided with many possible stimuli to be present to, or is presence more directed to the designer's goals? Are "bumps in the road" built in to pull attention back to current perceptual stimuli? Mediated experiences may have presence consequences such as focusing, limiting, amplifying, or extending normal sensory stimuli. Even when technology is involved, it is the experience itself (the mediated experience) and not technology alone that engages the subjective experience of presence (Heeter, 2003, p. 344).

2. Robotics design

Disappearance of the technology means acceptance of the visual presentation as unmediated, as real, as something *familiar*. Presentations should be designed so that spectators eventually forget about the technology projecting them, yet each simulation is entirely dependent on the ability of that technology to reproduce a realistic — but not *too* realistic — illusion. Exactly how far to go along the scale of realism is the tricky part.

Studies show that human affective quality is impacted by the visual complexity of virtual worlds (Russell, 2003; Russell & Pratt, 1980) and that humans prefer complex (Roberts, 2007) and attractive (van der Heijden, 2003) visual stimuli. When that visual complexity adds up to a humanlike form, we tend to assume humanity in the object. Whether the visual complexity is real or projected, the human brain often fails to differentiate between reality and virtuality; the same neurons fire when we see the real Justin Bieber as do when seeing a virtual simulation of Justin Bieber (Blascovich & Bailenson, 2011). In addition, if an object — in particular, a machine or computer — displays qualities similar to a human being, we tend to assign some degree of sentience to the object. Blascovich & Bailenson claim that if viewers believe a virtual simulation to be an avatar, they will assume sentience and interact with it accordingly, as in any face-to-

face situation, but if viewers believe the simulation to be an agent, the assumption of sentience is less likely (Blascovich & Bailenson, 2011). However, most fans of Hatsune Miku are well aware that she is an agent, not an avatar, yet they react to her as they would to any human performer (real or avatar). Other studies, particularly *The Media Equation* by Reeves & Nass, show that humans respond to computers and virtual media as if they and their presentations were real (1996), and Nass' continued work has revealed that people "apply social rules and expectations to computers" (Nass & Moon, 2000, p. 82) (see also Yee, Bailenson, Urbanek, Chang, & Merget, 2007) in responses that are mindless (Langer, 1989), that is, restoring learned, simplistic response behaviors.

Avatars and agents thus far have been designed along the range of anthropomorphist qualities, from simple, blocky puppet-like simulations to detailed depictions with facial expressions. Many avatars and agents designed for use in business and medicine are little more than faces on screens (in the case of GPS navigation or smartphone assistance from Siri, just voices), rarely full-bodied simulations like 2.0Pac or Hatsune Miku. The level of anthropomorphism, however, has not diminished the affective quality or the typical psychosocial factors in our human interactions with them (G. Riva, 1999). If the simulation is realistic enough, the "Eliza effect" is achieved: the perception of subtlety, understanding and emotion in an agent as long as that agent doesn't destroy the effect (Weizenbaum, 1966). That affective quality can be transmitted via three variables of nonverbal communication: movement, anthropomorphism, and photographic realism. Hatsune Miku's movements are believable enough, as is her anthropomorphic humanoid form. She is not, however, a photographically precise representation of a human being; in all official Crypton presentations, she is depicted as a

line-drawn stylized cartoon character. Yet fans accept her, find her familiar, and the affective quality remains. Blascovich & Bailenson discount this third variable as the least important in the viewer's acceptance of a virtual simulation (Blascovich & Bailenson, 2011), but in designing these representations it is the most important variable to keep in mind and a tricky one to master, lest the simulation tumble into the uncanny valley. The successes of all the previous virtual performers chronicled above contain a common trait: As fabric puppets or two-dimensional, stylized animations, each anthropomorphized character was easier for the public to accept because their design stopped well short of the uncanny valley.

Robotist Masahiro Mori's theory of the uncanny valley suggests that human likeness in an artificial life form evokes our trust only up to a certain point (Mori, 1970), at which the potency of the resemblance becomes, in a word, creepy. As shown in Figure 6, familiarity with humanlike artificial lifeforms increases steadily as the resemblance grows, then suddenly the resemblance becomes unsettling and the lifeform is rejected; further beyond that, however, a near-perfect resemblance is accepted to greater degrees. That dip in the progressive familiarity response is the uncanny valley.

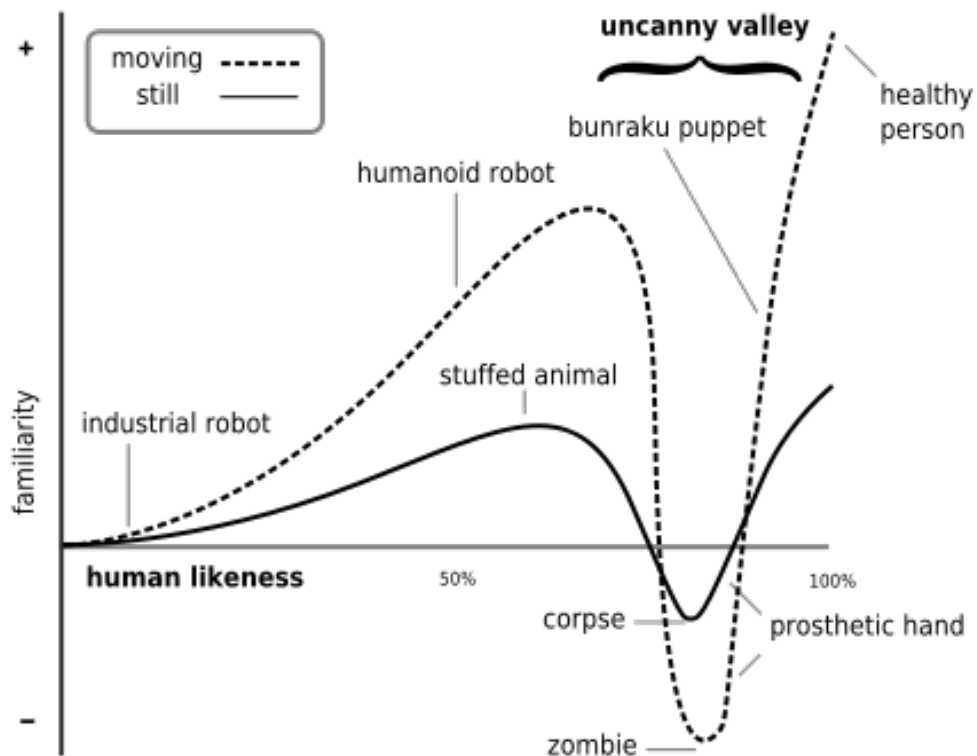


Figure 6: The uncanny valley as depicted by roboticist Masahiro Mori (Mori, 1970)

Mori's graph is populated by various humanoid representations and our resulting positive or negative responses to them. Stuffed animals and generally lifelike robots are elevated along the curve, and across the valley is the promised land of highly familiar, recognizable figures. But the uncanny valley directly addresses matters of life *and* death, with the lifeless or undead figures existing in the purgatory of unsettling unfamiliarity — the situation between the two discrete states making zombies even more frightful than an actual corpse. Thus, if a humanoid creation or representation seems not quite real enough, it evokes “dread and creeping horror” — the feelings Freud used to define his psychological concept of the uncanny (Freud, 1919).

Mori proposed his theory as an explanation of why certain inhuman objects made people feel unsettled and uncomfortable. Presuming that the end goal of robotics is to produce a synthetic device that looked and acted human, Mori sought to identify the cause of the creepiness and thus instruct designers how to avoid contributing to it. His application-oriented conclusion advises designers to create artificial life forms that stop just short of the uncanny valley rather than shooting for its far side (Mori, 1970). The advice largely has been heeded in his field. Honda's ASIMO (Advanced Step in Innovative Mobility) robot has been designed to look like a genderless child in a space suit, an aesthetic that "gives him a more likable and less 'intimidating' appearance" (diseno-art.com), and MIT's Humanoid Robotics Group, despite its name, avoids designing devices that look too human (Group, 1994-2003).¹⁷

Mori developed his theory with androids in mind, but it also has been applied for decades within animation and computer-generated special effects. Creators of digital entertainment content ignore the uncanny valley at their peril. Echoes from the depths of its real/not-real abyss resounded throughout criticism of two films that attempted to push the boundaries of digital human imagery: 2001's "Final Fantasy: The Spirits Within" and 2004's "The Polar Express." Both films utilized performance capture, a technique in which human actors perform movements that are filmed and translated into lifelike digital animation — turning human bodies into "information processing devices receiving and transmitting signals to effect goal-directed behaviour" (Hayles as quoted in Aldred,

¹⁷ ASIMO himself has flirted with music celebrity. On May 13, 2008, the robot successfully conducted the Detroit Symphony Orchestra in a live performance of the song "Impossible Dream" during a charity concert. Watch video of the event here: <http://www.youtube.com/watch?v=qRUyVCfFh1U>.

2011). The creators of both films strove for photo-real presentations — the far side of the uncanny valley. But their attempt fell short, and they plunged into it instead, with each film receiving considerable media and audience backlash over the creepiness of the depicted characters.

“The Polar Express” is a Christmas fantasy story about a young boy who boards a magical train to the North Pole. The film is entirely digitally animated, with the movement and expression of most human characters based on performances captured from real-life actors. Film critic Roger Ebert wrote of “The Polar Express” — directed by Robert Zemeckis, who years earlier had mixed live action with animation in the film “Who Framed Roger Rabbit” (1988) — that its characters “don’t look real, but they don’t look unreal, either; they have a kind of simplified and underlined reality that makes them visually magnetic,” even though he opened his review by noting, “It’s a little creepy” (Ebert, 2004). While the animation of “The Polar Express” was based on human performance, the film’s publicity emphasized the presence of the central human star behind the computerized sheen on screen, Tom Hanks. Likewise, the film itself presents its digital depictions as elaborate costuming, rather than replacing or replicating the self. “The Polar Express” seems to “construct its digital human characters as extending and enhancing human agency” (Aldred, 2011), as if the transformation of humanity into digital imagery were merely augmenting human faculties rather than realizing Marshall McLuhan’s theory of auto-amputation (McLuhan, 1964). Given what was noted earlier about humans bestowing acceptance of artificial humanoids more quickly if they are assumed to be avatars rather than agents, this could have been a shrewd move on Zemeckis’ part to attempt bridging the uncanny valley.

Filmmakers behind “The Polar Express” also may have been attempting to learn from the mistake of the “Final Fantasy” film, which eschewed a celebrity figure and created its digital star, Aki Ross, from scratch as a composite of bodily, facial and vocal performances captured from several different actors and stand-ins. (Often during production, director Hironobu Sakaguchi and lead animator Roy Sato took turns positioning themselves as Aki’s physical source material (Aldred, 2011)). Jessica Aldred claims this technological scenario could change the definition of a performer, while Sato echoes the labor frustrations of the Archies’ Don Kirshner when he revels in the creative freedom he enjoyed from demanding, idiosyncratic human actors (“Unfortunately, actors are kind of bound to their own personal style, their own personal way of doing things. Whereas with Aki, well ... I can make her do anything I want”). Hanks, in turn, even raved about the “freedom and the possibility” the technology gave him to expand his performance range (“You will no longer be limited by your size, shape, skin colour, age or gender. If you have the interpretation that the director wants for the role, then you can play any role. I could play Florence Nightingale, I could play Abraham Lincoln, and so could Meryl Streep”) (Aldred, 2011). Andrew Darley refers to this result as “second-order realism,” a severing of the connection between photographic image and its original subject (2000, p. 82). “Simply put,” Aldred echoes, “it strives to replicate cinematic realism, but without any connection to the real-world referent” (Aldred, 2011). This second-order realism overtly demands extra scrutiny by the audience. Critic Roger Ebert described “Final Fantasy” as

a world that is neither live action nor animation, but some parallel cyberuniverse. The characters live in that cyberspace, too. Not for an instant do we believe that Dr. Aki Ross, the heroine, is a real human. But

we concede she is lifelike, which is the whole point. She has an eerie presence that is at once subtly unreal and yet convincing. Her movements (which mirror the actions of real actors) feel about right, and her hair blows convincingly in the wind. The first closeup of her face and eyes is startling because the filmmakers are not afraid to give us a good, long look — they dare us not to admire their craft (Ebert, 2001).

This teased-out, intensified — and, as Ebert points out, facilitated and encouraged — gaze produces a “heightened and hyperbolic form of judgmental attention,” a closer scrutiny than we would give normal cinema or less-uncanny animation (Sobchack, 2006, p. 179).

In fact, as analog and digital media have converged, new patterns of consumption across the board have fostered this enhanced mode of engagement (H. Jenkins, 2006), patterns which both illuminate and realize one of the defining characteristics of the postmodern condition, Baudrillard’s notion of the hyperreal: “A hyperreal henceforth sheltered from the imaginary, and from any distinction between the real and the imaginary, leaving room only for the orbital recurrence of models and the simulated generation of difference” (Baudrillard, 1994, pp. 2-3) or, as Mark Poster sums it up, “the duplication of the real by means of technology” (Poster, 1998, p. 42). Baudrillard saw the concept of virtuality not just within technology but within an acceptance of images as reality he believed to be perilously pervasive throughout society. That is, when the virtual object is present and the antecedent of its simulation is not, the virtual is thus real — and thus less uncanny. Umberto Eco picks up the hand-wringing in his *Travels in Hyperreality*, fretting over Disneyland tourists’ allegedly greater fascination with mechanical pirates and jungle animals than with human actors and live animals (as

quoted in Ryan, 2001).¹⁸ But this is the intensified gaze described earlier — an additional layer of appreciation for the art, not a subtraction of desire. Viewing of the reproduced, virtual object encompasses the usual aspects of aesthetic judgment *plus* the added aspect of appreciating the art and craft that went into the design of the simulation. Immersion isn't total — perhaps we've been applying too isolationist a word to the experience — and, as Ryan argues, we remain able to exercise our critical faculties in the experience (Ryan, 2001). Designers want the simulation medium to be transparent, but viewers require enough information about the medium to operate on this heightened level of presence and awareness. A delicate balance, indeed.

Spectators, in other words, are active in the entertainment, not passive recipients. Contemporary communication theory and performance studies have moved well beyond the previous notions of overly receptive audiences susceptible to any shot from media's hypodermic needle (Bineham, 1988) and have begun to embrace a concept of playful, intentional, media-savvy audiences quite aware of the illusions presented to them and the fluctuating boundaries between the real and the virtual. Jane McGonigal cites historian Tom Gunning's observations of early experimental cinema: "The spectator does not get lost but remains aware of the act of looking." She calls this the "meta-pleasure" of simultaneously admiring an artist's mastery of the medium and immersion in the art's narrative (2003, p. 5).

¹⁸ Both Baudrillard and Eco ascribe the hyperreal and the subsequent omnipresence of technological simulations of real objects, people and places to be a condition peculiar to postmodernism. However, worry over technologically reproduced art was floated during the modern era in Walter Benjamin's famous essay "The Work of Art in the Age of Mechanical Reproduction" (Benjamin, [1936] 2008).

Our lifelong pervasive media exposure and its resultant conditioning also is a key factor in our acceptance of pop star simulations. While on the surface such presentations are technological spectacles worthy of awe, on many levels they are not *that* foreign, upsetting or jarring within most people's everyday experience of new media. Television and movies are saturated with digital special effects, from 3D depictions of tactical maps to holodeck characters and supernatural energy; entire programs now exist that are entirely CG, for young (from "Aqua Kids" to "Zigby") and old ("Star Wars: Clone Wars," which depicts humans, androids and aliens). Jon McKenzie differentiates between what he calls VVR, "virtual virtual reality" (the depictions of VR and holography we witness in novels, movies and television), and actual digitally immersive VR (1994, p. 91). Media consumers encounter VVR even well beyond the expected sci-fi realms, from the virtual designs and 3D blueprints of renovation experts on home-and-garden programs to the assistive conversations we conduct with Siri in the palm of our hands. In daily life, we regularly interact with virtual representations in business, education and entertainment, even dating and sex (Blascovich & Bailenson, 2011). Younger people especially are inoculated with virtual experiences; a Kaiser Family Foundation study reports that kids spend eight hours a day on digital media outside of classroom (Rideout, Foehr, & Roberts, 2010), much of that being social media involving presence and avatars. As Hayles suggests, we live in a "virtual condition" (Hayles, 1999, p. 18) in which we have learned to balance the real and the virtual moment to moment.

Japanese people, especially, swim in a new-media sea that prepared them for a phenomenon like Hatsune Miku. Roland Kelts' *Japanamerica* attempts an overarching explanation of the historical and cultural factors that established Japan as both a market

for high-octane fantasy narratives and an exporter of a 21st-century, high-tech style of cool (often called Cool Japan, “a catchphrase referring to the hoped-for economic and political influence of the nation’s content industries” (Condry, 2009, p. 2)) (Kelts, 2006). Japan’s economic recession at the end of the 1980s, Kelts argues, triggered a cultural renaissance similar to that which accompanied the Great Depression in the United States. By 2002, journalist Douglas McGray referred to Japan’s “gross national cool” (as quoted in Condry, 2009, p. 8) as a means to highlight “the export of cultural goods and styles that have become not only conspicuous proof of Japan’s international relevance, but also a powerful commercial force” that could “lift the nation from its economic doldrums” (Condry, 2009, pp. 8, 9). The quickest summation of the economic origins of the new Japanese pop culture paradigm comes from “The Mirror of Idols and Celebrity,” Patrick Galbraith and Jason Karlin’s introduction to their pivotal collection, *Idols and Celebrity in Japanese Media Culture*:

The concentration of media institutions in postwar Japan has produced a self-referential system of representations that has remade everyday life in the image of consumer capitalism. The ethic of hard work and diligence that propelled Japan’s postwar economic “miracle” reached a critical juncture during the 1970s ... During the 1980s, the rise of the bubble economy marked the excesses of the consumer-capitalist regime, embodied in the idol (Galbraith & Karlin, 2012, p. 13).

Indeed, as the recession took hold of Japan, its “golden age of idols” emerged — a marked rise in the emergence and media omnipresence of young, usually female pop stars (Matsutani, 2009). Pop idols are “highly produced and promoted singers, models and media personalities” who are, perhaps because of the heightened circumstances of the recession, “packaged to maximize consumption” (Galbraith & Karlin, 2012, p. 2). As a

result, Japanese idols are utterly disposable, rising and disappearing quickly — hundreds of them a year in Japan alone, along with dozens in surrounding Asian countries, all contributing to a contemporary “highly saturated media environment that produces celebrity spectacle for the purpose of promoting goods and services” and a modern “hyper idol age” (Galbraith & Karlin, 2012, p. 25), a term meant to invoke “hypercapitalism” (Graham, 2006).

Hypercapitalism is a deregulated form of capitalism that permeates once-separate spheres of culture and commerce (Vujnovic, 2012), and the idol culture as endemic of hypercapitalism also has spilled its banks and reached populations and segments it previously might not have (Galbraith & Karlin, 2012). Particularly online and through social media, consumption of pop idol narratives in Japan once was an activity written off primarily to the *otaku*, a tricky slang term:

In the late-1980s the terms *otaku* and *otaku-zoku* (otaku-tribe) came on the scene to refer to young people with an obsessive interest in some aspect of popular culture which they accessed through the emerging computer/Internet technology without ever leaving their bedroom. ... But unlike ‘hacker,’ *otaku* refers not just to someone skilled in using computers in nontraditional, unintended, and anti-authoritarian ways, but to someone whose computer interest and acumen is in the service of their obsession with a particular area of popular cultural knowledge. One is not just an *otaku* but a *manga*-(comic book-) *otaku* or a *pop-idol*- (pop-singer-) *otaku* or a Twin Peaks-*otaku* (Tobin, 1998, p. 109).

In the West, we call them nerds, geeks, obsessive fans. But just as those terms in the West, however, have been reclaimed as a symbol of pride and thus labeled or been self-applied to a wider range of consumers, the *otaku* are likewise “a broad section of contemporary Japanese youth ... the largest subculture in contemporary Japan — as invisible as it is immense” (Kinsella, 1998, p. 289). Plus, fan behaviors once attributed

only to the *otaku* are now visible throughout society (Galbraith & Karlin, 2012). Add to that two more important factors — the fact that, as Kelts claims, Japanese consumers nurture fantasies quite similar to their American counterparts but take those fantasies much more seriously (2006), and the fact that in Japanese entertainment there is less of a clear division between fictional narratives and real ones (“...the same qualities that define reality TV are central to Japanese television programming and its celebrity system”) (Galbraith & Karlin, 2012, p. 6) — and you have a market easily primed for the reception of a virtual pop idol.

Also relevant is Japan’s fixation on characters in entertainment and marketing — and not just any characters, cute ones. “If you haven’t lived in Japan,” Ian Condry writes, “it may be hard to appreciate how ubiquitous are the images of characters. They advertise everything. Cutesy characters often adorn business cards of serious companies and even government agencies” (2009, p. 14). Think of the ultimate cute Japanese character, Hello Kitty. Daniel Black’s excellent survey of this unique aesthetic, “The Virtual Ideal: Virtual Idols, Cute Technology and Unclean Biology,” shows how the “cult of *kawaii*, or ‘cute’” (2008, p. 37) brings us back to the application of Mori’s uncanny valley in the design of virtual idols. The cute aesthetic, Black observes, manipulates the previously discussed human tendency to anthropomorphize, reimagining the human body in ways that amplify (or improve) its most desirable features. Such streamlining “moves away from an admiration of the machine as machine and towards a desire to have the machine appear more like a living thing,” ultimately producing “simultaneously a representation of the human body, technology designed according to organic principles, and a cute character” (Black, 2008, pp. 44-45). As the product of a content collective, Black also ties the issue

of labor to a virtual idol's emergence from the more difficult-to-manage pool of more demanding human idols:

The virtual idol can therefore be understood as a logical progression from the more established model of idol creation. Rather than invest considerable time and resources in the moulding and packaging of a biological body in order to create a product which can only ever approximate an ideal, and which will inevitably lose its appeal as it ages, the virtual idol promises the possibility of building an idol to order, ensuring that it perfectly reflects consumer tastes and will never change. Key to the virtual idol's desirability, therefore, is its freedom from the biology which ages the living idol's body and impedes attempts to refashion it to match consumer tastes. Currently, the virtual idol remains dependent only upon the biological body for its voice, and Yamaha has recently produced Vocaloid ... Presumably it is only a matter of time before the virtual idol cuts the last cord of biological dependency (Black, 2008, p. 39).

Even human idols now are turning to Vocaloid software to stay current and maintain their hit status. The popular idol group YMCK, for instance, in 2009 released an entire album using the Hatsune Miku vocal software (I. Martin, 2012).

The cultural influence of Japanese cultural production in these recent boom years has made its impact beyond its own borders and even well beyond Asia. Japanese cultural products have infiltrated the West in the form of TV series ("Pokemon") and video game platforms (Gameboy, Playstation), and Japanese manga and anime have become popular exports as well as influences on other animated productions. In pop music even, erotic anime visuals appeared on screens during one of Madonna's world tours, and American band the Flaming Lips composed and released a concept album about a fictional anime heroine called "Yoshimi Battles the Pink Robots" (Richardson, 2005, p. 4).

Most modern cultures, too, possess a fairly standardized narrative of the pop music star. When Miku was first designed for Crypton's software marketing, she was

fashioned to conform to the familiar narrative of a young pop starlet. Without a human being to base her on, the choices of design were made as a collage of pop star tropes. The “Final Fantasy” and “Polar Express” films created their avatars and agents using performance-capture techniques. Those characters were digitally embodied from human models directly transferring their live action into digital presence. 2.0Pac and Hatsune Miku, however, were created without direct human models. Hatsune Miku’s videos and live performances are animated from scratch, and while 2.0Pac is based on the former appearance and movements of the late rapper the simulation was created also from scratch without direct transfer from existing video. The virtual pop star’s most direct antecedent is the familiar narrative of the pop star itself.

That narrative (any narrative) is crucial to the next step in successfully experiencing a virtual performer. If all these cultural and economic factors are in place, and if the simulation is sufficiently present, vivid, and lifelike — if we are interacting with the virtual object or environment in a way that is indistinguishable from interactions with a real object or environment, that is, if simulation fidelity is achieved (Mania & Chalmers, 2001) — then we are able to suspend disbelief (Bates, 1991). This is the crucial function that allows a mere moment of awe and spectacle to transition into hours of entertainment and enjoyment. Pimental & Texeira: “The question isn’t whether the created world is as real as the physical world, but whether the created world is real enough for you to suspend your disbelief for a period of time” (1993, p. 15).

Richard Schechner’s theory of performances in everyday life is divided along the line between make-believe and make-belief. In the former, the distinction between what’s real and what’s not is kept clear. The conventions of an artistic performance (“the stage

itself as a distinct domain, the opening and closing a curtain or dimming the lights, the curtain call”) usually facilitate this and help to “mark the distinction between pretending and being” (Schechner, 2006, p. 35). Make-belief performances, however, “create the very social realities they enact” and “intentionally blur that boundary” (Schechner, 2006, p. 35). Jane McGonigal applies Schechner’s dichotomy to her study of pervasive gaming:

In make-believe games, he suggests, players *pretend to believe*; in make-belief games, players willfully “forget” or deny their own performance and thereby enable themselves to *believe for real*. But I want to resist this emphasis on the degree to which players are conscious of their performance, as if this self-awareness were a kind of psychological safety net always in danger of falling (or being intentionally tossed) away. I propose, instead, that the frame of representational play remains visible and sturdy to players in even the most believable performances of belief (2003, p. 4, original emphasis).

Acceptance of a virtual simulation can be achieved as described, but to reach and maintain some level of immersion, a corresponding narrative is required (Sherman & Craig, 2003). Alessandra Gorini, Giuseppe Riva and others theorized along these lines, claiming that suspension of disbelief in a virtual experience was made easier by adding narrative — a hypothesis they empirically measured, testing subjects inside VR environments both neutral and narrative and concluding that the narrative “characters and objects, as well as the environment itself, were perceived as more real, and the experience was judged more interesting and involving than in the non-immersive condition” (Gorini, Capideville, De Leo, Mantovani, & Riva, 2011, p. 103). Narrative doesn’t necessarily require full-scale plot development and a corresponding lengthy virtual experience. Ryan’s textual approach to virtual immersion calls for designers to “construct the setting for a potential narrative action, even though it may lack the temporal extension to

develop this action into a plot” (Ryan, 2001, p. 15). The narrative doesn’t have to be complex or even complete. In Japanese anime, performances are driven less by narrative than by strength of character, which itself makes products easier to present in different media and thus keep transmedia stories going (Condry, 2009).

Within VR and gaming, a good amount of study has been done of successful character design (Freeman et al., 2003; Garau, Slater, Bee, & Sasse, 2001; Goetz, Kiesler, & Powers, 2003; Pertaub, Slater, & Barker, 2002; Vinayagamoorthy, Steed, & Slater, 2005; Zagalo & Torres, 2008), social interaction (Breazeal, 2002; Cassell et al., 1999), and displays of emotion (Haringer & Beckhaus, 2012; Martinho, Paiva, & Gomes, 2000). Emotions are important to human cognition and are crucial to the establishment of believability (Dautenhahn, 1998), and a corresponding narrative contributes to and greatly enhances the affective quality of a virtual experience (Louchart & Aylett, 2003). The characters we see within this narrative experience, though, don’t have to appear perfectly realistic. One survey of VR character studies concluded that increasing photorealism of virtual characters is not sufficient to increase human response (somewhat supporting the uncanny valley theory) and that subtle behavioral cues can do more to facilitate a human bond with a virtual character than most other components of fidelity (Vinayagamoorthy et al., 2005). These studies all approached our earlier cognitive/technological delineation of what is virtual, concluding, as Hoorn et al. did, that in designing VR “experience instead of technology is the key word. VR is not a technique; it is one possible outcome of the biological capacity to *imagine*, to think in advance, and be prepared” (Hoorn, Konijn, & van der Veer, 2003, p. 19). In other words, don’t turn up the resolution, turn up the emotion:

Today's tendency in VR is to boost the number and quality of the realistic features at the cost of the unrealistic features ... However, no matter how many realistic features are brought in, the represented reality remains virtual. In view of the state of the art, there is always a contextual cue (e.g., the head-mounted display unit) that makes the user aware things are not real ... There even may not be a need to capitalize on realistic rendering to obtain the desired effects (Hoorn et al., 2003, p. 21).

3. Performance studies

So content is king. But an emotional character and his or her narrative requires a framework: a performance. In fact, more descriptions of presence argue for a concept having less to do with integrating technology than with designing a content-driven, performance-related experience, that is, “the question of human performance, of designing experience, alters the values and goals of technological performance” (McKenzie, 1994, p. 88). This is the underlying thesis of Brenda Laurel's cornerstone work, *Computers as Theatre*, which contains a full chapter outlining the “Design Principles for Human-Computer Activity” (those principles being these: action, character and thought, language and communication, enactment). For Laurel, “designing human-computer experience ... [is] about creating imaginary worlds that have a special relationship to reality — worlds in which we can extend, amplify, and enrich our own capabilities to think, feel, and act. ... [and] the theatrical domain can help us in this task” (1991/1993, pp. 32-33). This led Jon McKenzie to conclude: “What we are witnessing in the late-20th century with VR is perhaps less the birth of an electronic theatre and more a rebooting of the human performance paradigm” (1994, p. 90).

The attributes that contribute to the believability in and acceptance of a Hatsune Miku performance barely differ from those of a human performance. Schechner, who

coined the term performance studies and helped establish the field, postulates that a performance is any behavior that is “restored” or any human action or event that has been constructed through rehearsal and preparation, and then “framed, presented, highlighted or displayed” (2006, pp. 36, 32), building on Erving Goffman’s much earlier definition leaning toward effects: “A ‘performance’ may be defined as all the activity of a given participant on a given occasion which serves to influence in any way any of the other participants” (1959, p. 15). From these overly broad foundational perspectives, performance can include not only theater and music concerts but sporting events, religious rituals, even certain uses of language — any action that is “showing doing,” that is, spotlighting the action (Schechner, 2006, p. 28). Under Schechner’s welcoming rubric especially, the idea of performance assumes a theatrical dimension to nearly all human activity and thus can be applied to any conceivable action or event. This is far too broad an application of theory, particularly for the purposes of this study. In the case of virtual pop stars (and, I would venture, in most cases), it’s unnecessary to explicate the performance studies concept that deeply because the simulations we’re dealing with are presented exactly in the way most people commonly understand the framing of an artistic performance: a singer with a band on a stage. Indeed, an assumption of normalcy is the simulations’ chief goal.

Schechner, however, supports the manufactured performance of a virtual pop star by his inclusion of context and interactivity. A performance is not just the action of the performer but the action of the audience, too — their inclusion, attendance, reaction — and the corresponding preparation and aftermath on both sides (beforehand, performers rehearse, audiences schedule and make plans to attend; afterward, performers and

audience both may read and discuss criticism of the performance). A performance doesn't lie within the performer or the audience but in what occurs between them. So even if the performer is programmed and animated so that each performance is exactly the same, the concept of performance is completed by its context and interactivity:

What about mechanically, digitally, or biologically reproduced replicants or clones? It may be that a film or a digitized performance art piece will be the same at each showing. But the context of every reception makes each instance different. Even though every "thing" is exactly the same, each event in which the "thing" participates is different. In other words, the uniqueness of an event is not in its materiality but in its interactivity (Schechner, 2006, p. 23).

Indeed, "presence in the theatre has less to do with the distinction between speaking and writing than with the way in which the architectural and technological components of the performance space either promote or inhibit a sense of 'reciprocity' between actors and spectators" (Copeland, 1990, p. 30). Then again, a theatrical performance can exist without even a specially designated performance space, without costume, without effects of any kind; the only requirement for performance is an interactive relationship between performer and audience (Grotowski, 1968).

Specifically, the primary task of a musical performance is to express the structure of the music (and, if applicable, lyrics) so that the listener might grasp it, appreciate it, and leave it with an impression having been made (Lussy, 1882; Stein, 1989). This is accomplished through the listeners' perceptual and cognitive abilities, and is divided between two basic aspects of a musician's performance: a normative aspect (those qualities expected of all competent performers) and an individual aspect (those qualities that make the particular performer unique, defined either by how they differ from the

normative commonalities or by how they redefine what is normative) (Repp, 1992). The primary struggle of performance criticism is distinguishing between and grading the various scales of the two — a challenge given that, as speech psychologist Bruno Repp has observed, there is no agreed-upon vocabulary to describe them:

Although volumes have been written about different performers and their characteristics, these discussions rarely go beyond generalities, and the vocabulary used . . . are not specifically linked to particular performance properties; they also may be used differently by different writers. There is no consistent terminology, nor a well-developed and generally accepted theory of performance description and evaluation, that would make possible an objective characterization of performance commonalities and differences. Music criticism is an art rather than a science, and the critic's impressions, accurate as they may be, are filtered through an idiosyncratic web of personal experiences, expectations, preferences, and semantic associations. In fact, the belief is widespread that performance differences cannot be characterized objectively (1992, p. 228).

In theater and in film, believability is conferred by displays of emotion generated within the context of actual, physical actions (Stanislavski, 1988) and clear displays of vulnerability, humility and confidence (Geduld, 2012). Pop music scholar Simon Frith has suggested that singers resemble film actors more than stage actors in that the singers actually perform (on stage and on record) two separate characters — a “double enactment” of their more “personally expressive” self, singing from their own experience, and the persona of their particular character or material. “They enact both a star personality (their image) and a song personality, the role that each lyric requires,” Frith writes, “and the pop star's art is to keep both acts in play at once” (1996, p. 212). Performance studies scholar Philip Auslander breaks these into three ongoing roles for the pop singer: the real person (the human performer), the performance persona (Frith's star personality), and the character (Frith's song personality) (2004, p. 6), a further

emphasis of the performer's charge to both be himself and not be himself (Schechner, 2006). The degree to which and the direction in which these roles develop and evolve "are subject to delicate negotiations with the audience" (see Figure 7) (Auslander, 2004, p. 9). Offstage appearances remain part of the performer's overall persona and should not be assumed to be a genuine presentation of the performer's real personality (Auslander, 2004), though thus far virtual pop stars such as 2.0Pac and Hatsune Miku have not been presented in offstage settings, conducting interviews or appearing for paparazzi.

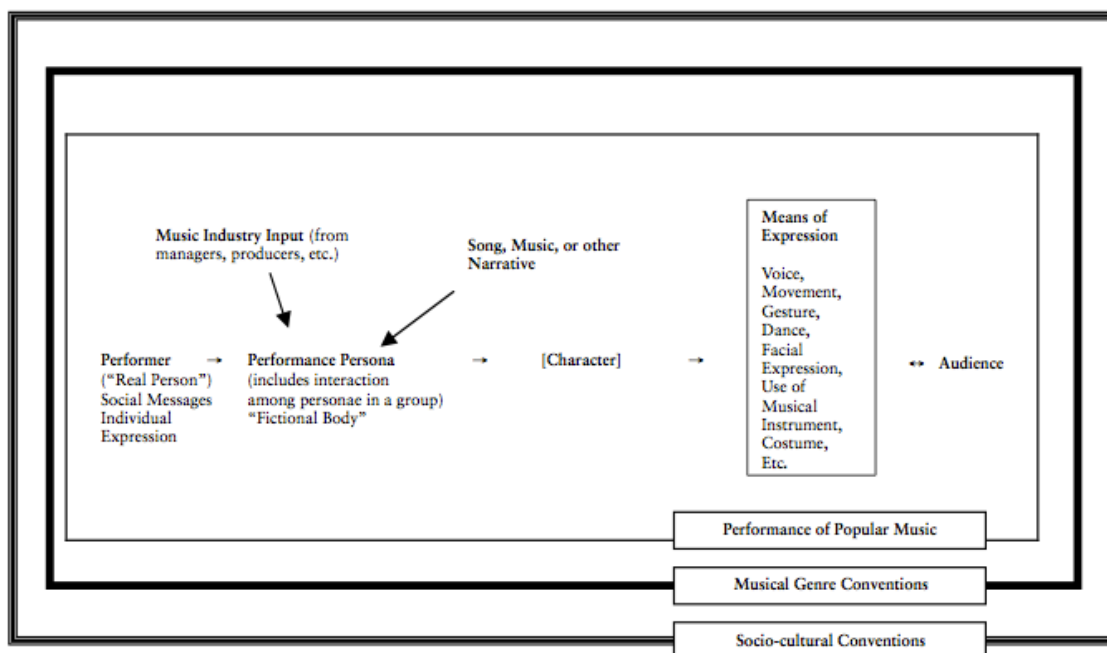


Figure 7: Philip Auslander's model of pop music performance (Auslander, 2004)

Since, as philosopher Theodore Gracyk contends, the primary text of pop music is its recordings, then pop concerts are already visual manifestations of what is now chiefly a digital aural medium (1996), an outlook echoed by cultural studies titan Lawrence Grossberg and his argument that pop concerts are merely after-images of the material contained in the sound recording (2002). That does not, however, imply a degradation of expectations from the recorded performance to the stage. Even before seeing the music performed, Auslander explains, fans already have experienced the sound recording as an embodied performance and “regardless of the ontological status of recorded music, its phenomenological status for listeners is that of a performance unfolding at the time and in the place of listening” (2004, p. 5). That is, technological and digital production of sound arrives on stage already intertwined with a performative experience.

If we’re getting into staged performances that are mediated visually, aurally and other ways, then we’re returning to Baudrillard and his sense of the hyperreal, “a reality so mediated by media that we’re no longer capable of distinguishing ‘the real thing’ from its simulation (or maybe it’s just that we so often seem to prefer the simulation to the real thing)” (Copeland, 1990, p. 29). By his standard, all reality is always mediated, presented as previously reproduced (see also Auslander, 2000b; Jameson, 1993). Increasingly, this is true of staged performances. Whereas classical music remains dominated by live human performance (Lipman, 1990; Philip, 2004), recorded performances — or the style of their particular sound — dominate most other media or are at least in the forefront of the aural experience. (Likewise, the majority of performance and musicology scholarship uses recorded performance as the primary source material (Dogantan-Dack, 2012).) Specifically, musical theater has witnessed the greatest affective transformation in this

regard — now commonly using microphones in order to sound more natural to an audience conditioned by television and recording technologies (indeed, such usage is a vicious circle, in that “the use of relatively invisible microphones placed on the bodies of actors only reinforces our perception of an amplified voice as ‘natural’” (Auslander, 2000b, p. 36)) — and Jonathan Burston’s excellent study of technology’s impact on a specific evolutionary form of musical theatre he calls “megamusicals,” high-stakes stage productions designed in the context of global touring and big business, illuminates much about virtual pop stars’ peculiar qualities of liveness. To mount and tour a standardized production of, say, “Cats,” “Phantom of the Opera,” or “Chicago” requires a standardization of production that is technologically assisted if not based. Much live theater now uses microphones, but the acoustic designs for the larger megamusicals have introduced and codified an audio-visual separation now common to watching television and movies, even pop concerts with human performers. Burston does not cite Baudrillard but he uses his term to describe the new sound on stage:

Within the parameters of the megamusical aesthetic, it can be said that live musical theatre is no longer expected to produce a ‘live’ sound. Instead, it now aims to reproduce an acoustic entirely identifiable with digitally recorded music. It also aims to carry its scrubbed, undistorted timbres out to its audience almost exclusively via loudspeaker technology. It strives to create *a kind of hyper-real sound*, closely and indeed often deliberately linked to the aesthetics of the compact disc. Crucially, the new sonic aesthetic of the megamusical has as its musical corollary the conspicuously ‘global’ pop songwriting style which I call the ‘FM sound.’ (1998, p. 208, my emphasis)

Miked sounds produced to fit the radio aesthetic reduce qualities of liveness, and Burston cites John Corbett’s concept of “fetishistic audiophilia,” or the desire “to separate the sound of music from the body performing it” (Burston, 1998, p. 210) thus effecting

Corbett's separation between music and musician (and referring back to the "second-order realism" mentioned earlier (Darley, 2000, p. 82)). Recording technologies limit the sounds of breath and movement, and microphones allow vocals to be clearly projected at the audience even when the performer is facing upstage. Thus, "the sound of the body is evacuated from the stage even as its image remains" (Burston, 1998, p. 213). This disembodiment serves to "widen the gap between the bodies of performers and the sound of their music" — a division which, if left unchecked, inevitably leads to yet another apocalyptic prediction: "the elimination of the musician" altogether (Corbett as quoted in Burston, 1998, p. 210).

Burston cites Broadway sound designer Tony Meola describing the separation effect as "an invisible curtain" between audience and performer (1998, p. 212). Roger Copeland's study of mediation effects in the theater cites Richard Foreman's 1988 conceptual production "What Did He See," in which "a transparent, Plexiglas wall separated the audience from the performers. The actors' voices were heard 'indirectly,' filtered through microphones and speaker systems" (Copeland, 1990, p. 28). The technology used to present today's virtual pop stars, as previously described, uses just these — an invisible curtain, on which 2.0Pac and Hatsune Miku are projected, and its resulting separate but synchronous sound reproduction. Again, this is a technique we've had exposure to even in the context of human performers who lip-sync during pop concerts — or, more common these days, rely on "support vocals" from recordings or unseen performers as they dance, further separating the actions of the body from the sound the audience receives — and who are roundly criticized (and, in the case of Milli

Vanilli, censured) when the technology experiences an error and shows the audience exactly where this division lies.

The mixing of live performance with electronic media imagery has been another challenge to the previous performance paradigm. For many years, theater productions and pop concerts have incorporated film and video in their performances, from artistic uses (Philip Glass' "1000 Airplanes on the Roof," a staged melodrama in which a live actor appears to move in and out of projected film scenes) to more logistical ones (video screens at concerts help ticket buyers justify dropping money on those nose-bleed seats). While Blau claims such juxtaposition causes a "confusion of realms" (1982, p. 113), Auslander defends the hybrid as a natural evolution of performance (2000a). Paul Sanden goes as far as to delineate between "corporeal liveness" and "virtual liveness," the latter being performance that surpasses human abilities by means of added sound or visual effects. These enhancements do not, he argues, erase all traces of liveness from the performance or diminish the central importance of recognizable, human performance. Referring to the concept of virtual pop stars as "sounding cyborgs" (Sanden, 2012, p. 46), Sanden explains how an audience fills in the mediatized blanks:

... listeners, in seeking their own subject positions, may also assign subjectivity to that with which they seek communication (in this case, what they hear on a recording), even when they know there is no 'real' performing human body producing those exact sounds — when physical boundaries of human music performers are surpassed by technological means. In other words, they construct a virtual performing 'You' — a performing persona — in order to complete the line of communication (2012, p. 49).

Given that, as Auslander argues, images broadcast through media are not merely reproductions but performances in themselves (1997), and given the power of virtual pop

stars to be presented through many media — to, as Patrice Pavis noted about mediatized performance, “easily multiply the number of their spectators, becoming accessible to a potentially infinite audience” (1992, p. 101) — it’s intriguing that their concert performances have thus far occurred in the physical spaces where human performances take place. Hatsune Miku performs on stages built for human performers, and does so accompanied by human musicians alongside her. Why not simply create and distribute a video of Miku with animated musicians on an animated stage? First, because this would not be done “simply”; the extra labor of animating an entire environment is considerable and costly. Second, remember Miku’s *raison d’être*: she was — and still is — a marketing symbol for a human vocal synthesizer. The goal is to present the simulated voice in its immediately understood context for the purposes of showing off the software available for purchase rather than merely animating an entertainment experience. Performance is “lively”; video is “petrified” (Molderings, 1984). If the simulated voice is meant to sound real, it must be heard in the real world.

4. Mixed reality

This meshing of the virtual and physical constitutes mixed reality. Here is another area of the literature that requires some braiding of the rapidly emerging terminology. The initial thrust of research into technology that blended digital information with views of the real world referred largely to augmented reality, as the digital information was seen to augment the physical view. A foundational definition of augmented reality is “any case in which an otherwise real environment is ‘augmented’ by means of virtual (computer graphic) objects” (Milgram & Kishino, 1994). A few years

later, Ronald Azuma clarified the distinction between VR (the user cannot see the real) and AR (the user can see both the real and the virtual). AR is thus supplemental, a “middle ground” between the virtual and the real (1997). Now the scholarship has begun to dissolve even the barrier between the real and the virtual. Regarding our reality as a strict dualism in which we move back and forth from one to the other — between online and offline, between virtual and real, between live and mediatized — is an increasingly outmoded view (Jurgenson, 2012). As a result, much of the current research now employs the term mixed reality, implying a mixture of the virtual and the physical along a bidirectional scale between those two poles.¹⁹ Cyberspace, as mentioned, was never a completely separate world we jacked into *a la* “The Matrix.” Reality lies somewhere between the completely physical and the completely virtual — along a scale of degrees, as depicted in Figure 8 — and described this way:

Think of digitally modified reality as a piece of a continuum that begins on one end with the naked perception of the world around us. From there it extends through two stages of “mixed reality” (MR). In the first one, the physical world is like the main course and the virtual world the condiment In the other stage of MR, the virtual imagery takes the spotlight. Finally, at the far end of the continuum lies nothing but digitally produced images and sounds, the world of virtual reality (Bolter & MacIntyre, 2007, p. 33).

¹⁹ A chuckle-worthy but still apt allegory of the fusing divide comes in this sensory description: “This convergence of immaterial systems and material structures, of the *dry* digital and *wet* molecular worlds, of the artificial and organic, produces for the artist a kind of *moist* media” (Ascott, 2001, p. 13). I have not seen this neologism catch on.

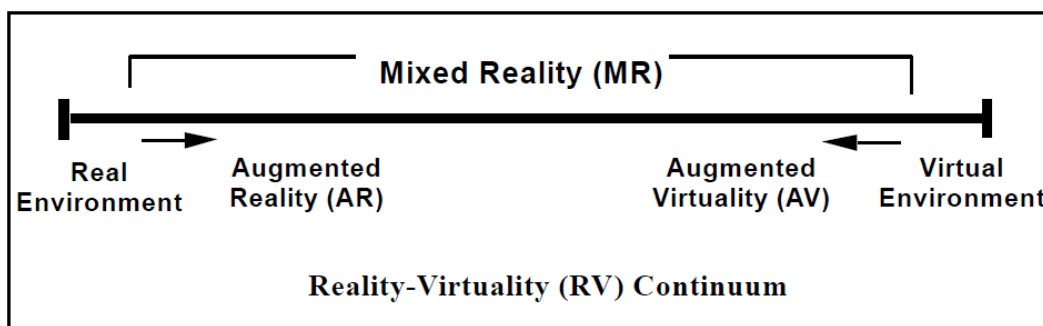


Figure 8: Milgram & Colquhoun's Mixed Reality scale (Milgram & Colquhoun, 1999)

In line with Milgram & Colquhoun's scale, this study will refer to any overall physical-virtual blend as mixed reality (MR), and the scaled directions accordingly as augmented reality (AR) or augmented virtuality (AV).

In his influential essay “The Computer for the 21st Century,” Mark Weiser discussed the emergence of ubiquitous computing (the presence of information processing throughout physical reality, not always requiring screens and keyboards for human-computer interaction) by marveling at the idea that we would have conceived of total virtual reality *inside* a computer in the first place, expending such effort to focus “an enormous apparatus on simulating the world rather than on invisibly enhancing the world that already exists” (1991, p. 94). He introduced the term “embodied virtuality” to refer to the goal of “drawing computers out of their electronic shells” (Weiser, 1991, p. 98). Weiser forecast much of the world we live in now, in which computing is an inextricable — and often unseen — part of our lives, from RFID tagging to GPS locators. Adam Greenfield calls this proliferated computing “everyware,” which he explains “isn't so much a particular kind of hardware, philosophy of software design, or set of interface

conventions as it is a situation — a set of circumstances ... interwoven with the existing rituals of everyday life” (2006, pp. 31-32).

This does not mean, however, that we live in a brave new utopia of seamlessly mixed reality. Existing systems don't always make it easy to move between the physical and the virtual:

Just as Ford is reputed to have said about his automobiles, “You can have it in any colour you want as long as it is black,” so today's computer designers say, “You can have it in any form you want as long as it has a keyboard, a display and a mouse, regardless what you are doing” (Buxton, 2001, p. 15).

Our holographic, three-dimensional dreams consistently teased within our entertainment have not yet been fully or, to some degree, even partially realized — but virtual pop stars are harbingers of an emerging, ubiquitous digital mixed reality. They embody the eversion of cyberspace — another concept foretold by William Gibson, who birthed the term “cyberspace” in his novel *Neuromancer* (1984) and then killed it off in his later novel *Spook Country*: “Someone told me that cyberspace was ‘everting’ ... And once it everts, then there isn't any cyberspace, is there? There never was, if you want to look at it that way. It was a way we had of looking where we were headed, a direction” (2007, p. 86). Gibson explained eversion simply in an interview (“Cyberspace has everted. Turned itself inside out. Colonized the physical” (W. Gibson, 2010)) and used the notion to claim that future humans will describe this historical moment as characterized by “a need to distinguish between what they thought of as the real and the virtual” (W. Gibson, 2011).

The barrier between reality and cyberspace was always the screen. Just as this barrier started to become permeable, new scholarship arose to study its nature. Lev

Manovich's archaeologies of screens (Manovich, 2001) and Charles Musser's much earlier history of screen usage (Musser, 1984) are the major tributaries feeding Erkki Huhtamo's newly fashioned field of screenology, studying the short history of screens and how they alter what they present (Huhtamo, 2004, 2010, 2012). As a study focusing not "only on screens as designed artifacts, but also on their uses, their intermedial relations with other cultural forms and on the discourses that have enveloped them in different times and places" (Huhtamo, 2004, p. 32), screenology strives "to make screens visible again — to frame them, so to speak" (Huhtamo, 2012, p. 145). Screens began life as frames for 19th century light shows, making their projection systems invisible to an audience (Huhtamo, 2004), a roundabout way of describing the function of today's screens, "conveyors of audiovisual messages and windows linking us with other — mediated — realms" (Huhtamo, 2010, p. 329). Although, near the end of the 19th century, one visionary imagined screens functioning exactly as they do now and as we still imagine they might in the future:

In his *Le Vingtième siècle*, Albert Robida (1883) imag(in)ed *L'Epoque*, the newspaper of the future. It was primarily an audiovisual medium, available for home subscribers via the téléphonoscope, an imaginary communication device, a kind picturephone. However, *L'Epoque* could also be experienced outside the newspaper's headquarters in Paris on two "immense glass plates, twenty-five meters in diameter," erected on tall scaffoldings, and visible from the street, viewing platforms around the newspaper building and the windows of neighbouring houses. The one on the left side of the building was dedicated to advertising. The one on the right displayed live news feeds from around the world, transmitted by *L'Epoque's* roaming reporters armed with small transmitters or "pocket-telephonoscopes" (Huhtamo, 2010, pp. 330-331).

To augment reality, the screen has been the go-between thus far. Reality can be digitally augmented two ways: by overlaying the digital image onto a see-through screen

or by mixing the digital image into the reproduction of the real from a video source shown on a screen (Azuma, 1997). The latter came first in the form of infographics projected over the shoulders of television newscasters and maps shown behind the bodies of weather forecasters — the chroma key effect, commonly known as the “green screen,” which layers two distinct video images based on color hues — and the former exists today in smartphone apps that add information layers to images of reality via the phone’s camera. Long before “The Polar Express” and “Final Fantasy” created their worlds from scratch, filmmakers began digitally augmenting their imagery to cut the costs of location permitting and set building (the early virtual sets of George Lucas’ “Radioland Murders”), and time-intensive special-effects makeup (the widely reviled Jar-Jar Binks character, digitally created from performance capture, in Lucas’ “Star Wars: The Phantom Menace”). The overlay technique is blossoming now in the form of virtual pop stars (the Musion Eyeliner system) and, due in 2014, Google Glass, a commercial system of clear lenses in which the viewer also can see virtual digital information and images.

AR technologies mean the screen triumphs — even as it disappears. Weiser’s 1991 herald of ubiquitous computing began, “The most profound technologies are those that disappear. They weave themselves into the fabric of everyday life until they are indistinguishable from it” (1991, p. 94). With the advent of virtual pop star projection, one of many “inhabitable interfaces” taking root in ubiquitous computing technologies (McCulloch, 2004), the whole world is now a potential screen. Watching entertainment on TV, watching a movie in a cinema, watching videos on portable tablets or smartphones — in each case, the presentation of the virtual remains optional. We can move our eyes away from the screen, back to reality, in order to exit the virtual world and

end our immersion. As augmented reality tech increases the presence of virtual objects and information within real space, it decreases the ability to easily escape the virtual. This is a significant development, one Luigi Lentini calls “a manifestation that is absolutely new in all of history” (1991, p. 336). Lentini, a Costa Rican engineer, considered this situation from the perspective of an architect designing public spaces in his paper “Private Worlds and the Technology of the Imaginary: Effects of Science and Technology on Human Representations and Self-Conceptions.” Lentini saw the intrusion of the virtual into reality as taking the screen’s transparency and turning it into an opacity — the virtual information applied to the view of reality actually blocks out real information, overlaying physical objects and environments, and obscuring them from view. He depicted this expansion of the screen in his paper with Figure 9, evoking imagery of the sci-fi movie “The Blob” (1958), as if the screen is now growing from its formerly rectangular source into a nebulous, amoeba-like shape overtaking more and more of our reality.

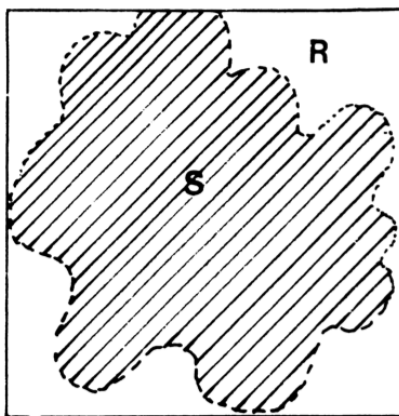


Figure 9: Lentini’s expanding screen, showing how new uses of the screen (S) are expanding to cover reality (R). (original image from (Lentini, 1991))

“If the limits of the screen disappear,” Lentini wrote, “there is always an ‘in front of,’ an ‘in back of,’ an ‘above’ and a ‘below.’ But holograms, for example, with their three-dimensional effects, would cause these perceptions to disappear, to the extent that they join what is real with the image, in scientific terms, or they hide it in terms of human perception” (Lentini, 1991, p. 337). He mentions superimposition in terms of “exclusion” (Lentini, 1991, p. 336) — the very opposite of William Bricken’s “inclusion,” which he called “the primary defining characteristic of VR” (Bricken, 1990). But Lentini’s view is not alarmist or an attempt to thwart the march of AR into our mixed-reality spaces, public and private. He concludes boldly:

The possibilities of expression have been multiplied enormously both for the artist and for everyone. Now there is no screen, institutionally approved location or stage. Everything can be transformed into a space of multiple dimensions. ... The individual, with respect to himself or herself, faces for the first time in history, outside of the realm of magic, the materialization of the imaginary and the possibility of sharing it with others, the possibility of being the object and the subject of the imposition of the imaginary. (Lentini, 1991, pp. 338, 337)

If virtual pop idols are presented as an illusion of 3D presence, then the tech must evolve to actualize that desire. The technology is progressing in that direction, but slowly. Just this year, screen technology took its first real step away from flat squares when South Korean tech giant Samsung unveiled prototypes for several flexible, high-resolution screens, a new product line called Youm. As Brian Berkeley, senior vice president of Samsung’s San Jose Display Lab, demonstrated the screen tech at the annual CES technology conference, he made a point of bending one screen and showing another smartphone screen with a curved edge, promising “a whole new ecosystem of devices, devices with bended, foldable and rollable screens” (Rodriguez, 2013). If screens can be

flexible and curved, they could soon not only inhabit physical reality by appearing on previously cumbersome surfaces but they could *become* those objects — the curved top of a lamp is a screen, the armrest of an easy chair is a screen, an art object on the wall suddenly becomes a screen. Reality is augmented with interfaces well beyond the desktop or handheld rectangle.

As commercial performance-capture technology catches on and evolves, these physical interfaces we're used to will dissolve. "When machines are enabled to respond to spoken commands, the keyboard will become superfluous," Ryan writes. "Next to go will be the screen and the sight of the machine: visual displays should occupy the entire field of the user's vision, rather than forming a world-within-the world, separated from reality by the frame of the monitor" (Ryan, 1994). The desire to get beyond the looking glass of screens was voiced early on. In 1965, computer scientist Ivan Sutherland was imagining reality-augmenting display technology that we're just beginning to catch up with — eye-tracking, gestural interfaces, a "kinesthetic display" incorporating as many human senses as possible (Sutherland, 1965). If the computer begins to see humans as animated objects, the computer could begin to present itself as an animated human. Data storage will evolve from strings of letters and numbers into archives of conversation and motion, physicality and performance — "the computer archives of restored behavior" (McKenzie, 1994, p. 104).

We will move from the painted bits of 2D screens to the tangible bits of 3D simulations (Ishii, 2001). All physical space will be potentially augmented, populated by various "processed transmissions," including visual projections and sounds, making up a constructed, mixed reality (Søndergaard, Petersen, & Parmerud, 2001) full of

“increasingly sophisticated representations of artificial life in which objects, both virtual and physical, can behave in ways that suggest ‘aliveness’” (Allen & Mendelowitz, 2001, p. 299). Already,

Airports in both London and Paris have begun experimenting with digital boarding agents that materialize out of thin air to guide passengers to their gates, both amusing and confusing children and adults alike.

This intrusion into the real world is beginning to happen all over, says Jason Yim, CEO of the marketing firm, Trigger, adding that “you are going to begin seeing things like characters jumping off cereal boxes and crawling around the breakfast table and creatures coming down from movie posters.” Right now, he says, “every poster, every bus shelter or kiosk could initiate this kind of digital experience.”

For now, says Mr. Yim, the human eye can still discern what is fake and what is real. But within five years, he suggests, “that line will begin to blur.”(Goodale, 2012)

And as fully immersive MR takes hold, it will become an expected feature of public and private spaces, in place of today’s tethered screens (Bolter & MacIntyre, 2007). It is thus necessary “to reconsider the notion of the virtual as it relates to everyday reality, in addition to rethinking the digital in relation to our common conception of materiality” (van Doorn, 2011, p. 531), and master the design techniques that present successful virtual simulations within real space.

III. METHOD

A. Mode of inquiry

This study emerged from exploratory investigation into this evolving technological and entertainment phenomenon, and sought to identify and describe the production process at work in creating, designing, and developing virtual pop stars, as well as in delivering the virtual presentation within real physical spaces, such as a concert stage. Chiefly, I sought to ferret out what existing theory (from the variety of fields and disciplines already discussed) might be at play, consciously or not, in the creation of these presentations — or what new theory might be emerging from the phenomena.

The primary research question pursued was: What decisions are the creators of digital entertainment agents making in order to facilitate communication with their audiences, and what data are these decisions based on? Per the preceding literature, and inherent in this research focus, I also was interested in what factors in the design of these virtual pop stars addressed the issue of the uncanny valley, as well as which production and visual presentation factors during a virtual pop star performance are designed to contribute directly to the construct of authenticity and an experience of liveness.

This was a qualitative study based in grounded theory (Glaser & Strauss, 1967), combining semi-structured interviews and observations to generate categories of data for inductive analysis.

B. Data collection and coding

An initial purposive sample of potential subjects, based on the existing literature and journalism, was drawn first from the areas of designers and engineers (those workers

involved in the conceptualization, artistic rendering, production, programming and any other creative choices driving the design and presentation of virtual pop stars), marketing and executives (those involved in making production and commercial decisions about the virtual performance technologies, their presentation, and their marketing), creative and performing artists (those involved with the production of songs for the Vocaloid software, but only those whose content has been selected for presentation by Crypton Future Media as marketed music and/or a song in the set list of a virtual pop star concert performance; those involved with the production of the Vocaloid software itself; as well as other artists who have had direct experience with virtual performance), and others (those involved with the culture, commerce, and critical commentary on virtual pop stars). From this initial purposive group, I snowballed the sample, asking sources to identify (and, ideally, introduce) other relevant sources related to the discussion, and adding interviews and documents accordingly. Snowball sampling was appropriate to the exploratory nature of this study.

During a period of five months (April 15 to Sept. 15, 2013), a total of 25 such possible subjects were contacted about interviewing for this project. Four consented. Thirteen never responded to inquiries (involving at least three attempts through verified email addresses and/or phone numbers); two responded initially and then stopped responding after receiving the research protocol and consent form; the chief executive at Crypton Future Media agreed to an interview, via an assistant, was sent written questions to answer by email, but never again responded; four declined. One software developer agreed to an interview, but as a teenager he was considered ineligible as a minor for this research protocol.

A significant obstacle in speaking with those involved in the production of the 2.0Pac presentation, it turned out, was the existence of a legal non-disclosure agreement on behalf of the rapper Dr. Dre with the creative team at Digital Domain; both artists connected to the project and representatives at Digital Domain informed me that they could not speak about the project because of this agreement. Reputable media sources seeking similar information also cited the existence of the gag order (Kaufman, 2012).

Despite these obstacles, many of the sources targeted for this study have discussed their work (including some of these specific projects) in numerous existing interviews, speeches and other sources available online and through media outlets. Thus, data collection was expanded to include 127 of these existing sources.

The four direct interviewees for this project were the following:

- Paul Debevec (Associate Director, Graphics Research, USC ICT; and Research Professor, USC Computer Science; pauldebevec.com),
- Wolf Neve (owner, founder, and director of technology of Synthesized Reality Productions; synthesizedrealityproductions.com),
- Michel Lemieux (founder and co-director of hybrid-theater production company Lemieux.Pilon 4D Art), and
- Bob Ostrander (senior vice president of Provision, a Los Angeles-based company making and marketing holographic-display technologies).

Two interviews — Debevec (May 22, 2013) and Neve (Sept. 10, 2013) — were conducted via Skype, audio only; two interviews — Lemieux (Aug. 2, 2013) and Ostrander (Aug. 14, 2013) — were conducted by phone. Each was recorded and then transcribed for the research corpus.

Interviews were semi-structured, allowing for the kind of “creative interviewing” process that is flexible and responds to situational dynamics (Douglas, 1985) in order that I could follow where new knowledge lead me. I adapted skills honed during my professional journalism career in order to fashion investigative rather than structured interviews, in which thinking on my feet allowed me to pursue new lines of inquiry in the moment rather than following up with the source much later. Interview questions were constructed around the primary lines of inquiry in the preceding research questions and expanded into a list of foundational questions (see Appendix A) adapted for each semi-structured interview.

All research notes and interview transcriptions were collected within the Evernote note-taking and archiving software, and coded openly as a “process through which concepts are identified and their properties and dimension discovered” (A. Strauss & Corbin, 1998, p. 101). Ideally in grounded theory, preconceived ideas should not be forced on the data by looking for evidence to support established hypotheses (Glaser & Strauss, 1967), but use of literature to establish a study stems from a base of professional knowledge — “literature sensitivity” (A. Strauss & Corbin, 1998) and “accumulated knowledge” (Dey, 1993, p. 66). Evernote’s subject tagging and search function facilitated data classification and analysis, allowing for the repetition and increased usage of certain keywords and concepts to become clearly identifiable per the constant comparison method, in order to record “reflections and annotations of the data” (Jones & Alony, 2011, p. 105) and then begin to “group answers ... to common questions [and] analyze different perspectives on central issues” (Patton, 1990, p. 376). Memos were largely free-flowing and wide-ranging in order to capture all of the thinking process as the study

proceeded (P. Y. Martin & Turner, 1986). As interviews and further research was conducted, the memoing and constant comparison method continued, proceeding through axial coding — creating subcategories and associating these with “properties and dimensions” (A. Strauss & Corbin, 1998, p. 123) — and selective coding, finally “integrating and refining the theory” (A. Strauss & Corbin, 1998, p. 143) by arranging categories, subcategories and their associations to develop the inductive analysis of the phenomenon. Data collection ceased once the interviews and research begin to reach saturation, the point at which no new data emerges from the investigative process (Glaser, 1978).

At this point, theoretical coding of the data began, bringing “the fractured pieces back together again to conceptualize causal relationships between the hypotheses derived through open and selective coding” (Jones & Alony, 2011, p. 108), bringing description from the study and the conceptual relevance that emerges (Geertz, 1973) together into some substantive theory about the virtual pop star phenomenon (Goulding, 2001).

C. Grounded theory analysis

The choice of grounded theory stems from the exploratory nature of this study. Grounded theory is detailed, rigorous and systematic, but crucially it allows for significant flexibility and space for growth. Virtual pop stars are a rapidly emerging phenomenon; presentations and commercial plans for the technology have changed significantly just in the two years since I first took an interest in the subject. I fully expected to encounter ideas and theoretical possibilities that have not yet emerged in the literature, or to have suppositions from the preceding literature review altered or

obliterated in the course of interviews. This did occur. Thus, as an outgrowth of pragmatism and symbolic interactionism, grounded theory is best equipped to handle the aspect of change in the system being examined (A. Strauss & Corbin, 1998). In studying a system that has not been subject to much scrutiny, the purposeful discovery of grounded theory is most useful in providing rigorous insight into such areas of the unknown (Jones & Alony, 2011). In particular, grounded theory is especially suited to the study of emerging technology and information media because

[t]he ontology and epistemology adopted in this research accepts that knowledge is not static, but is always emerging and transforming, and is interpreted by both observer and participant. Meaning is conveyed through dialogue and action. Within dialogue and action are embedded understanding, experience, and emotion. Only through interaction and discourse can meaning be unlocked and conveyed to the observer. From this perspective, Grounded Theory provides a method which enables a researcher to adduce true meaning and understanding. (Jones & Alony, 2011, p. 98)

In grounded theory, analysis begins as soon as the first bit of data is collected (Glaser & Strauss, 1967), and in that sense the previous literature review already has initiated some analysis in my notes. The very forming of interview questions leaned toward a pre-coding process. But every concept acquired through grounded theory research is provisional until it begins to repeat, reoccurring in observations, documents and interviews (or by being conspicuously absent from the sources) (Corbin & Strauss, 1990). Concepts are the basic units of analysis (Corbin & Strauss, 1990). Those identified in the literature review shaped the basic interview questions, and those that emerged during data collection were coded and organized as described.

IV. RESULTS & DISCUSSION

First, a point of terminology. As discussed earlier, the use of the term “holography” in relation to these projected performance simulations is inaccurate and has proven something of a nuisance to both simulators and actual holographers. However, as often happens when particular scientific terms are embraced as colloquialisms²⁰, most subjects in this study (the simulators) each have acquiesced to the now-common usage of the term. “The words ‘hologram’ and ‘3D,’ like the word ‘love,’ are some of the most abused words in the industry,” said Provision’s Bob Ostrander (personal communication, Aug. 14, 2013). Most subjects, usually quite early in an interview, copped to the fact that what they were discussing was “holographic-like” and, while not technically holography, “for the general population, this is what is considered holography” (as quoted in Garey, 2011). 4D Art’s Michel Lemieux echoed a common refrain, describing his coming to terms with the public inaccuracy: “A lot of people call it holography. At the beginning, 20 years ago, I was kind of always saying, ‘No, no, it’s not holography.’ And then I said to myself, ‘You know, if you want to call it holography, there’s no problem.’ We’ve seen it in ‘Star Wars.’ Yes, it’s not technically holography, it’s an illusion” (personal communication, Aug. 2, 2013). Musion co-director James Rock also invoked the “Star Wars” touchstone in describing his own acquiescence: “We’ve deliberated about this. The thing is that the world’s population, certainly in places where there’ve been access to Hollywood movies, have seen digital effects. So everybody thinks Musion is a hologram.

²⁰ For a corresponding study of how a word becomes entrenched (and, in this case, Americanized) slightly off-center from its original denotation, see Sydney Ross’ wonderfully readable “*Scientist: The Story of a Word*” (Annals of Science, 18, [2], June 1962, pp. 65-88).

They see Princess Leia in ‘Star Wars’ going, ‘Help me, Obi Wan Kenobi,’ but actually that’s a post-production effect that’s been done to a piece of film. If the world calls Musion a hologram, although technically it isn’t a hologram, I think we’re fine to ride on the back of what people perceive holograms to be” (3dfocustv, 2011). Other terminology is still in flux. Within a month after the debut 2.0Pac performances, the brass at Digital Domain held a conference call for investors in an attempt to clear up “a lot of misinformation about the technology,” including what to call it (DigitalDomain, 2012). Central to nearly all public discussions of 2.0Pac has been Digital Domain’s chief creative officer Ed Ulbrich, who several years earlier was still wrestling with the temporal terminology of how to describe an animated performance like 2.0Pac, saying, “What we have the ability to do now is actually *re-create entirely brand new performances*” (Wertheimer, 1997, my emphasis). In Japan, makers of Vocaloid characters and songs debate the words they use to describe making their creations sing. “In Japan, when making a Vocaloid song, we use the verb *chokyo suru* (to tame). But it’s a verb used to teach an animal a trick,” says one fan-producer. “Nowadays, ‘taming’ (*chokyo*) is standardized, but another large group use *chosei*, which means to tune a voice” (as quoted in Knight, 2013c).

A. The canned and the canny

Discussion of the uncanny valley in the design of virtual performing characters surfaced frequently and prominently in the study, and it divided evenly among the two emerging models: stylized animation figures that keep to this side of the valley, such as

Hatsune Miku, and photo-realistic figures that leap toward the other side of the valley, such as 2.0Pac.

1. Stylized vs. photo-real animation

To Miku and her ilk, the look and design of the characters always was intended to adhere to Japanese forms of stylized, anime animation. The reasons for this were largely cultural — “There’s no such thing as resistance to comics and anime in my generation,” said Crypton’s CEO Hiroyuki Ito, so in the end “I decided to use the illustration of a cartoon girl” (A. Takahashi, 2008). When Crypton contracted the artist Kei Garou to design the look of Hatsune Miku, the character that would represent Yamaha’s Vocaloid software, he was given free reign except for two pieces of information: (1) the character was intended to be an android, and (2) her appearance had to feature prominently the color cyan, based on the existing color scheme for Yamaha instrument synthesizers (Senpai, 2013).

As discussed, Hatsune Miku was created solely to be a character on a box, a marketing image for the Vocaloid software. Being a synthesized voice as opposed to a synthesized version of a more inert instrument, Ito wanted the image to communicate the life and energy of a real human: “For DTM [desktop music software], you can use a picture of the guitar or photos to imagine the instrument of the piano. For Vocaloid, because of the human voice ... I thought we should put a picture of flesh-and-blood to say, ‘This is about people.’ ... That was particular about it: that there is a movement in [the] illustration. I wanted to feel the rhythm and dynamism” (A. Takahashi, 2008). In particular, Ito said he sought an image that conveyed “a human touch” (Santos, 2011) —

an extension of an effort to balance the android origins of the product with some element of humanity and add, particularly for Japan's marketplace, a requisite dollop of cuteness. This balance of technology and biology was discussed frequently by Wataru Sasaki, a producer at Crypton who works primarily with the actors recording voices for the software's databases, saying, "Using a voice actor's voice — which is already 'not normal' — and mixing it with a robotic kind of voice, of course, it will end up as a very unique sound. ... I wanted to aim for a voice that was cute, but robotic, and in the end result was still cute." He added another point, which he repeated in other interviews, about youth being the particular source of the energy he and Ito wished to convey:

Anime is made by old men. I think that Miku fans' imaginations and the people who think about Miku's different songs and styles are way more creative than anime. I have so much expectation for the young generation, and I want Miku to be a container for the energy of those people. We don't need anime, because I think the fan's creativity is at a higher level than anime. I want to keep the fans aware of that fact (Macias, 2011).



Figure 10. Yume, the character created as a commercial mascot for Synthesized Reality Productions. (synthesizedrealityproductions.com)

In incorporating the U.S.-based Synthesized Reality Productions, which produces virtual pop star performances on a more grassroots level for fans, its creators fashioned their own company mascot, Yume, a typically slender, doe-eyed female wearing a white hoodie with cat ears and with a lengthy braid of blue hair that curls behind her like a tail (Figure 10). On first glance, Yume looks like many other Japanese Vocaloid characters, but SRP's co-founder Wolf Neve parsed the subtle cultural differences in her design:

... It's supposed to be that tomboyish next-door girl, which is the American girl, the next-door tough girl. She is the American. She is different. She's got hips, boobs, and a butt, you know. She's built like an American girl. [laughs] And I think we said she's 18. She's older, a little more mature. This outfit that she's on right now is a sweatshirt, and she wears biker shorts and a skirt. She's not a very super-cute, 'Watch me dance around and my skirt flips up.' We took a very different approach to it on purpose, because we wanted her to be an American character. We didn't want her to be a Japanese character. We wanted her to represent us. And she will be featured one day in our concerts. ... We wanted a cuter character, but without having to be, like, a 14-year-old girl being exploited on stage, right? That's always, to me personally, sat kind of weird. Yes, it's animated. Yes, it's not real. But it's always held that kind of underlying stigma in the American culture. 'You're watching some young girl — you're a weirdo.' Well, no, but ... (personal communication, Sept. 10, 2013).

This was the most overt discussion of any pedophilic desires inherent, from a Western cultural point of view, within Japanese anime design and, now, Vocaloid character design. My discussion with Neve included his observation that roughly 10 percent of the audiences at his virtual pop star concerts are older men attending by themselves. I had estimated the same percentage at both Miku simulcasts I've attended, a contingent I have referred to in private, using an old pedophile stereotype, as "the raincoat crowd."

Whatever the facts and cultural issues there to be further explored, Neve's statement of such a boundary to be negotiated indicates not only its reality but its affect. Many studies

have explored how art and technology have challenged and expanded socially constructed gender and sex roles, particularly in relation to virtual reality worlds (Butler, 1990; Haraway, 1991; Turkle, 1984). The depictions of most existing Vocaloid characters in Asia adhere to the norms of Japanese anime and the particular indiscretions of that format's gender creation and depiction — females with enormous doe eyes, accentuated breasts, age of consent-confounding youth. The design of virtual performing characters there is so inextricably linked to anime culture that an independent and more functional style has not yet emerged, and may not. Neve spoke of designing SRP's mascot as slightly tougher and older, but he conceded that in the end his creative decision consciously conformed to the stylized gender norms of anime. He then added that two more performing characters are in the design stage at SRP, one of them significantly younger (personal communication, Sept. 10, 2013).

This leads to the other cultural issue raised here as to how an anime-based image such as Miku might translate to Western audiences. Crypton has been at work on an English-language version of the Miku Vocaloid for some time, which was previewed in full in July 2013 (VocaloidFR, 2013). "Context and meaning can easily change when changing something into a different language," Crypton's Sasaki said. "As long as the meaning in different languages is the same as in Japanese, then that's fine. But if the meaning changes fundamentally, and the end result doesn't sound 'cute,' then we don't want to force ourselves to localize into a different language" (Macias, 2011). Cuteness is a primary concern, both as a visual and an auditory quality, and the latter is more of a challenge to achieve than the former. Sasaki explains: "To keep Hatsune Miku's voice cute when pronouncing English words is extremely difficult. Right now, we have a few

words in English with a Japanese accent. We're trying to find if the American fan[s] are actually seeking for this or would like to have fluent English instead, so we would like to research about this while we're developing" (Mak, 2011). No plans have been discussed to alter Miku's image for a Western audience in any way. Neve's efforts to butch up SRP's mascot as a means of appealing to American fans shows one Western point of view on this cultural transition. One perspective from the other side comes from Crypton's director of global development, Kanae Muraki, who suggested, during a conference presentation about the mutable nature of Miku's identity, that "fans in the States could create their own Miku" by depicting her "just eating a burger" (theKKSshow, 2012). Sasaki, however, voiced a concern to keep Miku's presentation culturally Japanese when he described the Miku live concert debut in America in 2010, saying, "I think it wasn't too 'Americanized' or presented as American-style entertainment. It wasn't too sophisticated, and that turned out to be a good thing" (Macias, 2011). In Neve's business dealings, he reports encountering the same desire expressed in more forceful terms: "We've also been told before, 'Well, how can you put on a good concert if you're not from Japan?'" (personal communication, Sept. 10, 2013). Making anime-inspired virtual performers a success in the West already has antecedents, though, in hybrid film projects such as "Scott Pilgrim vs. the World" (Big Talk Films, 2010) and on stage in performances by the aforementioned Gorillaz, the look of whom was created by artist Jamie Hewlett, a comics artist partially inspired by Japanese anime, particularly the work of Studio Ghibli ("Ten questions for graphic artist Jamie Hewlett," 2012).

Significant to the cultural assimilation of Vocaloid character design and performance in America are organizations such as Synthesized Reality Productions and its predecessor, Vocalekt Visions, which started producing licensed, localized Vocaloid concerts in August 2011. An unstated assumption by most subjects in this study seemed to be a goal of experiencing virtual performance without any extra layers of mediation — that is, to watch a direct video of Hatsune Miku or to watch a live concert presentation of Hatsune Miku, but not necessarily a video of a concert or a video of or about her videos. However, only about 5,300 Americans thus far have witnessed an official live Hatsune Miku concert (Scott, 2012) — compared to about 85,000 worldwide (Mallenbaum, 2013) — not counting the nine U.S. movie theaters that presented the 2011 simulcast and the two movie theaters (one in Los Angeles, one in New York City) that showed a second concert on Aug. 31, 2013 (delayed broadcast rather than simulcast), and the audiences for both 2.0Pac performances were approximately 90,000 each (though these are total festival attendance figures, and all 90,000 concertgoers each day likely were not viewing the main stage at the time of 2.0Pac’s performances). On the other hand, YouTube videos of Miku and 2.0Pac have viewer counts in the tens of millions. In order to facilitate less-mediated experiences, SRP’s stated goal is to evolve the phenomenology of the live concert experience by increasing the frequency and accessibility of Vocaloid concerts, even at the risk of suffering the quality. Production of a full-fledged Hatsune Miku theater or arena concert, for instance, is an extensive undertaking, requiring more than 150 workers with access to and knowledge of high-end technology (Scott, 2012). Thus, few such events have taken place in Japan and especially in America. Tempo-P, one of the co-founders of Vocalekt, said, “A passion of mine is spreading Vocaloid into places

where there was none. How I see it is: Japan gets all the fun. Sega puts on these concerts for the fans and their execution is amazing, except they're always over there [in Japan].” Vocalekt, he said, was created to meet a demand in America for virtual pop stars, serving “the market ... for smaller-scale live Vocaloid performances” (Scott, 2012). Vocalekt produced a handful of performances, including one simultaneous concert (May 26, 2012, a single performance presented in both Bucharest, Romania, home to one of Vocalekt’s other co-founders, Neutrino-P, and a theater in San Jose, Calif.) and a well-documented appearance at the 2012 Animation on Display convention in San Francisco. The second performance, in a ballroom before an audience of what looks like at least several dozen, first featured performances by World Vocaloid Dance 01, a troupe of human singers and dancers dressed as Vocaloid characters,²¹ followed by the rolling out of a rudimentary transparent, Musion-like projection screen on which numerous pre-programmed Vocaloid characters were shown singing and dancing. The visuals are of noticeably less quality than those produced for official Crypton/Sega productions — featuring comparatively blocky characters and jerky movements, definite slips into uncanny territory — for obvious reasons.²² “Because we’re talking about a lot more money vs. the smaller guy,” SRP’s Neve said, while lamenting the massive amount of work required just to produce

²¹ See my conclusions for suggestions of further study that could be pursued into the obvious parallels in this fan behavior to those of “The Rocky Horror Picture Show.”

²² Vocalekt performances were depicted using a freeware application called AniMiku, developed by a 16-year-old fan and software developer who goes by the handle Re:VB (pronounced “reverb”). AniMiku takes pose and motion data from MikuMikuDance, the groundbreaking freeware that has allowed novice users to create Miku-related digital animations for years, and combines it with the music audio to render a version of the designs suitable for large-scale projection. “So basically you create the animations, load it into the program, hit play, and you have the concert run for you without any other effort,” Re:VB explained (39diyMMDconcert, 2012). AniMiku includes an extra physics engine to produce slightly more realistic motion than in MikuMikuDance.

the visuals for this kind of concert presentation and breaking down a pie chart of duties that included a 50 percent chunk dedicated to “all animation — motion, model-making, clothing-making, making sure that you’re not having the character’s hand go through its own head” (personal communication, Sept. 10, 2013). As opposed to the 150 full-time corporate workers cited above, Neve claims the part-time, after-hours labor of two to three people. Thus, if the grassroots organizations can produce and deliver shows with greater access and frequency, their quality is lower. Higher quality production means less frequency.

Producing stylized animations, however, provides creators significantly greater artistic freedom over photo-real efforts, Neve says. Comparing his efforts to the 2.0Pac and similar photo-real presentations, Neve says, “With the photo-realism, you have to do whatever used to exist, unless you’re going to do a ton of editing,” which requires significant labor, money and technical expertise. “I can make my character look like whatever I want, dress her however I want, make her do whatever I want, which is not meant to sound dirty” — again with the nod to implied improprieties. Then Neve, himself also a concert producer (for human performers) and a musician, continued by casting animations as a better artistic choice not only than photo-real depictions but actual human performers themselves:

... I can have Miku fly, I can have her do push-ups, I can have her run the stage, I can have her snap her fingers and do a costume change. I could have Britney Spears on stage. If I pull her up on the hoist too quick, she might break her hip. If I try to do a costume change, she might trip and hurt herself. If I have her do push-ups, she’s going to give me the finger. I can do this over here, but with a real person I’m limited. I can have my character go for a hundred hours straight, no problem. I can have a real person go for two hours (personal communication, Sept. 10, 2013).

This, of course, raises labor and ethical concerns for further study. Many such concerns are now being explored by the burgeoning field of machine ethics.²³ Is there actually “no problem” in cracking the whip on a virtual performer “for a hundred hours straight”? Such questions increase in urgency in proportion to the development of AI for these characters, and consideration of the ethical treatment of machine-based life or its simulations already is focusing on the increasing complexity of decision-making algorithms and Internet bot applications.

2. Licensing vs. produsage

Another distinct advantage of anime visuals vs. photo-realistic is their greater fluidity in moving between media and thus becoming transmedia products. The reasons for this lie less with reproduction ability than with licensing: It’s easier to license the likeness of a drawn or animated character — a more distinct product — than it is to obtain permission to reproduce the realistic likeness of an actual human being. While this study did not focus explicitly on the legalities and intellectual property issues related to the creation and performance of virtual characters, the subject came up often in relation to a producer’s ability to stage a performance. As discussed earlier, the rules for using, adapting and producing materials based on proprietary characters are much looser in Japan than in the more litigious United States. However, for uses beyond mere fan

²³ For a look into machine ethics, turn to Blay Whitby’s “Sometimes It’s Hard to Be a Robot: A Call for Action on the Ethics of Abusing Artificial Agents” (Interacting With Computers, 20, 2008, pp. 326– 333) and Harold Thimbleby’s “Robot Ethics? Not Yet. A Reflection on Whitby’s ‘Sometimes It’s Hard to Be a Robot’” (Interacting With Computers, 20, 2008, pp. 338–341), and especially David J. Gunkel’s *The Machine Question: Critical Perspectives on AI, Robots and Ethics* (Cambridge, Mass.: MIT Press, 2012).

enjoyment and non-commercial sharing, licenses must still be obtained for public displays and performances.

Hatsune Miku, as one observer describes her, “is great free media” (as quoted in Knight, 2013b). Crypton, as explained by CEO Ito, requires no licensing fees for “fan-based activity,” only for commercial uses. A free license, the Piapro Character License, is available for visual representations of the character, allowing “any amateur or fan to do their activity”; but anyone seeking to make money off of a character presentation, such as a concert, must “make a contract, whether to make a trademark or to perform a concert. Since it’s business, we will need to take a license fee from those companies” (Mak, 2011). Therein lies the rub for amateur promoters such as Tempo-P and Neve. The aforementioned labor costs are difficult for amateurs to absorb strictly as a non-commercial hobby. “We’re not big enough to pay them back,” Neve says. “But hopefully one day they’ll be like, ‘Hey, you’re advertising our product, so if you do an official product we’ll kick in and help advertise, which would make sense.’” Otherwise, he says, “It’s hard to justify covering our costs sometimes when part of the cost is, ‘Hey, dude, I have to eat’” (personal communication, Sept. 10, 2013).

Another sizeable slice of Neve’s production pie chart, 15 percent, was the work of gaining licenses for the characters included in his performance. As yet, no centralized licensing brokerage exists for Vocaloid creations — there’s no comparative Harry Fox Agency or BMI and ASCAP collecting mechanical and performance fees for virtual, crowd-sourced content — so promoters like Neve are required to contact each character’s creator individually to obtain permission to use that character in a projected public performance. “With regular human performers, like a cover band, you’d write the record

label and say, ‘Hey, I want to use this. How much do you want? What’s your cut?’ That’s it. Not this. This is so underground still that people want you to ask by individual artist about, like, ‘Can I use your song?’” (personal communication, Sept. 10, 2013). It’s a new vista of intellectual property management, to which two existing theories seem applicable. Axel Bruns’ theory of “produsage” (2007) — a term extending Alvin Toffler’s much earlier portmanteau, “prosumer” (1980, p. 11), describing a similar concept of the revolving functions of producers and consumers/users — describes the near-simultaneous production and usage of content, specifically content that is based on collaborative engagement, “fluid roles” of the producers, a near-constant unfinished aspect to the products, and “more permissive approaches to legal and moral rights in intellectual property than is the norm in traditional, corporate content production” (2008). This exactly fits the creative system in which Vocaloid character content is created and exhibited — the exhibition via performance being itself an extra level of adaptation and tweaking of the existing product. One fan, for instance, might design a particular character’s look and fashions. Another fan may then write a song based on that visual character. Another might create a video of that character singing that song. By the time a promoter seeks to stage that character singing that song, new creative choices are still at play. Vocalekt animators have transcribed existing MikuMikuDance poses and choreography as well as created wholly original movements, appearances, and fashions for particular characters during particular songs. The difficulties in regulating, much less legislating, such constantly evolving product is the subject of Bruns’ analysis:

In other words, a palimpsest cannot be created on the basis of existing, standard copyright law, unless extensive permissions for re-use and redevelopment are granted by each participant. In most produsage environments, such permissions are instead handled on a generic basis

through the adoption of open source- or creative commons-based license schemes which explicitly allow the unlimited use, development, and further alteration of each user's individual contribution to the communal project. Often, contributors in such environments give away the rights to non-commercial use of their intellectual property, yet retain the rights to direct commercial exploitation, and the right to be attributed as the originator of a specific contribution (2008).

A possible framework for managing such fan-created work is a system of “interpretive rights” proposed by legal scholar Nathaniel Noda, in which a newly fashioned “creative teleology” would direct a fan-created work and keep credit and permissions intact (2010).

As these works manage to cross the uncanny valley, however, potential legal disputes may arise over not only the work itself but the application of the likeness to the work's human antecedent. Celebrities, for instance, possess considerable trademark and copyright protection over the use of their names, voices, and images, even after they die. Now with digital filmmaking and simulated holography performances, according to several entertainment lawyers, celebrities must consider the possibility of their realistic likeness being reanimated for new performances or commercial statements (McCartney, 2012). Such decisions likely will be made by the performers' descendents and managed by their estate. Perhaps a new form of advance directive will be required — a human (or AI!) executor overseeing a living virtual-likeness trust on behalf of the deceased.

3. Digitizing DNA

Just such a generation-bending, probate-challenging experiment occurred near the end of this study, which both exemplified and expanded the issues discussed here. Two more dead rappers were digitally resurrected: N.W.A.'s Eazy-E (who died of AIDS complications in 1995) and the Wu-Tang Clan's Ol' Dirty Bastard (who died of a drug

overdose in 2004) appeared on Sept. 7 and 8, 2013, respectively, in San Bernardino, Calif., during the first two opening nights of Rock the Bells, an annual package tour of hip-hop performers. Eazy-E appeared in performance of “Straight Outta Compton,” “Boyz in Da Hood,” and “Foe Tha Love of \$” alongside the living human members of the group Bone Thugs-N-Harmony, while ODB performed “Shame on a Nigga” and others with a cadre from ODB’s former collective, the Wu-Tang Clan.²⁴ Both performances were realized and projected using technology similar to the 2.0Pac performances and facilitated by one of the 2.0Pac production companies, AV Concepts, in addition to Guerilla Union (the production company of Chang Weisberg, founder of Rock the Bells) and Play Gig-IT (an animated, music-related gaming platform on Facebook). AV Concepts founder Nick Smith would not divulge the cost of these projects but noted that a “large project” could start at \$100,000 and get into the millions, “depending on the amount of content you want to create,” and that Weisberg “wasn’t scared by any of the cost” (Cheney, 2013).

But both new photo-realistic figures had one significant difference. Whereas 2.0Pac was animated using motion-captured performances by unknown actors and digital facial modeling, the appearances and performances of both holo-Eazy and holo-ODB were pieced together from those of their children. For holo-Eazy, a body was digitally

²⁴ Plans to resurrect Eazy-E existed from the genesis of these related projects. Video director Dylan Brown mentioned in an interview that the 2.0Pac project was born out of a suggestion by Los Angeles-based pop-rap group Far East Movement. “We were going back and forth exchanging creative ideas on how to make their live shows pop, and I got an email one night from these guys saying, ‘Look, we want to look into hologram technology,’” Brown claimed. The idea never materialized with that group; however, Brown says in 2010 he sent a demo of the technology to Snoop Dogg, who allegedly responded, “I want to do that with Dr. Dre.” Dylan recalls being with Snoop Dogg three days later, musing, “Yo, we can bring ’Pac back, we could bring Eazy-E back, we could do some amazing stuff.” The 2.0Pac project began shortly after (KiddFuture, 2012).

sampled from son Lil Eazy-E (Eric Wright, Jr.), a face was sampled largely from daughter Erin, and the voice was borrowed from son E3 (Derrick Wright); for holo-ODB, son Young Dirty Bastard — who already had plenty of practice from many performances as a tribute act to his late father — provided motion-capture performance data (Cheney, 2013).²⁵ Weisberg, in a promotional interview, described this compositing process as one that would “help us reproduce the most realistic experience possible” (guerillanation, 2013).

In this portion of the study, the words “authentic” and “legacy” abound more than any other. Weisberg, in particular, talks up the new performances not only in terms of their technical improvements but because the additional (and, admittedly, cost-saving) participation of likeness-bearing offspring infused the performances with an awe-worthy authenticity unable to achieve with fresh animation alone. Weisberg:

If you’re familiar with the Tupac virtual performance at Coachella, that was basically a computer animation as well as a capture of an actor playing Tupac. We decided to take it a step further and incorporate the family members, the children of these two icons to help recreate these icons with an authenticity and integrity that would be unmatched. As far as working with [Eazy-E’s widow] Tomica Wright, I’m normally used to working with acts, but to work with Eazy’s widow on this avatar was an experience in itself. Because you put yourself in that person’s shoes and

²⁵ At the time of our interview, Wolf Neve had no knowledge of the Eazy/ODB performances. He watched the videos of both as we spoke, then — while also being unaware of how they were produced with family contributions — critiqued the ODB performance as a means of suggesting the extra difficulties of photo-real production vs. anime-style, by saying, “He’s got the mike in his hand, he’s jumping around, that’s it, that’s all you can make him do, really — unless you take someone who’s built like him, looks like him, and you alter the face onto him. That’s a lot of work, a lot of hours, a lot of money.” Which is, of course, exactly what transpired. He then, however, extended the thought process to this consideration of the future: “If you had just someone who resembled him, looked like him — maybe even one day we’ll see people get facial reconstruction to, you know, ‘My job is to look like Eazy-E, and they surgically altered me to look like Eazy-E, and they just take pictures of me all day, and I make a couple million’” (personal communication, Sept. 10, 2013).

think about all the things you'd want to have for the avatar — from the way pants are creased to the way he holds his mic, to the way he looks and sounds. ... It's so close to life and authentic and real (Jackson, 2013).

Video director and 3D animator Chris “Broadway” Romero, who produced these new virtual performances, remarked that since the children of Eazy-E and ODB were each already performers in their own rights, they were thus already “channeling the energies of their fathers,” so it “totally made sense to let them be a part of this performance. Let their DNA digitally go into the creation of the assets” (guerillanation, 2013). There's quite a bit to unpack from that last sentence, but I'll focus on the DNA component. Days earlier, Romero used the same metaphor in describing the project: “There's digital DNA infused into these projects and it's the only way I like to work, as much as I can. I don't like to coldly separate from stuff, especially if there is willing family involvement” (Markman, 2013).²⁶ Weisberg, too, digs down to the digital genetics: “The actual DNA of these avatars is comprised of the family members of the late rappers” (Kennedy, 2013b). YDB, in particular, spoke often about his contributions to the project, taking ownership of a performance that was not presented or marketed directly as his own. “Basically I am the hologram. It's all me,” he said. “I did the performance ... I'm 24 years old, so what they did was [aged] me to 27 years old, when my father was in his prime” (Kennedy, 2013b). Earlier, he extended the DNA metaphor

²⁶ Romero's reference to “the only way I like to work” refers to a resume that includes a separate posthumous Tupac animation as well as Romero's career breakthrough, an animated video for Big Pun's single “How We Roll” created and released a year after the rapper's death in 2000. In discussing the Eazy-E/ODB projects, Romero recalled that establishment of his legacy: “In 2001, I was sitting with Fat Joe in the back on an Italian restaurant ... It was kind of the same types of conversations I have now with Eazy-E and Dirty's family. They have the same concerns that Fat Joe and Big Pun's people had with his legacy 12 years ago. I carry that reputation and that desire to keep extending the legacies for artists who aren't here” (Markman, 2013).

into that of a resurrection or a possible cloning: “I’m satisfied with my life because my father was something great on the planet. Now we’re about to bring him back, you know what I’m saying? Back into existence” (guerillanation, 2013). ODB’s widow remarked on the unexpected emotional reaction to seeing the finished product: “They have my son moving, but it’s my husband’s body of how he used to move. Instead of taking something that happened a long time ago they have something original. It was remarkable. It was really nice to see my husband onstage. I couldn’t believe it.” *My husband* — Eazy-E’s widow concurred, referring to the virtual performance as an “accurate, authentic reflection” of one by her late husband. “We aren’t trying to mimic something, you’re creating something,” she said. “We’re building, in the capacity, a reflection to carry on that’s a piece of him. It’s not going to be him, but it’s going to be as damn close as you can get” (Kennedy, 2013b).

For all involved with the production, the contribution of family members to the appearance of the virtual performance *increased* the experienced presence of the deceased/virtual performers. Audience members, too, were reported as eagerly anticipating the virtual performances throughout the day (Kennedy, 2013c), and most “appeared awestruck at the ‘ghost’ that sauntered slowly across stage” (Kennedy, 2013a) and reacted with “applause, bewildered [expressions] ... and audible gasps” (Kennedy, 2013c). Then again, “the crowd knew what was coming. ... considering that the ‘performances’ were announced four months ago [(Cubarrubia, 2013)], the crowd was still audibly impressed” (Kennedy, 2013a). In a blog post filed on deadline within hours after the holo-Eazy performance, the same Los Angeles Times critic criticized the performance, saying it “oddly felt stationary” but attributing this, significantly, not to any

technical foibles but to the probable age and station in life of Eazy-E himself: “The late rapper would have turned 50 on Saturday ... and his hologram had the sort of swagger you’d expect from an agile, but probably retired, emcee who threw in the towel on gangster wrap [sic], long before his age would have determined he was possibly past his prime. We’ll never know, though” (Kennedy, 2013c). In that final statement, the writer ignores the idea that this representation operated as one answer to that very inquiry.

An account of the second night featuring the holo-ODB appearance contains a notable irony. Wu-Tang Clan performances tend to be notorious debacles, and advertised members of the sprawling collective often fail to show at the concerts. This was the case Sept. 8, 2013, at Rock the Bells, with two prominent members noticeably absent. In addition, the preceding set by the human performers was plagued with failures of the sound system and other equipment, resulting in frequent stoppages and amplified expressions of extreme displeasure from the performers. The holo-ODB performance, however, went off without a hitch (Newman, 2013), perhaps providing evidence to support the idea that digital performers are significantly more reliable than their fleshy counterparts.

B. Invisibility and interaction

1. Magic and the uncanny valley

The trend in the West is toward this kind of photo-real presentation — a trend that’s even influencing the formidable domain of non-photo-real animation. The latest film from Disney’s Pixar Animation Studios, “Monsters University,” released in June 2013, included (as Pixar films always do) a short film as an introduction. These Pixar

shorts usually are tests of new animation techniques and proving grounds for new directors — 1997’s “Geri’s Game” tried out new techniques for animating humans and clothes (Robertson, 1998), 2008’s “Presto!” experimented with software that generated crowds for audience scenes (Desowitz, 2008) — and the short preceding “Monsters University” was a groundbreaking film called “The Blue Umbrella.”

Director Saschka Unseld, formerly a layout artist on films such as “Toy Story 3” and “Cars 2,” crafted the entirely digital film using a newly emerging technique called “global illumination,” a series of algorithms that reproduce more realistic lighting in the digital scenery. “What it does,” Unseld explained, “is it kind of simulates what real light does. Basically, that it bounces off of surfaces; off the walls. If there’s a red wall, the light bounces off and actually takes on red light and all these complex things that happen with real light” (Bishop, 2013). The seven-minute film follows a sentient blue umbrella, which takes a fancy to a red umbrella; with the help of other animated urban objects, the two umbrellas eventually are reconnected for a happily-ever-after ending. The film shows humans only as indistinct forms, but the city scenery is highly realistic, owing to the global illumination effects. One journalist described the “startling” scenery this way: “When a ‘walk’ sign on a street signal smiles, it looks like a video that has been modified with special effects to smile. ... It has photorealistic shading, lighting, and compositing. ... the animated rain looks like real rain — and everything else that’s animated looks real, as well” (D. Takahashi, 2013). Another wrote: “The effect is so striking, I spent the first three shots of the movie wondering why Pixar had decided to show live action footage before the short itself began” (Bishop, 2013).

These reactions pleased Unsel, who stated them as his goals for the film. “There are no limits to how animation can look and feel,” he said. “I’m interested in pushing people’s perceptions of what an animated movie can be” (Kim, 2013). He described tests he made of the photo-real effect and watching people’s reaction to being shown the footage:

... And every time I showed it, I always sat next to the screen so I saw the people watching it, and I hit play, and people just watched basically me shooting something on my iPhone. They were like, “Why is he showing this to us?” And then this first kind of coming to life happens, and I always saw in the faces of people how amazed they were, and how much it caught them by surprise. That’s when we came up with the idea, the magic in this is that it’s real, and comes to life. If it would be cartoony or stylized, it would be like, “Yeah, you’re expecting that,” but not in this context. We thought, “What if the whole thing would be photo-real, just to maintain this magic of it?” (Bishop, 2013)



Figure 11. Imagery in Pixar’s all-digital “The Blue Umbrella” is photo-realistic except for the anthropomorphic lines depicting facial expressions on the title character and his love interest. (Pixar Animation Studios)

Once the domain of anything-goes stylized animation, magic now lies in the veined, sweaty hands of photo-realism — or, more accurately I should say, magical photo-realism. As it exists as a genre of literature and, to a lesser degree, film, magical realism assumes that defined fantastic elements are natural amid mundane, everyday environments. A mixture of a little magic into the efforts to re/produce something realistic goes a long way toward engaging audiences. The most recent Hatsune Miku simulcast in August 2013 featured many more instant costume changes and magically appearing/disappearing microphone stands than the previous simulcast in 2011. “Yes, we all know that she is not an individual that exists,” said one observer in the “Mikumentary” film series, “but seeing her disappearing from the stage like that makes us recognize that she has a virtual existence. She has a strong presence on the stage, but we feel that she is also virtual” (as quoted in Knight, 2013a). In the crafting of visuals for “The End,” an opera built around and starring Miku solely, which premiered Dec. 1, 2012, at Japan’s Yamaguchi Center for Arts and Media, music director Keiichiro Shibuya said, “Rather than logical consistency, they [visual artists] use the power of visuals to find a way. ... Let’s say the script says, ‘The hand is stretched out,’ and if an actor is on the stage all he can do is stretch his hand. The length would be less than one meter. If a computer graphic or animation expresses the stretched hand, the hand can be stretched out 10 meters.” The opera’s visual artist, who goes by YK BX, later added, “Also, I inserted movement that not an actual human but only a computer graphic can do. Besides, since characters are released from gravity and quantity of matter, I took in some scenes where they float or dynamically move around to make it more entertaining” (MikuChannel, 2013). In crafting 2.0Pac’s exit from the stage, director Dylan Brown said

creators opted to have his image burst into a cloud of gold sparkles: “He has a mystique and that aura that kind of transcends death even.” He used the digital resurrection of Tupac to justify the endurance of hip-hop itself: “There was a time, 15 years ago, 20 years ago, when people were waiting for hip-hop to disappear. Now not only is hip-hop here to stay, even if you die, we’ll bring you back” (McCartney, 2012).

While smiling, loving umbrellas are certainly magical, the city scenes of “The Blue Umbrella” and even the impressive journey of the wind-blown title character are utterly recognizable and realistic; likewise, its photo-realistic depiction on screen. The blinking dots (eyes) and emotive curved lines (mouth, eyebrows) on the surface of the umbrella (see Figure 11) are magical elements that help the viewer assume sentience and agency in the object. Those facial features could have more easily been two-dimensionally animated and superimposed onto the photo-real object, but Unseld incorporated even their simple lines into the 3D rendering, the result of which is a more believable three-dimensional depiction, magic and all (Desowitz, 2013).

While Unseld’s lighting algorithms helped him generate realistic-looking rain, just years earlier this same effect was extraordinarily difficult. Ed Ulbrich, later the creative chief at 2.0Pac-producing Digital Domain, wrung his hands over this challenge in an earlier interview about producing a digitally animated commercial for Acura automobiles, titled “Dance,” as “easily in the top five most complicated commercials we’ve done,” and adding, “When you see rivulets of water dripping down a car, that’s as difficult and complex as it gets in CG. Every drop of water and piece of gravel and nook and cranny and mountain and shrub and bird and cloud is computer generated. There is so

much going on in every one of those frames. ... The cars were the easiest part of the commercial” (Shortman, 2004).

Mastering the realistic animation of human beings remains exponentially more challenging — yet, as Ulbrich claims in five different interviews within this study, “The holy grail of digital effects is to be able to create a photorealistic human being” (Markoff, 2006). Near the conclusion of this study, Provision had launched a Kickstarter campaign to raise \$950,000 toward the production of a full-size human figure projected into real space and visible without a screen or eyewear (Faircloth, 2013). Musion, the company behind 2.0Pac’s projection screen, has deployed a smaller version of its technology packaged as Musion EyeSay, featuring flat, life-size transparent mannequins into which are generated 3D-simulating imagery of a stationary human speaking and its accompanying audio. Two such stand-ups were stationed along security lines at Britain’s Manchester Airport, featuring projections of existing airport employees Julie Capper and John Walsh reminding passengers to have their boarding passes ready and explaining liquid restrictions. “I have to say, it’s strange to see yourself in virtual form,” Capper said, “and I’m hoping that I’ll be able to rely on my virtual self to carry some of my workload. I wonder if I can send it to meetings in my place and whether anyone will notice” (“Manchester Airport Hologram Style Staff Start Duty Today,” 2011). Musion’s James Rock said, “Anecdotally, people have been giving their passports to the two mannequins” (3dfocustv, 2011). Similar projection mannequins have been displayed at trade shows in Russia (Shagiev, 2010), airports in Norway (minimericals, 2010), and the Mall of America (jtroiden, 2008).

Still, like the Miku and 2.0Pac performances, these examples are little more than traditional 2D video projected into stylized screens that affect a mild 3D illusion. The uncanny valley is easily crossed by traditional video images. 2.0Pac, holo-Eazy, holo-ODB, and numerous other projects recently and in the works — these involve the re/creation of new performing personas. When construction, digital or otherwise, of a human face and/or body is at stake, the uncanny valley, as Paul Debevec said, “is always a concern because it’s a real effect” (personal communication, May 22, 2013). Debevec is a researcher at USC’s Institute for Creative Technologies where he’s helped to construct and utilize six Light Stages — lighting-and-camera structures that efficiently capture how an actor’s face appears when lit from every possible lighting direction, data that is then used in creating visual effects in film (read on for a more detailed explanation of the process). In his nearly 15 years working with these systems, Debevec says he’s come to a “refined idea of the uncanny valley,” which is a matter of degrees:

... it’s not like you have to get every aspect of the digital character 100-percent right in order to get across the valley. The thing is that you have to get all the aspects of the character *pretty* good. I’d say you need to be — if you’re past 85 percent or past 90 percent on every aspect — those last few percent to a hundred can be the hardest, of course — but if you’ve got the facial shape 85 percent right, if you’ve got the lighting on the face 85 percent right, if you’ve got the skin 85 percent right, if you’ve got the dynamics like wrinkles 85 percent right, if you’ve got the animation of the lips and the eyes and the three-dimensionality — if all of those things hit 85 percent, and the look of the hair and the simulation of the hair, then you’ve got something that people can just be cool with, and belief will be suspended, and you’re golden (personal communication, May 22, 2013).

Eric Barba, the visual effects supervisor at Digital Domain, shoots slightly higher, aiming for “a shot that’s 95 percent there — and that last five percent can be really challenging,” while acknowledging the practical realities of the uncanny valley theory: “We’ve all been looking at faces since we were born; we just know when something isn’t right. Artists

can't always put a finger on it and maybe can't verbalize it" (Iezzi, 2009). But once the goal line is crossed, the effect is groundbreaking. "It's a game changer," says Digital Domain's Ulbrich. "It'll be difficult to do a less realistic character now" (Iezzi, 2009).

The following excerpt from a transcript of a National Public Radio feature about the 2008 film "The Curious Case of Benjamin Button," in which a completely computer-generated version of actor Brad Pitt stars throughout the first half of the movie, introduces the compromise still required after that game-changing achievement:

LAURA SYDELL (reporter): ... The space between zombies and the computer-generated Brad Pitt is something called the uncanny valley. What that means is that when a robot or computer-generated character gets really close to looking human, if it doesn't go all the way, it looks creepy. That's why zombies wig people out, says Digital Domain's Preeg.

Mr. STEVE PREEG (Character Supervisor, Digital Domain): Even though they're a lot closer to humans than a primitive robot, people react better to the primitive robot and would rather have that around than a zombie in the house.

SYDELL: That's why it's been a lot easier for Pixar to make a robot named Wall-E cuddly than it was for Digital Domain to make a believably human reproduction of Brad Pitt. They knew they couldn't get anything wrong — not a dimple, not a wry smile, not a crease in the forehead — or they were in zombie land.

Mr. PREEG: In fact, we had a hard time hiring people for this show because everyone thought we were going to fail. No one wanted to be associated with a project where we made Brad Pitt look creepy and, you know, a \$150 million movie goes down the toilet because we made a zombie Brad.

SYDELL: But now that they've done it, gone to the other side of the uncanny valley, much more may be possible. There is no reason that they can't create a believable human character that isn't based on a movie star.

... SYDELL: But animators do need some sort of real human model, says animation supervisor Betsy Paterson.

Ms. BETSY PATERSON (Visual Effects Supervisor, Rhythm and Hues): Most of the animators have a mirror right by their monitor so that as they're working, they kind of make the faces and kind of try to figure out what is that essential thing that really gives you the feeling of the mood or attitude that you're trying to convey (Norris, 2009).

2. Still wanted: humans

For now, anyway, humans are still a required antecedent of digital virtual performance. Digital animators scan faces for 3D computer models, capture motion for Hatsune Miku dances, record voices or combinations of voices to add authentic-sounding audio. Each process is still merely copying or translating a human action. The machines still rely on the human to reproduce a successful digital performance. USC's Debevec:

I think the important distinction to draw right now is we're replacing the visuals; we're not actually replacing any of the acting. A performance that's come from a digital actor — either it's a successful translation of a performance from a human actor, like Andy Serkis becoming Gollum or King Kong or Caesar, or it's the result of great animators animating them somewhat laboriously like Woody and Buzz in "Toy Story." Of course, that's often done looking at video of what the real actors did and then you have this reference ... So all the acting and performing is still done by real people even if the standing in front of a camera and reflecting light part is done by the digital actors (personal communication, May 22, 2013).

When, in a 2007 project, Digital Domain animators sought to reanimate popcorn spokesperson Orville Redenbacher, who died in 1995, they started with photographs and footage from old television commercials. Then, Ulbrich said, "we brought in a team of sculptors and we started out really in clay. So we built a sculpture of Orville that everybody agreed looked just like him, and from there, we scanned that sculpture into our computers and created a 3D computer model" (Simmelkjaer, 2007). About 40 workers over six months produced a virtual Orville for a series of new TV ads. The campaign was short-lived, however, when a storm of negative commentary engulfed the subject online and the re-animated spokesperson plunged into the uncanny valley, dragged down by the nickname "Deadenbacher" (Walsh, 2007).

Humans have an eye for detail in other humans. If the slightest detail is off — *bang*, you're Deadenbacher. Image resolution must be superfine in scanning *and*

reproduction. “We are programmed from birth to recognize human faces,” said Steve Perlman, developer of an innovative camera system designed to capture that realistic detail (Markoff, 2006). Digital Domain’s Ulbrich, in discussing the creation of Virtual Brad for the “Benjamin Button” film, lamented the state of performance-modeling technology when the project began in 2004. Seeking to capture “the things that make [Pitt] who he is” and “translate them through the process,” Ulbrich recognized “a giant chasm” between the abilities of the existing tech and his goals. In a TED Talk presentation about the process, Ulbrich showed video of an early motion-capture example, a face with 100 markers on it for the computer to analyze as the actor made certain facial expressions. Ulbrich’s conclusion: it was a “crappy performance.” What was needed, he said, was the information between those markers. Eventually, he married a visual communication theory from the 1970s with Perlman’s brand-new technology to create an effective method for capturing and reproducing photo-realistic digital animation.

Not finding solutions within entertainment-related computer sciences, Ulbrich turned to the medical field, where he encountered the Facial Action Coding System (FACS), a well-established method of cataloging human facial expressions and their corresponding muscle movements. Created by Swedish physician Carl-Herman Hjortsjö (1969) and further documented by psychologists Paul Ekman and Wallace V. Friesen (1978), the FACS is a taxonomy of nearly 100 coded facial expressions, which can be combined to form nearly any possible emotional expression universal to age, race, culture, and gender. The system has been automated in several digital uses, from psychological analysis to facial recognition detection; using Perlman’s technology,

Ulbrich and Digital Domain were able to utilize the codes to capture realistic static facial data and actualize a believable performance. DD's Preeg suggested using Perlman's Mova Contour system, a performance-capture technology that uses special makeup on the actor's face to obtain its 3D data. The process:

The Contour system requires actors to cover their faces and clothes with makeup containing phosphorescent powder that is not visible under normal lighting. In a light-sealed room, the actors face two arrays of inexpensive video cameras that are synchronized to simultaneously record their appearance and shape. Scenes are lit by rapidly flashing fluorescent lights, and the cameras capture light from the glowing powder during intervals of darkness that are too short for humans to perceive.

The captured images are transmitted to an array of computers that reassemble the three-dimensional shapes of the glowing areas. These can then be manipulated and edited into larger digital scenes using sophisticated software tools like Autodesk's Maya or Softimage's Face Robot (Markoff, 2006).

In this case, Digital Domain ultimately generated a library of "shapes" for Pitt's facial characteristics and unique movements — "thousands and thousands of Brad Pitt micro-expressions," Ulbrich said. (Cohen, 2009). With Pitt in the chair, his face painted, surrounded by Contour's lighting and camera system, Digital Domain was able to generate a digital database that could reproduce a digital face capable of nearly anything Pitt's original could smile or smirk out. The process Ulbrich now refers to as "emotion capture" (Ulbrich, 2009).

Much of this technique was born out of research Debevec produced around the turn of this century into high-dynamic-range imaging (Reinhard et al., 2010) and image-based lighting (Debevec, 1998). Currently at USC, Debevec directs the Graphics Lab at the university's Institute for Creative Technologies, where he manages the series of Light Stages and their accompanying modeling software — a system he explains as "a computer-controlled lighting stage with high-resolution cameras that let us photograph a

face and turn a real person into a digital character” (personal communication, May 22, 2013). A detailed description:

The Light Stage is a sphere-shaped icosahedron two meters in diameter that almost entirely surrounds the subject. Attached to the sphere are 468 white Luxeon V LED lights. Over the course of three seconds, an eight-bit microprocessor flashes the lights in arbitrary pattern sequences and simultaneously triggers the shutter of two cinema-grade digital cameras. The cameras can record up to 4,800 frames per second at a resolution of 800 by 600 pixels.

The resulting scans display the actor’s face in every possible lighting condition and in such detail that skin pores and wrinkles can be seen at the sub-millimeter level. Light is captured as it reflects and refracts below the skin’s surface; direct and indirect light are separated out in a breakthrough technique that, during subsequent steps in the process, gives digital artists much greater control as they animate.

Debevec’s team then plugs the data into specialized algorithms that churn out highly complex facial models (Shafer, 2010).

“It’s important to get that amount of detail for skin to look like skin,” Debevec said, “to get that kind of roughness and the roughness you get on the forehead and the cheeks that’s different than the nose, that helps someone look like a real person rather than a mannequin” (personal communication, May 22, 2013).

In pre-production for the sci-fi film “Avatar” (2009), lead actors Sigourney Weaver, Sam Worthington, Zoe Saldana, Joel Moore, and Stephen Lang visited the USC lab and sat for two-hour sessions in the Light Stage, acting out various facial expressions required for their digital performance. Weta Digital, the visual effects company founded by film director Peter Jackson, then used the resulting 3D facial models to reproduce not only the digital structure and texture of the actors but also the lighting conditions in which they were filmed (Shafer, 2010). No special makeup is required for the Light Stages — in fact, actors can be facially captured while wearing the makeup required for their regular performances, as was the case when actress Naomi Watts was scanned in the

Light Stage for her digitized scenes in “King Kong” (2005). “Pretty much whatever makeup you want, the Light Stage will just scan that and reflect that,” Debevec said (personal communication, May 22, 2013).

Debevec’s own experiments in the Light Stage have been less fantastical. Instead of blue-skinned aliens, he’s produced two virtual performers: Digital Emily and Digital Ira. For the first, Digital Emily in 2008, Debevec, in collaboration with digital animation company Image Metrics, scanned a series of high-resolution facial expressions in the Light Stage and modeled them to a digitally animated character based on the original human performer, soap opera actress Emily O’Brien. This project copied O’Brien’s performance and re-created it digitally, keeping it rooted on the same far side of the uncanny valley as the original. “We’ve never shown it to anybody at the first viewing who thought that it wasn’t just a young woman sitting there answering questions” (personal communication, May 22, 2013). It is exactly that — Emily is merely speaking through a digitally imposed mask.

For Digital Ira, a 2012 collaboration with animators at gaming company Activision, Debevec and his team sought to expand their scope (Ira reproduces an entire digitized head) and “create a real-time, photoreal digital human character which could be seen from any viewpoint, any lighting, and could perform realistically from video performance capture even in a tight closeup,” which Emily did not (Alexander et al., 2013). Significantly, Digital Ira was engineered to render the performance image in real-time. Whereas Digital Emily’s data was captured, rendered offline, and digitally pasted into the video of O’Brien’s original performance, Digital Ira’s three-sentence performance thus far was driven entirely by the computer in real time. It’s a step closer to

Ulbrich's idea to "have a director direct a real-time performance from an actor, and have that actor's motion and that actor's performance, actually drive the synthetic actor" (Wertheimer, 1997).

Once firmly across the uncanny valley, though — once we cease being able to differentiate which digital representation is an actual reproduction of a human and which is an actualized virtual creation — then we lose the "intensified gaze" previously discussed. The absence of "second-order realism" (Darley, 2000, p. 82), a lack of "any connection to the real-world referent" (Aldred, 2011) restores a performance's *tromp l'oeil* for the critical eye. The closer scrutiny and heightened judgment produced by the knowledge that what we're seeing isn't real (Sobchack, 2006) may prove to be a transitional effect — one that ushers in the arrival of all new media before fading in order to allow the return of belief suspension and the more successful effect of narrative and performance. It's a tipping of the balance between narrative immersion and technical admiration that McGonigal described as "meta-pleasure" (2003, p. 5)

Virtual performance technology basically has to do the same thing — master enough data and methods to instill its own muscle memory. Debevec said it's all about tricking the subconscious:

I do think that if you tell people it's not real, then they can look at it more critically and then they can latch onto things like maybe the skin's a little too diffused or the eyes blink a little too slow. But that's things they're conscious of, and the uncanny valley is really a problem because it affects you subconsciously, and if you fool the subconscious it's not listening to you too much in terms of what the brain thinks about how good the scattering coefficient is of the teeth (personal communication, May 22, 2013).

3. Hybrid performance and interaction

So now the technology has become transparent — psychologically, subconsciously. But part of the effort in achieving that goal — in getting across the uncanny valley, in eliminating the intensified gaze — involves also eliminating the actual sight, feel, and learning curve of the actual physical technology. That’s why Pepper’s ghost simulations tend to work as well as they do; the illusion is presented seemingly out of thin air, within a recognizable context, and without any extra skill or gear required on the part of the user/viewer. “At Coachella, if you would have shown that on a large screen, nobody would have talked about it,” Nick Smith said of the 2.0Pac performances. “If you have people put on 3D glasses, people would have said, ‘That was kind of cool.’ But it wouldn’t have made it a big sensation. People went out there and saw something they weren’t expecting to see. That’s what made the impact” (Humphrey, 2012). A dead man performing live was indeed unexpected; however, embodying that experience as a human-seeming rapper standing on the same concert stage occupied by other human performers all that day — that was utterly expected. The surprise was in the narrative, not the context; it is allowed by the technology. But for most of the crowd (at least in the first performance, before social media and online reports explained the event) the technology producing the surprise had to be guessed at, ferreted out, investigated.

That’s because concepts of 3D viewing largely are still tied to photographs of 1950s movie houses featuring crowds of moviegoers wearing cardboard specs with red and blue stereoscopic lenses. Even “Avatar” required eyewear. Telepresent 3D simulations remain “an under-marketed technology,” according to Provision’s Ostrander, “and when anybody talks to you about 3D they naturally think about the James Cameron

movie where you have to wear glasses. When they think about without-glasses, it's another type of technology that's out there but it creates so much eye stress you can only watch it for about 40 seconds. ... The next step is getting our technology out there and publicized, that there is something great, that you don't need 3D glasses to watch, and it's very easy to produce content for it" (personal communication, Aug. 14, 2013). The storytellers producing content for display systems want viewers immersed in the narrative, not fixated on its method of delivery. Subject after subject in this study pointed squarely toward an unwavering belief discussed in the literature in making the technology disappear. Ulbrich in 1997: "This technology — if we've done our jobs effectively, it's invisible. You're not aware that it's going on" (Wertheimer); Ulbrich in 2009: "If we did our jobs well, hopefully you won't know we were ever involved" (Ulbrich). Pilon at 4D Art back in 1994: "The technology has to be totally transparent. If it isn't, the technical effects become a barrier between the audience and what's happening on stage" (Hustak); Pilon in 2000: "The problem with artists who use technology is that they put technology way up front, and they glorify it. Our goal is to make the technology invisible. ... Technology is merely a tool, like a musician's violin or piano" (Holtmeier). Pilon's partner, Michel Lemieux, in 1995: "We wanted to make the technology disappear. It doesn't look at all like a high-tech show. The set is almost old-time theatrical and you don't see any machines or computers, it's totally invisible" so that when the digital, 3D-simulated specters join the performance the effect is "quite stunning" (Morrow); Lemieux in 2013: "Everything is set up so it becomes totally transparent. People don't see it" (personal communication, Aug. 2, 2013). Lemieux, in fact, supports the idea that the

showing off of the technology is a transitional effect while extending his partner's previous violin example:

It's a bit the same thing when the synthesizer came into music. We had synthesizers everywhere, all over the place. Nowadays, a synthesizer is not such a novelty. It's an instrument, it's another possibility for you to do music. So you can use synthesizer, but it's not the only — it's not a novelty anymore. I think [virtual performance] technology has to evolve and become more mature. The principle of every artist is to make his instrument or his tools disappear. We don't want to see when, for example, someone plays violin, we don't want to hear the technical side of it. We want to hear the emotion that comes out of it. But to do that, you need to master your violin so much that your violin will disappear, in a way, it will become transparent. It's the same thing using technology. If you want to make a piece of art, your technology has to disappear (personal communication, Aug. 2, 2013).

Indeed, showing off the producing technology is its own kind of performance — Schechner's "showing doing" (2006, p. 28) applied to the behind-the-scenes designers and technicians as well as the traditional performers on stage. Provision's Ostrander said that in the design of his company's HoloVision kiosks the "whole intent is to try and let the customer see the technology to help entertain, attract, and inform" (personal communication, Aug. 14, 2013). The existing technology, however, is not shy. Its physical profile is sometimes demanding, and its abilities to render realistic imagery and simulate it within real space can be glitchy and/or produce imagery that's less than perfect. "We're just trying to give [viewers] every bit of help that we can in suspending disbelief that that person is there with them," Debevec said, but "we're not to the point where projecting someone in the room is going to look like they're completely in the room" (personal communication, May 22, 2013).

While complete and undistinguished telepresence is still on the horizon, virtual presence technologies are developing at a breakneck pace — and are oriented toward live

performance moreso than video presentations or cinematic insertion. Ulbrich claimed (to his investors) that all of Digital Domain's TV and film work essentially was a warm-up to being able to "bring these characters into live venues," and that "Dr. Dre's vision with the Tupac performance kind of triggered a tipping point, we think, and that's evidenced by the really the staggering number of calls we've been receiving about opportunities to take this further" (DigitalDomain, 2012). Artist-producer Patty Rangel also sees stages as the medium- to long-term home for emerging virtual performance technology. She added, "All the production companies are, 'We want to be experiential.' Everybody wants to be experiential. But it seems that was the way of the past. Now it's really about transforming the space and engaging the audience, knowing where they're coming psychologically, the cognitive science behind that. So what we have is the integration of mixed reality and virtual worlds onto the holographic stage" (Rangel, 2010).

One of Rangel's first virtual performance pieces was produced in conjunction with AV Concepts and the Second Life online virtual world. A human guitarist sat on a stool on a stage in San Diego, Calif., playing an acoustic guitar. Next to him, on an AVC Holographic Stage projection screen, a man stood while two women danced around him. The figures on the screen were virtual characters — actual avatars from the Second Life community. Instead of performing software agents, these digital figures directly represented people in real time, who performed on the San Diego stage from wherever they were logged into the Second Life site, which acted as mediator for the performances. Rangel's stated goal for the proof-of-concept performance was "to create a portal inside the Second Life virtual world for Avatars to teleport into the real world," and she

congratulated the performers “for being the first in history to make the leap between dimensions” (Rangel, 2011).

It’s here we begin to see the conflation of longstanding performance studies theories with emerging ideas about augmented/mixed reality. Nearly all the subjects of this study claimed that the point of virtual performance was to bring the real and the virtual together, balanced neatly in the middle of Milgram & Colquhoun’s mixed reality scale (Figure 8). The digital characters want to cavort with the fleshy ones, not drive them from the stage. In fact, a dependent relationship often was implied. “You have to get somebody else up there on stage to pretend to look at the person which they absolutely cannot see from the side, and that helps sell the trick to the audience,” Debevec said (personal communication, May 22, 2013). Ulbrich attempted to sell the live performance concept to Digital Domain’s investors by stressing that it would present “live performers with virtual performers, so you can see a headline act and guest appearances can appear with them, which we think will drive great awareness and excitement around those appearances” (DigitalDomain, 2012).

For Lemieux and his hybrid productions at 4D Art, mixing bodies and bits is entirely the point of the performance. Possessing an obvious reverence for classic film, Lemieux still insists he wants to take what’s good and engrossing from the cinematic experience and apply it to the live theater stage, where appropriate. “We do it with actors and dancers to create a new form of theater mixed with movies, actually,” he said. “It’s like an element of the movies that interacts with the theatrical element” (personal communication, Aug. 2, 2013). But his cultural breeding experiment actually is driven by a loss of faith in the cinema, which he now sees as having overused digital visual effects

at the expense of narrative immersion and, frankly, basic wonderment. Film viewing now, he implied, was nearly all intensified gaze, second-order realism, meta-pleasures. “We’re too aware of these processes, too savvy,” he said (personal communication, Aug. 2, 2013). “We don’t believe in film anymore, it doesn’t matter how much money you spend on special effects,” he said earlier. “But in the theatre, magic is still possible” (Conlogue, 1991).

For decades now, Lemieux has utilized the Pepper’s ghost technique — an old theater illusion updated with better, more transparent screens and brighter, more accurate projectors — in critically acclaimed productions, such as “NORMAN,” his 2007 tribute to Norman McLaren, and his 2005 interpretation of “The Tempest,” back to “Orfeo” (1998) and “Poles” (1996). In his most recent production, however, he was responsible for yet another pop star resurrection. Near the end of “Michael Jackson: ONE,” a resident music and dance show (developed by Cirque du Soleil in collaboration with the Jackson estate) that premiered in July 2013 at the Mandalay Bay Resort and Casino in Las Vegas, Jackson (who died in 2009) appears during a performance of his single “Man in the Mirror,” produced by 4D Art. Lemieux, speaking a month after the show opened, used this illusion to explain his mixed-reality mission statement:

We have a different approach. When they did Tupac, it was a very documentary way to do it: This is Tupac, he appears, and it’s like one long sequence. The way we do it is we kind of developed an artistic language using this kind of technology and, for example, Michael Jackson appears, but he disappears and reappears in other people, and there’s a definite artistic concept behind it.

... So it’s this idea that the spirit of Michael Jackson is in all of us. He appears with a magical touch, actually — not just making him appear. And I think Cirque du Soleil wanted something more than Tupac, which was really basic in appearance. It’s been the same thing with the Japanese pop stars. They appear — and that’s it. I think we developed a language really because, behind the trick, the illusion in itself is interesting, but if

you create an emotion with it then it becomes much more interesting. People see Michael Jackson, but they are touched not just because he's there but because he's on stage *with other people, with us* (personal communication, Aug. 2, 2013).

Here we see an important expansion of the idea of performance to include both actor-audience interaction and audience-audience interaction — and the unique challenge of digitizing one part of the former. Schechner's expansive theory of behavioral restoration includes the audience to the point of claiming as performance any pre-recorded, unchanging presentation because “the context of every reception makes each instance different” (Schechner, 2006, p. 23). Unless producers opt to change up the setlist overnight or make other alterations, the Miku concert on Tuesday is the exact same performance as Monday. The presence of the audience — a different crowd, likely, but even if it were the same people returning at a different time — makes the presentation a unique and “live” event allowing for that “sense of community developed by interaction” (G. Riva, 1999), whether that interaction is with performers or each other.

Miku's performances, significantly, each have included human musicians sharing the stage — except one: “The End,” the Hatsune Miku opera, which was widely reported as “the first humanless opera.” The show's creators each stressed in interviews that the performance was “without actual actors,” and musical director Keiichiro Shibuya, acknowledging the opera's weighty existential themes, even said, “I didn't dare feature actual actors and orchestra, to accentuate the emptiness” (MikuChannel, 2013). The complete absence of humans in the performance was taken to literal extremes earlier in 2007 when the retailer Target commissioned what it billed as the world's first “model-less” fashion show — a repeating, 10-minute loop of fashion ensembles walking a runway and descending stairs, apparently by themselves. Models were videotaped

strutting their stuff, but then their bodies were edited out of the video, leaving only the clothing behind. The resulting video was projected onto a Musion-like foil for a Pepper's ghost presentation (Jana, 2007). An earlier example: Pink Floyd laser light shows.

“Remember those, back in — what? — the '80s, where it was nothing but a crap-ton of lights and music?” Neve said. “No people, but that was still a live event. Is it a live concert? Maybe not. Is it a live event? Absolutely” (personal communication, Sept. 10, 2013).

But to really sell the trick, as Debevec said, a human being usually needs to be up there with the hologram. The character on the invisible foil needs a visible foil. Most subjects in this study discussed how to meet both of Steuer's determinants of presence. Admittedly, I had expected subjects to concentrate on the first one (vividness), but the important factor stressed in nearly all of this interview data was the second one — interactivity — and in a more direct way than I anticipated. Interactivity exists on both levels at a Hatsune Miku show; we have human performers to react with (at the most recent Miku simulcast, the two guitarists amped up this role considerably, stoking the crowd with furious guitar-solo expressions and making several applause-drawing jogs back and forth across the stage), and Schechner's allowance for intra-crowd interactivity is certainly in place. Typical interactivity, by crowd and musicians, with the centerpiece performer is merely reduced by the presence of a pre-programmed virtual figure.

The next challenge for developers is to make the tech interactive in real-time. That idea usually leads to leaps of wild futuristic speculation, though dramatic leaps forward aren't immediately required. Simply making a virtual performer such as Miku able to respond in small ways to a unique audience would be breakthrough enough. Miku

currently delivers her pre-programmed performance regardless of crowd response. The first applause meter appeared on a game show in 1956 (Clayton, 2009); surely the contemporary version of similar audio-detection technology could be wired into Miku's performance matrix, sensing whether the crowd responded more strongly to the ballads or the upbeat dance numbers, and adjusting the set list accordingly. A virtual performer could respond to heckles and boos, or return a cheer with, "I love you, too!" Locative features could be added easily, as well. 2.0Pac greeted his audience by asking a pre-programmed question, "What the fuck is up, Coachella?!"; if the much-ballyhooed follow-up tour of the presentation had materialized, GPS data could have been synced to each transmitted performance so 2.0Pac could automatically and accurately deliver an updated version of the 20th-century rock and roll cliché: "Hello, Cleveland!" (if not "Hello, 41.4822° North, 81.6697° West!").

USC's Debevec currently is working on a virtual performance project that will advance the liveness of vivid digital characters by significantly advancing their systematic interactivity. In collaboration with the Shoah Foundation, Steven Spielberg's archival project recording audiovisual testimonies of Holocaust survivors (also based at USC), Debevec leads a team in creating infrastructure for a hologram simulation at the U.S. Holocaust Memorial Museum in Washington, D.C. The project, called New Dimensions in Testimony, seeks to add just that — a third dimension to both the physical appearance of a Holocaust survivor and their recorded testimony, as well as the ability for that simulation to interact with viewers. In discussing the project, Debevec mentions three goals: "replicating the experience" of a person visiting in a classroom, "being there in person" (a "real human presence" that is "life-size," "being lit by the light of the

room,” and “making eye contact”), and “person-to-person interaction.” His bar for achieving believable interactions is lower than his uncanny valley standards: “If we can get something that’s 10 percent of the way toward that in-person interaction, it’s probably worth it” (personal communication, May 22, 2013).

The interactions are sequences of pre-programmed responses to anticipated questions. Holocaust survivor Pinchas Gutter sat in the Light Stage and before a green screen over the course of five days, not only imaging his face and body for a hologram simulation — which will be presented using a newer technique in a lecture hall at the museum — but also answering nearly 500 questions about himself and his tribulations during WWII. Debevec’s team is still working with natural-language computer scientists at USC to design a system that will both present holo-Gutter sitting in a chair talking to an audience of visitors and allow holo-Gutter to answer questions in real time.

Researchers have determined that there are about 100 questions commonly asked by an audience with a Holocaust survivor. Microphones will pick up the question, natural-language software will translate it for the computer in order to select the pre-programmed answer best suited to that question, and holo-Gutter will then deliver that response. If holo-Gutter is stumped by a question, he’ll simply say so and refer the person to someone at the museum who might be able to answer it (Rogers, 2013). Not perfect interaction, but down the road toward that goal.

Debevec mentioned the possibility of making 2.0Pac slightly interactive along these lines, even just to the point of having canned responses triggered by a human sound engineer as he/she judged the interaction required (another performative task reassigned to a techie behind the scenes). Even that need, however, will go away, he said: “You’ll be

able to do a full photo-real digital character up on stage and have them puppeteered by someone who's behind the curtain" (personal communication, May 22, 2013). That exact method of accurate real-time interaction is already available — with avatars, not agents. After the Second Life stage performance, Rangel also tested a system that generated real-time action in a digital figure projected onto a San Diego stage based on motion-captured movements of the avatar's user in New York (Rangel, 2012). Call it tele-performance. 4D Art has used a similar system in several stage productions. For "Orfeo," a modern retelling of the myth of Orpheus, several magical moments were created using Pepper's ghost projections on stage — but with live actors, not pre-recordings, producing the projected images from a "virtual studio" backstage. "It's very challenging for our performers," Pilon said. "It's all live. It's not prerecorded. It's different every night" (Holtmeier, 2000). The presence of characters visible to the audience but invisible to the actors adds a fascinating level of interaction but an extra level of preparation. The effect must be carefully rehearsed, Lemieux said, and rehearsal of the digital also still depends on human presence whether shooting pre-recorded projections or planning for live ones. In each rehearsal, he explained, stand-ins (who are dressed in black and edited out of the resulting projection) work in the video studio in order to provide an interactive presence for the actor being projected from the studio.²⁷ In his updating of "The Tempest," some

²⁷ So for pre-recorded scenes, the actual two actors are interacting in the studio ahead of time — the one who will be projected, and the one dressed in black who will be on stage while his studio performance is edited out of the projection. The one who's on stage, in effect, is on stage twice: he/she has presence in the flesh but also absence in the video projection. For real-time scenes, there's an actor on stage, and there's an actor in the studio with a stand-in. The stand-in also is unseen on stage but his absence is similarly present. Actor, present in the flesh; actor, present as a spirit; actor, absent but still somehow present — I call this the Holy Ghost effect.

actors appeared on stage first as virtual characters, then in the flesh. The permeability of the boundary, Lemieux said, heightens the kind of liveness only theater can provide:

The important thing in performing arts is the fact that it's real people, live people, on stage. And I think the virtual image becomes interesting when it's an interaction, when there's an interaction with live people. Then it becomes really interesting. Otherwise, it's a movie or a video installation. But if you do performing arts using this kind of technology the idea is really to add something to the theatrical experience but keeping the live quality of it, which is an incredible quality. Movies don't have that. A movie can play in a movie theater, and if nobody's in the hall the movie will still play. A theater show or a concert, it's impossible to replace it because there's something live. People are living and sweating on stage, people are laughing in the audience. There's something more.

Sometimes people ask us, with your virtual actors are you going to replace the live people, the live actors, and they miss the point. The point is really the shock between the virtual and real. That's really the place where it's very interesting where you have a live character interacting with a virtual one. Because we all live in virtuality. We all have imagination, we all have memories, we all dream at night, so we all have a step into the virtual world. That's why when we see things like that happening on stage it rings something deep in ourselves. It's not just "Wow!" because it's magical effects; it's more than that (personal communication, Aug. 2, 2013).

One question asked of every subject was, "What can a human performer do that a digital projection cannot?" The answers always started with or eventually arrived at real-time interaction, but Neve responded from his point of view also as a performer himself:

I can walk out and I can hug someone. I can stage dive. I'm a big guy and they'll probably move, but at least I can do it. I can tell someone in the audience, "Hey, you there! What's going on? How you doing today?" The holographic stuff, you can't. It's all pre-determined. ... With a live performer, though, I can tell him, "I love your music. You did a great job. I want to come back and see you." He can turn around and say, "Thank you very much." You can see him walking out of the building. If you're hot for him, you can go chase him to his hotel room. Whatever the outcome may be. With our holographic stuff, it stops right at the end of the show, and it starts back up when I do my next show. I put her away in a box, and that's where she stays. From the magic box she came, to the magic box she goes back (personal communication, Sept. 10, 2013).

C. Evaluating the future of eversion

The continuing evolution of virtual pop stars is tied to the development of three non-musical technologies: digital re/animation, projection systems, and artificial intelligence. Keeping in mind that technology forecasts tend to become outdated if not entirely quaint within hours of publication, I will close this section with a brief consideration of the trajectory of this tech and how it might advance future performances by virtual pop stars. In addition, each of these technologies will play significant roles in the overall eversion of cyberspace.

1. Digital re/animation

Like all computing hardware, the technology facilitating the creation of digital performances is subject to Moore's law and thus is expected to continue increasing exponentially in processing power. The faster the chips, the finer the available detail of rendered digital imagery and audio; the subtler the detail, the better the chances of landing a virtual simulation on the far side of Mori's slippery slopes, making it thus acceptable to human audiences. Whether animating original characters or reanimating images to create a simulation of an existing or deceased human performer, eventually technology will allow designers to create photorealistic characters that not only will fail to evoke the uncanny, they will go unnoticed as simulations. Once that technological bridge is in place, virtual pop stars and synthespians are likely to throng across it. With

technology supporting the visuals, the near future likely belongs to more photo-real, 2.0Pac-like simulations than anime-style, Miku ones.²⁸

Audio re/production technology is also roaring toward more detailed simulations. Music instrument synthesis not only has become strikingly realistic but more accessible; some of today's GarageBand instrument tools cheaply available for an iPhone sound as real as live instruments. The most difficult instrument to sample and reproduce has been the human voice; Miku now stands as the latest zenith of those efforts, with a new English version due on the market by the end of 2013. Thus far, a major pop star has not leant his or her voice to the Vocaloid-sampling process, but it's only a matter of time. This will open new vistas for both creative and copyright control. I have control over what is said with my own voice; when that voice is realistically sampled, simulated, and exists on the hard drives of various entertainment companies, that control is subject to new legalities and ethical concerns. Brad Pitt's physical likeness was completely digitized for the production of the film "The Curious Case of Benjamin Button" (a process facilitated by Digital Domain, the same company that re-animated the imagery for 2.0Pac). Down the road, could Digital Brad be dusted off to advertise a particular

²⁸ Not that I wish for delays, but I would have loved to complete this thesis *after* the opening of a new film, "The Congress," from director Ari Folman, tentatively scheduled for wider release in 2014. According to early reports from festival screenings, as well as a trailer available online (<http://www.youtube.com/watch?v=QHBl43lMJY0>), "The Congress" — based on the novel *The Futurological Congress* by Stanislaw Lem — bridges stylized animation and photo-real film in a nifty narrative speculating on these very issues. An aging actress with a reputation for being unreliable sells her digital likeness to a film studio, trading a hefty sum for the promise of never acting (in the flesh) again. The studio scans her body — in what appears to be a massive Light Stage — and moves forward to cast her digital self in new films. (Don Kirschner, we hardly knew ye.) Twenty years after that, the technology has evolved to allow the studio to sell these digital likeness, at which point the actress begins to object to the deal. All the while, though, her digital self begins "a new, virtual life" (Krammer, 2011), which is depicted in stylized animation through approximately 40 percent of the film (Fischer, 2011).

product or make certain political statements? I asked Debevec what kind of document a person is required to sign before he puts them into a Light Stage for scanning. He made clear that his team is contracted by the studios or companies hiring them for the scanning. “I’d have to look at the agreement,” he said. “I don’t know if it lets us put them into a commercial selling vacuums or not” (personal communication, May 22, 2013).

SRP’s Neve’s thoughts about the implications of this process twist the temporal linearity of 2.0Pac-like digital resurrections back on itself. “If you’re a record label, you could say, ‘You’re going to die one day, and I still want to make money off you,’” he said. “Let’s say you were able to go back 30 years and were able to get video, 3D video, of all of them — would the Rolling Stones still have a job right now?” (personal communication, Sept. 10, 2013). Indeed, why wait to resurrect the dead when you can virtually freeze stars in their prime? The Rolling Stones still record new albums on occasion, but their concerts are crammed with ’60s and ’70s hits; if given the choice of seeing and hearing the Stones perform as they are today (wrinkled old men, still good but noticeably off from their heyday, and charging exorbitant ticket prices, largely because of the significant expense of hauling real humans around through physical space and geography) or seeing and hearing life-like hologram simulations of the Stones digitally 3D-remastered from earlier performances in their prime, I suspect it wouldn’t take long for the hologram thing to finally catch on in the West. A star’s younger self could put his older self out of business. Or new pop stars, once they’ve reached a particular height of commercial success, could simply scan themselves at that moment — call it creative cryostasis — and retire early, basking on the beach or pursuing entirely different careers while their holo-self, frozen in time, continues touring and filling a bank account with

visual royalties. After some time, the aged star might no longer be recognized and troubled by paparazzi.

2. Projection systems

For the immediate future, Musion's James Rock is content with utilizing the current make of the Stones in helping him forge a new business model for entertainment delivery systems. "If we can get the Rolling Stones to come and perform in front of our camera ... for an afternoon, do five songs," he says, he could then say, "Mick, you don't have to ever go out on tour again and you'll be earning a revenue" (Rock, 2012). The projection would then tour, a Pepper's ghost system set up in a concert hall showing the performance as many times as the market will bear. Multiple systems could be deployed, covering the country and thus earning revenue in a shorter amount of time. Concert performances could become a boutique specialty service for those wishing to be present, and a pay-per-view living-room bonus for those wishing to be telepresent. Since technology usually shrinks as it evolves, the future of concerts could be the Stones projected into your house, Madonna voguing on your tabletop, Siri introducing Justin Bieber in the palm of your hand.

Musion also has redirected its business toward teleconferencing, repurposing the patented components that resurrected Tupac Shakur on a concert stage and marketing it to busy executives as TelePresence. The system captures a person's full-size, full-body image and re-presents it on an invisible screen on a stage anywhere in the world (connected by high-capacity data lines) utilizing the same Pepper's ghost technique, making it possible for "somebody [to] be in Sydney when they are actually appearing on

stage in London,” according to Rock (2012). It’s significantly more engaging than an appearance phoned-in via Skype to a monitor on the wall, and the Musion system’s attempt to hide the presenting technology at least gives the illusion that one layer of mediation has been stripped away from the communication. In addition, the image is straight video — perfectly photo-real and not at all uncanny. Plus, while a TelePresence presentation can be pre-recorded, ideally it is projected in real time, with two-way audio and video feeds making the communication interactive. During a live demo of the TelePresence system, a digitally projected image of a man on stage asked another man sitting in the second row, “Do you now feel you’re talking to a video or a person?” The man in the audience said right away, “Oh, a person, no question” (Rock, 2012). The campaign whistle-stop could be affected, too, if the technology is used by “politicians to deliver speeches from one location to reach multiple audiences at another, live and with a realistic full body and full gesture presence that they are until now unable to do,” Rock said (Pennington, 2012).

These are still 2D technologies, however, and — keeping with my earlier stated “desire” of digitally animated characters to rise from the flat surfaces and kick screens to the curb — the trajectory of projection technology development is toward 3D projection within real space without the need of screens or eyewear. The ubiquity of computers has begun to seed something like screen burnout. “We have screens all over our life,” Lemieux said. “I have many televisions, many computers — everywhere there are screens. So we don’t want to come on stage and see other screens” (personal communication, Aug. 2, 2013). Stephen Smith, the Shoah Foundation’s executive director, said the goal of the Holocaust survivor holograms is to get beyond screen

projection: “This takes it one step further as far as you won’t be projecting onto a screen, you’ll be projecting into space” (Rogers, 2013). Now, the closest technology to approximating real-space holograms in full size and color is a laser system based on traditional holography — the Urban Photonic Sandtable Display (UPSD), housed privately at the Defense Advanced Research Projects Agency (DARPA), which creates “3D holographic displays with up to 12 inches of visual depth” enabling “360-degree viewing by a team of 20 people without 3D glasses or goggles” (“DARPA Successfully Completes 3D Holographic Display Technology Demonstration Program,” 2011).

The next focal point of the digital 3D industry is Ulbrich’s “holy grail” — a full-size, photo-realistic human being — as symbolized by Princess Leia. Within the last year, several breakthroughs indicated that the Force may indeed be with designers pursuing this goal. Researchers at Hewlett-Packard Labs in Palo Alto, Calif., successfully tested a small display that produces a stereoscopic illusion of a three-dimensional object hovering in real space above the screen, and viewable from different angles without glasses (Fattal et al., 2013) (reported in one newspaper with the gleeful headline, “Princess Leia hologram could become reality” (Sample, 2013)). Joi Ito, director of MIT’s Media Lab, claimed in 2012 that a display system “about the size that ... will fit inside an R2-D2” would be testable within a year (Pachal, 2012); in 2013, the lab’s Mark-II, a successor to a holographic display originally designed by hologram pioneer Stephen Benton in the 1980s, was demonstrated by transmitting the performance-captured 3D image of an MIT student dressed as Princess Leia and delivering the same dialogue. These results so far are crude but promising. Private tech companies, too, are at work developing life-size holographic displays. But in between full-body presentations and mobile phones are mid-

size displays, such as another MIT project called Sixth Sense, an augmented-reality projector that hangs around the user's neck and projects displays and imagery in space ahead of the user. Another project, fVisiOn at Japan's NICT Universal Communication Research Institute, has generated several glasses-free, three-dimensional projections from a tabletop display — from a tiny teapot to a miniature Hatsune Miku (Yoshida, 2011).

The performance potential for these displays is clear. MIT's Ito posits such reality-augmenting displays could significantly impact not only daily life but “performance art” and “storytelling” (Pachal, 2012). Debevec and other subjects see other potential uses, from teaching classes (and, no doubt, further expanding the current debate over massive open online courses), the previously mentioned business conferences and political stumping, even “as teaching tools for people studying to become therapists who aren't quite ready to work with a real, emotionally troubled person” (Rogers, 2013). Rangel said her next goal was to make such technology portable — a 7-foot tube weighing less than 60 pounds,²⁹ easily transportable anywhere one wanted to “have an avatar appear as a full-bodied person and appear at any conference” (Rangel, 2012) and allowing, say, professors to appear anywhere and perhaps open a new field of “simulation-based learning” (Garey, 2011). Video games, too, are a clear opportunity to have “characters who were much more sentient and able to think up their own lines and their own emotions — then this could be much more real,” Debevec said (personal

²⁹ As to portability, the projection device that actualizes Rei Toei in Gibson's *Idoru* is described twice as a large silver thermos, which in the narrative sits proportionately once in a restaurant chair and again in a car seat. Toei briefly returns in Gibson's next novel, *All Tomorrow's Parties* (1999), again actualized by a portable projector one character “unslings” from a bag. Meanwhile, in the real world, James Rock at Musion suggested his telepresence technology “could end up as a consumer product ... similar to an aquarium-sized system in the home” (Pennington, 2012).

communication, May 22, 2013). Curt Thornton, CEO of Provision, a Los Angeles company developing 3D simulations for marketing purposes, suggests eventually plugging a life-size holo-display into a gaming system and doing battle, Wii-style (Thornton, 2010). Players could wait to fire until they actually see the whites of their opponent's eyes.

Some degree of physical interactivity with virtual performers may be in the offing, with several companies now seizing advantage of plunging prices for Kinect-type spatial-recognition cameras and employing them with holographic simulations to allow users to press buttons, select menus, even shake hands, all simulated in thin air. Ostrander said Provision is working to incorporate such technology into its holo-kiosks “because nobody wants to touch a keypad or a touchscreen where a thousand hands have been before” (personal communication, Aug. 14, 2013). This concept realizes Hiroshi Ishii's theory of transforming the “painted bits” of 2D screens into the “tangible bits” of 3D display, giving “physical form to digital information, making bits directly manipulable and perceptible” (Ishii, 2001, p. 19).

3. Artificial intelligence

“Where it really gets interesting is where these things start to have a mind of their own,” Debevec said (personal communication, May 22, 2013). This study began when I saw the animated, pre-programmed Hatsune Miku and thought of Rei Toei, a fictional artificial intelligence with near-complete agency in both cyberspace and the physical world. If artificial intelligence, like holographic display tech, develops in the direction of speculative portrayals in film and literature, robot and virtual performers eventually could

become “autonomous enough to demand their own bank accounts, book their own gigs, chase or lead new musical trends, set their own riders” (Collins, 2011, p. 35). In fact,

Really potent AIs may supplant human musicians through sheer virtuosity, reliability and work ethic; they may prove exceptionally popular with human audiences, if they do not sublime into new musical realms beyond the ken of biological hearing, where humans cannot follow (Collins, 2011, p. 37).³⁰

As detail and believability of simulations improves, the need for the psychological safety net of performer narratives will fall away. If performer narratives, as explained earlier, help us to keep at an arm’s length those virtual characters at the beginning of Mori’s scale, believable characters on the far side will shed that requirement, allowing a multitude of virtual narratives to blossom. Beyond the previous template of virtual characters simulating performance and life stories, a variety of synthespians should appear — both remediating old narratives and performance forms as well as forging new ones. Beyond even performance, the potential exists for virtual personal assistants, friends, lovers. Significant study of these extra ethical implications should proceed.

³⁰ For an entertaining consideration of these very ideas, see “Virtuoso,” an episode of “Star Trek: Voyager” (season 6, episode 13; 2000), in which the starship’s EMH (Emergency Medical Hologram) becomes prized by a particular civilization — not for his medical skills but his singing. He is (spoiler alert) eventually supplanted by a new hologram programmed with a vocal range far surpassing the capability of humans.

V. CONCLUSION

A. Dimensions

This study began amid a moment of surprise and wonderment — a bit of shock at seeing a digital virtual character performing in the context of human performers and thinking that it challenged numerous assumptions about what a performance was, how I as a music critic had, for 20 years prior, been defining the idea of performer, and the potential of new media in the realm of music and augmented or mixed realities. The audience at that first Hatsune Miku performance seemed to have progressed past the spectacle of her live concert presentation and embraced her as any other human performer. Though this study has hinted at and revealed several additional elements to this particular fandom — its particular production method utilizing crowd-sourced content, the resulting self-reflexive appreciation of some community members' own work, innovative new structures and uses of online networks, and more, all ripe for further examination — it has shown the current class of virtual pop stars to be instrumental to a certain progressive arc of human response to new technologies. These current virtual pop stars are transitional figures, bridging our experience with the normative behavior and abilities of human performers, who thus far remain as the characters' digitally translated antecedents, toward a future co-starring more vivid, interactive, and possibly even intrusive digital characters.

The raising of performing characters off the screened 2D plane and into full 3D space (simulated or otherwise) brings with it new challenges to aspects of performance and its communicative qualities, namely to social and interpersonal distance. Such distance, it seems, or at least the voluntary ability to traverse it, is key to virtuality itself.

Notions of virtuality previously discussed define the state as one with clearly marked entries and exits, whether literary (one can close the book and dissipate the narrative's imaginative immersion amid worldly distractions) or technological (experience of the manufactured VR world is dependent on putting on the eyewear/headset or taking it off). As Lentini concluded, our previous experience with the virtual has been one that has been literally framed, most often in modern times by an electronic screen; to return to non-virtual reality, we only had to look away. But as the presentation of digital performance now simulates and eventually will embody 3D projection, Lentini's claim of a new dawning of human experience begins to seem less hyperbolic. Virtual performers could soon step off the screen and into the room, becoming a presence to be reckoned with in similar terms as any physical object or, in this case, any human. As presence of the presentation increases, the distance between viewer and performer decreases.

Likewise, as physical dimensionality of the image increases, our ability to choose to ignore it decreases. The psychology of humans easily distracted by shiny objects, often applied pejoratively in colloquial usage, applies to any introduction of a "flashy" new electronic technology. The ubiquity of television screens has blunted the ability of its flickering signifiers to distract as easily as in the medium's early days, and the increased presence of 3D performers on tabletops or stages big and small no doubt will follow the same bell curve of rising fixation and falling interest. This is partly aligned with the "showing doing" performative aspect by the makers of the emerging technology: at first, those presenting this newfangled tech refrain from complete immersion by allowing for some of the presenting tech to remain in view, because the marvel of the presentation is often in the ability to see the gadgetry itself at work. As discussed, with wider exposure

over time this self-reflexivity becomes less important to the marketing of the presentation, and the performances ultimately pull focus back to the full force of their narratives. As happened in the movies, one day we won't care as much about the presenting technology and we'll just watch the performance. But for now ... hey, look! *Shiny, singing hologram!!*

B. Dualisms

That decreased distance between viewer and performer implies that the comfortable arm's-length granted by traditional performer narratives and the safe compartmentalization of screens both begin to fall away. If the performer is presented as or actually is in the room with us, then the virtuality of the character decreases, as well. Proust's notion of the virtual being "real without being actual" and Deleuze's recentering of the virtuality-reality binary ("the virtual is opposed not to the real but to the actual") collapses as we experience with most of our senses — sight, sound, possibly eventually touch, perhaps even smell (ODB, presented in Odorama!) — a performing being in physical space right next to or in front of us. The character is then both real *and* actual, despite its digitality. Second-order materiality, second-order realism — the "virtual register" dissolves, maybe not completely but sufficient to bring these characters far enough out of the liminal space to interact (once they are able to do so) on a very first-order level.

Thus, the virtual performers are engaging with humans situated within already familiar contexts. As long as humans remain the antecedent for the design and creation of these virtual digital performers, viewers don't have to learn whole new skill sets for

interacting with and relating to them. The success of the virtual hip-hop concerts and Miku's creative ecosystem has proven this. The repeatedly stated need for a human model in this study's data is key to the current transitional state of virtual performance. Cyberspace and virtual reality are in the process of everting into the reality of physical space; however, cyberspace and the computers that produce virtual performance don't yet possess a complete collection of data about what makes a human representation appear completely realistic. If interaction — one of Steuer's two determinants of presence within mediating technology — is, as stated, an important goal for the subjects of this study, then vividness — Steuer's other determinant — must increase dramatically in proportion. This is happening, as evidenced by the technologies and experiments described here. These examples illustrate not only the aforementioned transitional process of virtual performance but also our clear preference for photo-realism in telepresent humans or digital performers, at least in the West. William Gibson's desire for "higher rez, less anime" is the norm.

In their efforts to avoid the pitfall of the uncanny valley, designers and creators are, in their current nascent virtual performance works, building the foundation of a representational archive of human facial expression, emotional conveyance, and body movement that future designers or independent AI characters will draw from to make their presentation within our 3D world acceptable and believable. This could be seen as the basis for a big-data project on par with recent data-compilation projects, such as the completed Human Genome Project or the newly proposed plans to map the human brain. Each of these examples had as their goal the desire to build a base of data from which future inferences and diagnoses could be made. Similarly, a massive foundation of data

must be laid first so future digital singers and synthespians can draw from it. For instance, much of the textual information available via the Internet, particularly in its infancy, was the result of a kind of typesetting, the transcription by humans of texts on paper sources into digital files. Today's 3D digital artists are functioning in this way: compiling banks of a different kind of "big data," largely visual information, which tomorrow's artists — or, again, independent artificial intelligences — will mine in order to communicate with humans on a level acceptable and familiar to us. (More Gibson quoting: "What sort of computing power did it take to create something like this, something that looked back at you?" (W. Gibson, 1996, pp. 311-312)). Steve Perlman, creator of the Contour performance-capture system, mentioned humans being "programmed from birth to recognize human faces" (Markoff, 2006). His initial verb is a key metaphor: humans possess certain programming to determine the viability or uncanniness of another human or a representation of a human; thus, the creators of virtual performers are trying to bring these computing systems up to speed with our own innate abilities, programming them to render human simulations accordingly.

C. Decisions

But who acts upon this programming — who restores this stored behavior? The performer, of course. This study shows how fluid that definition has become and that creative decisions in the context of live performance are being reassigned from the performer on stage to a greater number of behind-the-scenes technical personnel. This already has happened with human performers, now directed in most stage action by more and more pre-set computerized cues. The process cures when a human's performances

are translated into a digital character. Yes, YDB leapt about in front of a green screen and his physical performance was captured for the digital resurrection of his own deceased father; however, his performance was limited by several determining technological factors. He could only leap so high, lest his performance exit the frame ordained by the camera capturing the performance and the range of projection on the resulting on-stage invisible screen. On the floor of his physical performance stage can be seen a rectangle demarcated by masking tape, the zone in which YDB must confine his performance for best capture by the technology. As mentioned, mouths are difficult to animate and lip-sync, so he had to hold the microphone directly in front of his mouth much of the time. Film actors know such constraints well, and just as the wider ranging expression of theater historically was compressed to fit the medium of the movies so now the breadth of onstage music performance is being boxed in for digital duplication and re-creation. In film, this expanded into a crew the number of non-performing personnel impacting or making direct performance decisions, both before the captured performance and in post-production. Each of the interview subjects in this study indicated that creative decisions rest with a multitude of figures in the production team. Debevec noted that creative decisions about what Digital Emily would actually say during her brief performance were driven entirely by what facial expressions the lines would produce for technical replication (personal communication, May 22, 2013). Neve lamented not having enough additional people to assist in creating his performances, adding that whatever technical shortcuts saved the most labor and time were selected for performance (personal communication, Sept. 10, 2013). Lemieux mentioned wanting to bring elements of the cinema to the stage, but I'm certain he was speaking of artistic uses of technology and

wasn't referencing this kind of creation-by-committee, resource-allocation performance decisions.

If eventually a viable artificial intelligence is achieved, then creative decisions of performance may one day revert back to the performer as autonomous digital virtual star. Debevec claimed above that the *current* goal of performance capture techniques was not to replace the human performer, merely to refract his and her behaviors through a digital lens. But if the databases of digitized human performance build sufficiently, the grandchildren of Digital Emily and Digital Ira may be able to begin mining it and selecting their own behaviors to restore, with or without human direction. Instead of pre-programming a synthespian's performance, the programming could include all possible expressions and outcomes so that, as Debevec posited, "a director, a real director, could work with a virtual actor, and if they say, 'Once more with feeling,' they'll get a different version of that performance. That's something that's just in the early stages" (personal communication, May 22, 2013).

Of course, we can only input into these databases what we know and collect from our own experience. This results in considerable use of remediating metaphors in the transition from old media to new. Just as the masses were ushered more comfortably into personal computing by way of on-screen page metaphors — word processing, pagination, comfy white 8.5-by-11-inch representations for documents — rather than the formidable C: prompt, the existing virtual pop stars bring us along with the aid of human performers' usual tropes. Beyond the previously mentioned linguistic debate about what to call the act of "singing" software, my favorite Miku remediation is her use of microphones. Miku has no literal voice. She is a visualization of several computer processes, one of which

includes audio production and mixing; these simulated vocal sounds are transmitted directly from the software to the amplification system in the concert venue. Yet Miku is nearly always depicted using some form of microphone — most often a headset but also, at key moments, a standard mike either held in her hand or mounted in a mike stand — especially when the ballads come up. The microphone and especially that stand — the better to hang on in a moment of lyrical angst — provide props for a certain mimicry that communicates particular emotional cues. Neve, in discussing his own live character presentations, said he insists to his animators that a microphone be used. “There’s some sci-fi movie where the girl’s singing and she has implants in her throat connected to the PA system, and that’s not very appealing. You don’t connect with that,” Neve said. “You connect with the mike in hand, the microphone stand, Britney Spears headset. Even subconsciously, we’re going, ‘That’s just like us!’” (personal communication, Sept. 10, 2013). Until virtual performance branches into its own particular creative models, performers have begun by borrowing from the only data available to them: that which has worked for humans and thus has been input as their performance model.

D. Data

Much of the rush to input this performance data and innovate technologies for actualizing it is driven by a representation (McKenzie’s “virtual virtual reality”) of humans fluidly reacting to a simulated holographic message: Princess Leia’s plea in “Star Wars.” A significant majority of subjects and sources in this study framed the discussion by referencing that visual effect, which engineers are now trying to realize. “I regret that I am unable to present my father’s request to you in person,” Leia said in her allegedly 3D

message to Obi Wan Kenobi, heralding a telepresent futurity with 3D voicemail and an embodied Siri. By retaining humanistic features in the presentation of these digitized characters, be they agents or avatars, existing interpersonal communication skills should require minimal adaptation to the newly digitized side of a 3D interaction, performative or otherwise.

The input of performative data, however, is continuing even as we rush to output the results back into the physical world. Cyberspace and its digital tools are, in effect, acting as a magic mirror through which we are reflecting our current selves and, like that employed by Snow White's evil queen, determining answers as to which character indeed looks fairest of them all. Researchers (in the case of Debevec's projects) and businesses (Crypton's shepherding of the Miku phenomenon) thus far have guided the creation of digital performing characters and their resulting presentations, via both 2D screens and 3D simulations, but as these abilities begin to trickle down to a wider, grassroots level (as Neve's burgeoning community illustrates) users of this tech and fans of its performing characters will be engaged increasingly in a collective social exercise of individual self-expression. Like the thousands of humans who utilize wearable computing devices and data-crunching apps to record and archive masses of self-monitored, self-sensing data about their individual lives — a recent movement known as “body hacking” or “the quantified self” (“Counting every moment,” 2012; Dorminey, 2012) — Miku fans add a performative aspect to this particular mode of data hoarding and expression. Aside from the trove of data building for photo-realistic characters in the West, Miku fans are compiling their own collective database of performative norms, which is already being mined by fellow content creators in the crowd cloud. The loop (see Figure 3) seeds its

own data and then snowballs as more users/fans add to and refine its store of choreography, animation models, facial expressions, and more.

Miku, 2.0Pac, holo-ODB, and the others — they are projections upon which fans can project their own psychological fantasies, desires and dreams. In the end, the success of these virtual performances comes down the element of light, whether in a realistic representation or in the candlepower of the projections delivering the virtual scene or performer. The vividness of “The Blue Umbrella” was enhanced by new light-mimicking software. Debevec’s stages have been driven by perfecting how light is reflected and captured from the human body. Neve’s home-spun concerts depend on affordable projectors that deliver sufficient brightness. The light also is a metaphor for the audience’s resulting awe. Victor Pilon, Michel Lemieux’s partner at 4D Art, described the wondrous responses of children to a virtual exhibit he and Lemieux designed for an interactive planetarium, mentioning “*la lumiere* — the light that was in them” (CJAD800, 2013). That’s the light that will remain a challenge to codify, digitize, and replicate.

E. Limitations and future research

The chief limitation of this study was the inability to attain direct access to the principal targeted sources at Crypton Future Media (because of their failure to respond) and Digital Domain (because of the non-disclosure agreement with their client). Future ethnographic study still should pursue these same sources, hopefully with better luck and fewer legal hurdles. I inquired repeatedly as to whether the gag order at Digital Domain had an expiration date; no one could provide an answer.

Opportunities for future study of these phenomena are myriad. As mentioned in the beginning, this study focused on one of two distinct audiences: the one that witnesses the performance as they would any human performer. The second audience — the active participants in the idol’s creative culture, the content creators — remains to be examined in depth. Indeed, some of the greatest labor on this thesis was in maintaining focus on just one or two — design and performance presentation — of the myriad and interconnected aspects of these creations. The complex network of Vocaloids and their produsage fans especially beckons to scholars of many stripes. A discussion of Miku is a discussion about topics central to communication (social media, network analysis, media studies, presence), sociology (labor issues, gender, ritual), cultural studies (death rites, fan studies, artistic translation), performance studies (theater and music, as well as film), economics and business (production/consumption, distribution, corporate branding), legal studies (copyright, trademark, licensing, intellectual property, authorship). Much of the Vocaloid fan community’s communication and production is mediated and stored, offering a large corpus of data to explore. I myself hope to participate in and/or see others pursue future studies of Miku’s complex fan community, critically evaluating their rituals of performance engagement and analyzing their groundbreaking communication and content-creation networks. The cosplay element of Miku’s and other Vocaloids’ fans also begs studied in the context of Susan Sontag’s concept of “camp” (1964) as well as in comparison to its obvious parallels in the simultaneous “floor shows” often performed by costumed fans during showings of the cult film “The Rocky Horror Picture Show,” particularly along the lines of that film’s “communal nature of fan participation” and the fluidity of interpretation and spectatorship (Weinstock, 2007). The music created by fans

for Vocaloids is ripe for content analysis, as well, with a particular ear for its (in my experience thus far) surprisingly narrow stylistic choices, likely the result of cultural currents vs. the limitations of the software itself. Lastly, Lemieux's own stage productions, particularly now that it's an impressive body of work spanning decades, would make for a worthy case study of interaction and presence in hybrid human-digital performance.

CITED LITERATURE

- 2-J. (2013). Gorillaz live shows / appearances *Gorillaz-Unofficial* Retrieved Jan. 25, 2013, from <http://www.gorillaz-unofficial.com/biography/gorillazliveshow.htm>
- 3dfocustv (Producer). (2011, Feb. 21). Musion Showcase Latest Hologram Entertainment Tech For 3D Focus! . *3D Focus TV*. Retrieved from http://www.youtube.com/watch?v=l2O7_bo1gps
- 39diyMMDconcert (Producer). (2012, Feb. 22). Vocalekt Visions at AOD 2012 - Part 1. *TempRecord*. [Video] Retrieved from <http://www.youtube.com/watch?v=umAbpHR8FPY&feature=c4-overview-vl&list=PLAE2FC00A1820F0E8>
- Abraham, A. (2012). *When Magoo Flew: The Rise and Fall of Animation Studio UPA* Middletown, Conn.: Wesleyan Univ. Press.
- Adder, J. B. (2006). Talk: Virtual Band (Discussion about the content page). *Wikipedia* Retrieved Jan. 23, 2013, from http://en.wikipedia.org/wiki/Talk%3AVirtual_band
- Aldred, J. (2011). From synthespian to avatar: re-framing the digital human in Final fantasy and The polar express. *Mediascape*, 1-12.
- Alexander, O., Fyffe, G., Busch, J., Yu, X., Ichikari, R., Graham, P., . . . von der Pahlen, J. (2013, July 21-25). *Digital Ira : Creating a Real-Time Photoreal Digital Actor*. Paper presented at the SIGGRAPH 2013, Anaheim, Calif.
- Allen, R., & Mendelowitz, E. (2001, Sept. 21-22, 2001). *Coexistence*. Paper presented at the cast01 // living in mixed reality: Conference on Communication of Art, Science and Technology, Sankt Augustin (Bonn).
- Ascott, R. (2001, Sept. 21-22, 2001). *The composite state of being: Notes on the technoetic implications of mixed reality*. Paper presented at the cast01 // living in mixed reality: Conference on Communication of Art, Science and Technology, Sankt Augustin (Bonn).
- Ashby, D. (2011). Say Hello to Hatsune Miku – The Digital Pop Star That Took Over Japan. *Geekscape*. Retrieved from Geekscape website:
- Asmus, J. F., Guattari, G., Lazzarini, L., Musumeci, G., & Wuerker, R. F. (1973). Holography in the Conservation of Statuary. *Studies in Conservation*, 18(2), 49-63.
- Auslander, P. (1997). Against Ontology: Making Distinctions Between the Live and the Mediatized. *Performance Research*, 2(3), 50-55.

- Auslander, P. (2000a). Liveness, Mediatization, and Intermedial Performance. *Degrés: Revue de Synthèse à Orientation Sémiologique*(101), 1-12.
- Auslander, P. (2000b). Tee Vee's Playhouse: Live Performance in a Mediatized Culture. *Aura: Film Studies Journal [Sweden]*, 6(1), 26-43.
- Auslander, P. (2004). Performance analysis and popular music: A manifesto. *Contemporary Theatre Review*, 14(1), 1-13.
- Azuma, R. T. (1997). A Survey of Augmented Reality. *Presence*, 6(4), 355-385.
- Bagdasarian, R. (1959). On *Let's All Sing With the Chipmunks*.
- Bakardjieva, M. (2005). *Internet Society: The Internet and Everyday Life*. London: Sage.
- Bates, J. (1991). Virtual Reality, Art, and Entertainment. *Presence*, 1(1), 133-138.
- Baudrillard, J. (1994). The Precession of Simulacra (S. F. Glaser, Trans.) *Simulacra and Simulation*. Ann Arbor, Mich.: Univ. of Michigan Press.
- Benedickt, M. (1991). *Cyberspace: First Steps*. Cambridge, Mass.: MIT Press.
- Benjamin, W. ([1936] 2008). *The Work of Art in the Age of Mechanical Reproduction*: Penguin.
- Benyon, M. (1982). On the Second Decade of Holography as Art and My Recent Holograms. *Leonardo*, 15(2), 89-95.
- Benyon, M. (1992). Do We Need an Aesthetics of Holography? *Leonardo*, 25(5), 411-416.
- Bineham, J. L. (1988). A Historical Account of the Hypodermic Model in Mass Communication. *Communication Monographs*, 55, 230-246.
- Biocca, F. (1992). Virtual reality technology: a tutorial. *Journal of Communication*, 42(4), 23-72.
- Bishop, B. (2013). Director Saschka Unseld discusses Pixar, photorealism, and the making of 'The Blue Umbrella'. *The Verge*. Retrieved from The Verge website: <http://www.theverge.com/2013/6/24/4457542/saschka-unseld-pixar-photorealism-and-making-the-blue-umbrella>
- Black, D. (2008). The virtual ideal: Virtual idols, cute technology and unclean biology. *Continuum: Problems in French Literature from the Late renaissance to the Early Enlightenment*, 22(1), 37-50. doi: 10.1080/10304310701642048

- Blanche, P. A., Bablumian, A., Voorakaranam, R., Christenson, C., Lin, W., Gu, T., . . . Peyghambarian, N. (2010). Holographic three-dimensional telepresence using large-area photorefractive polymer. [Research Support, U.S. Gov't, Non-P.H.S.]. *Nature*, 468(7320), 80-83. doi: 10.1038/nature09521
- Blascovich, J., & Bailenson, J. N. (2011). *Infinite Reality: Avatars, Eternal Life, New Worlds and the Dawn of the Virtual Revolution*. New York: HarperCollins.
- Blau, H. (1982). *Blooded Thought: Occasions of Theatre*. New York: PAJ Press.
- Blumenthal, E. (2005). *Puppetry: A World History*: Harry N. Abrams.
- Boissonet, P. (1989). Holography and the Imaginary Double: The Image of Body. *Leonardo*, 22(3/4), 375-378.
- Bolter, J. D., & Grusin, R. (1996). Remediation. *Configurations*, 4(3), 311-358.
- Bolter, J. D., & MacIntyre, B. (2007). Is it live or is it AR? *Spectrum, IEEE*, 44(8), 30-35.
- Breazeal, C. (2002). *Designing Sociable Robots*. Cambridge, Mass.: MIT Press.
- Breslauer, J. (1992, Jan. 12, 1992). Theater on a Chip : George Coates' 'Invisible Site' mingles performers and 'live' computer images in a symbiotic work that redefines the state of the art, *Los Angeles Times*. Retrieved from http://articles.latimes.com/1992-01-12/entertainment/ca-466_1_performance-art/2
- Bricken, W. (1990). *Virtual Reality: Directions of Growth*. Paper presented at the Notes from the SIGGRAPH '90 Panel, Seattle.
- Bruns, A. (2007). *Producers: Towards a Broader Framework for User-Led Content Creation*. Paper presented at the Creativity & Cognition Conference, Washington, D.C.
- Bruns, A. (2008). The Future Is User-Led: The Path towards Widespread Producers. *Fibreculture Journal*(11).
- Bryson, N. (1998). Books, Too, Have Their Destinies: Wenyon & Gamble's Bibliomancy. *Bibliomancy, the catalog of an exhibition of holograms by Susan Gamble and Michael Wenyon at The Boston Athenæum, February 12 -- April 25, 1998*. Retrieved from Wenyon & Gamble website: http://wengam.com/essays_shortlist/bryson/bryson.html
- Burston, J. (1998). Theatre Space as Virtual Place: Audio Technology, the Reconfigured Singing Body, and the Megamusical. *Popular Music*, 17(2), 205-218.

- Butler, J. (1990). *Gender trouble: Feminism and the subversion of identity*. New York: Routledge.
- Buxton, B. (2001, Sept. 21-22, 2001). *From Virtual to Mixed Reality*. Paper presented at the cast01 // living in mixed reality: Conference on Communication of Art, Science and Technology, Sankt Augustin (Bonn).
- Calbreath-Frasieur, A. (2012). Transmedia Muppets: The Possibilities of Performer Narratives. *Networking Knowledge*, 5(2), 173-186.
- Capucci, P. (2012). The case of holography among Media Studies, art and science. *Technoetic Arts*. doi: 10.1386/tear.9.2-3.247_1
- Carlson, J. (2012). A Short History Of The Hologram, As Told By 4 Pre-Tupac Holograms. Retrieved from http://gothamist.com/2012/04/17/the_history_of_the_hologram_as_told.php
- Carlsson, G., & Neovius, L. (1990). Implementations of synthesis models for speech and singing. *Speech Transmission Laboratory, Quarterly Progress and Status Report*, 2-3, 63-97.
- Cassell, J., Bickmore, T. W., Billinghurst, M., Campbell, L., Chang, K., Vilhjalmsón, H. H., & Yan, H. (1999). *Embodiment in conversational interfaces*. Paper presented in Proceedings of SIGCHI.
- Caulfield, K. (2012). Tupac's Virtual Coachella Appearance Spurs Huge Sales Bump. *Billboard*.
- Charles, D. (2009). Long Tails and Ears for Hats: The Story of Josie and The Pussy Cats. *Oldies Connection*. Retrieved from <http://lpintop.tripod.com/oldiesconnection/id17.html>
- Charney, A. (2011). Meet the World's First Virtual Pop Diva (press release): The Musebox.
- Cheney, A. (2013). Eazy-E, ODB Get 'Holograms' – Could Steve Jobs Be Next? Retrieved from <http://blogs.wsj.com/speakeasy/2013/08/22/eazy-e-ol-dirty-get-hologram-treatment-could-steve-jobs-be-next/>
- Childs, T. M. (2004). *The Rocklopedia Fakebandica*. New York: Thomas Dunne.
- CJAD800 (Producer). (2013, July 31). PLANETARIUM: Extended interview with artistic directors Retrieved from <https://soundcloud.com/cjad800/extended-interview-with-the>

- Clayton, E. (2009, April 20). Discover hidden treasures, *Telegraph & Argus*. Retrieved from http://www.thetelegraphandargus.co.uk/search/4303039.Discover_hidden_treasures/
- Coates, G. (1996). Interview with George Coates (transcript): Silicon Valley Radio.
- Cohen, D. S. (2009, Jan. 9). Acting Faces New Challenges in the Digital Age: 'Curious' ... and Curiouser, *Daily Variety*.
- Collins, N. (2011). Trading Faures: Virtual Musicians and Machine Ethics. *Leonardo*, 21, 35-40.
- The Concept of Presence: Explication Statement. (2000). *International Society for Presence Research* Retrieved Jan. 13, 2013, from <http://ispr.info/>
- Condry, I. (2009). Anime Creativity: Characters and Premises in the Quest for Cool Japan. *Theory Culture Society*, 26, 139-163.
- Conlogue, R. (1991, Oct. 18). Wizardry and wonderment: Michel Lemieux, *The Globe and Mail*.
- Conner, T. (2010). With star power to draw on, Gorillaz steps in front of the cartoons, *Chicago Sun-Times*. Retrieved from http://blogs.suntimes.com/music/2010/10/with_star_power_to_draw_on_gor.html
- Conner, T. (2012a). 'Metalocalypse' brings brutality to Dethklok concerts. Retrieved from http://blogs.suntimes.com/music/2012/11/metalocalypse_dethklok_concert_adult_swim.html
- Conner, T. (2012b). Second life: Freddie Mercury latest star reborn as avatar, *Chicago Sun-Times*. Retrieved from http://blogs.suntimes.com/music/2012/05/second_life_freddie_mercury_la.html
- Cook, P. R. (1993). SPASM, a Real-Time Vocal Tract Physical Model Controller and Singer, the Companion Software Synthesis System. *Computer Music Journal*, 17(1), 30-44.
- Copeland, R. (1990). The Presence of Mediation. *TDR: The Drama Review: A Journal of Performance Studies*, 34(4), 28-44.
- Corbin, J., & Strauss, A. (1990). Grounded Theory Research: Procedures, Canons and Evaluative Criteria. *Zeitschrift für Soziologie*, 19(6), 418-427.
- Counting every moment. (2012, March 3). *The Economist*.
- Crouse, R. (2000). *Big Bang, Baby: Rock Trivia*. Ontario, Canada: Dundum.

- Csikszentmihalyi, M. (1990). *Flow: The Psychology of Optimal Experience*. New York: Harper & Row.
- Cubarrubia, R. J. (2013, May 15). Rock the Bells to Feature Ol' Dirty Bastard, Eazy-E Holograms. *Rolling Stone*.
- Darley, A. (2000). *Visual Digital Culture: Surface Play and Spectacle in New Media Genres*. London: Routledge.
- DARPA Successfully Completes 3D Holographic Display Technology Demonstration Program. (2011). *Darpa.mil*. Retrieved from DARPA website: http://www.darpa.mil/NewsEvents/Releases/2011/2011/03/24_DARPA_Successfully_Completes_3D_Holographic_Display_Technology_Demonstration_Program.aspx
- Dautenhahn, K. (1998). *Storytelling in virtual environments*. Paper presented at the 13th European Conference on Artificial Life.
- Davis, R. E. (1976). *Response to innovation: A study of popular argument about new mass media*. New York: Arno.
- Deathmøle. Fear of Black Horses. *Bandcamp* Retrieved Jan. 23, 2013, from <http://deathmole.bandcamp.com/album/fear-of-black-horses>
- Debevec, P. (1998, July). *Rendering Synthetic Objects into Real Scenes: Bridging Traditional and Image-Based Graphics with Global Illumination and High Dynamic Range Photography*. Paper presented at the SIGGRAPH.
- Deleuze, G. (2000). The Virtual (P. Patton, Trans.). In A. Badiou (Ed.), *Deleuze: The Clamor of Being*. Minneapolis: Univ. of Minnesota.
- Desowitz, B. (2008). Presto Change-O for Pixar. *Animation World Network*. Retrieved from Animation World Network website: <http://www.awn.com/articles/production/iprestoi-change-o-pixar>
- Desowitz, B. (2013). Immersed in Movies: Pixar Goes Photoreal for 'Blue Umbrella' Short. Retrieved from <http://blogs.indiewire.com/animationscoop/immersed-in-movies-pixar-goes-photoreal-for-blue-umbrella-short>
- Dey, I. (1993). *Qualitative Data Analysis*. London: Routledge.
- DigitalDomain. (2012). Investor Call to Discuss Virtual Performer Business - Final. *FD (Fair Disclosure) Wire*.

- Dircks, H. (1863). *The Ghost!: As Produced in the Spectre Drama, Popularly Illustrating the Marvellous Optical Illusions Obtained by the Apparatus Called the Dircksian Phantasmagoria: Being a Full Account of Its History, Construction, and Various Adaptations*. London: E. and FN Spon.
- Discogs. Studio Five Retrieved June 10, 2013, from <http://www.discogs.com/artist/Studio+Five>
- Discogs. (2013). Mickael Turtle Retrieved Aug. 2, 2013, from <http://www.discogs.com/artist/Mickael+Turtle>
- diseno-art.com. ASIMO, Honda's humanoid robot Retrieved Jan. 5, 2013, from <http://www.diseno-art.com/encyclopedia/archive/ASIMO.html>
- Dodge, C. (1980). Any Resemblance Is Purely Coincidental. Internet Archive.
- Dogantan-Dack, M. (2012). The art of research in live music performance. *Music Performance Research*, 5, 34-48.
- Dorminey, B. (2012, May 31). Tic-Toc-Trac: New Watch Gadget Measures Time Perception For The Self-Quantifying. *Forbes*.
- Douglas, J. (1985). *Creative Interviewing*. Beverly Hills, Calif.: Sage.
- Draper, J. V., Kaber, D. B., & Usher, J. M. (1998). Telepresence. *Human Factors*, 40, 354-375.
- Dudley, J. (2006). Downloads, *The Courier Mail*, p. 38.
- Dyens, G. M. (1989). Holosculptures: Holography and Sculpture, Spirit and Matter. *Leonardo*, 22(3/4), 383-388.
- Ebersole, S. (1997). A Brief History of Virtual Reality and Its Social Applications. Retrieved from <http://faculty.colostate-pueblo.edu/samuel.ebersole/336/eim/papers/vrhist.html>
- Ebert, R. (2001). 'Final Fantasy: The Spirits Within'. *Chicago Sun-Times*. Retrieved from RogerEbert.com website: <http://rogerebert.suntimes.com/apps/pbcs.dll/article?AID=/20010711/REVIEWS/107110301>
- Ebert, R. (2004). 'The Polar Express'. *Chicago Sun-Times*. Retrieved from <http://rogerebert.suntimes.com/apps/pbcs.dll/article?AID=/20041109/REVIEWS/41006005/1023>

- Eidsheim, N. (2009). Synthesizing Race: Towards an Analysis of the Performativity of Vocal Timbre. *Trans: Transcultural Music Review = Revista Transcultural de Música*(13).
- Ekman, P., & Friesen, W. (1978). *Facial Action Coding System: A Technique for the Measurement of Facial Movement*. Palo Alto, Calif.: Consulting Psychologists Press.
- Endsley, M. R. (2000). Theoretical Underpinnings of Situation Awareness: A Critical Review. In M. R. Endsley & D. J. Garland (Eds.), *Situation Awareness Analysis and Measurement* (pp. 3-32). Mahwah, N.J.: Lawrence Erlbaum Assoc.
- Faircloth, K. (2013). This Kickstarter Wants Your Money to Create a Life-Sized Hologram, Because Princess Leia. *Beta Beat*. Retrieved from Beta Beat: The Lowdown on High Tech website: <http://betabeat.com/2013/07/this-kickstarter-wants-your-money-to-create-a-life-sized-hologram-because-princess-leia/>
- Farina, J. (2011). "Dickens's As If": Analogy and Victorian Virtual Reality. *Victorian Studies: A Journal of the Humanities, Arts and Sciences*, 53(3), 427-436.
- Fattal, D., Peng, Z., Tran, T., Vo, S., Fiorentino, M., Brug, J., & Beausoleil, R. G. (2013). A multi-directional backlight for a wide-angle, glasses-free three-dimensional display. *Nature*, 495, 348-351.
- Fields, D. (2012). The (Unofficial) Life of Josie Retrieved from <http://www.donosdump.com/Jozine/LifeOfJosie/introduction.html>
- Finch, C. (1993). *Jim Henson: The Works — The Art, the Magic, the Imagination*. New York: Random House.
- Fischer, R. (2011). 'The Congress,' From 'Waltz With Bashir' Director, Will Be Roughly 60% Live-Action, 40% Animated. *Slash Film*. Retrieved from Slash Film website: <http://www.slashfilm.com/the-congress-waltz-bashir-director-roughly-60-liveaction-40-animated/>
- Fontaine, G. (1992). The experience of a sense of presence in intercultural and international encounters. *Presence*, 1(1), 482-490.
- Freeman, D., Slater, M., Bebbington, P., Garety, P. A., Kuipers, E., Fowler, D., . . . Vinayagamoorthy, V. (2003). Can virtual reality be used to investigate persecutory ideation? *Journal of Nervous and Mental Disease*, 191(8), 509–514.
- Freud, S. (1919). The "Uncanny".
- Friedberg, A. (2009). On Digital Scholarship. *Cinema Journal*, 48(2), 150-154.

- Frith, S. (1996). *Performing Rites: On the Value of Popular Music*. Cambridge, Mass.: Harvard Univ. Press.
- Gabor, D. (1948). A new microscopic principle. *Nature*, 161(4098), 777-778.
- Gabor, D., Kock, W. E., & Stroke, G. (1971). Holography. *Science*, 173(3991), 11-23.
- Galbraith, P. W., & Karlin, J. G. (2012). The Mirror of Idols and Celebrity. In P. W. Galbraith & J. G. Karlin (Eds.), *Idols and Celebrity in Japanese Media Culture* (pp. 1-32). New York: Palgrave Macmillan.
- Garau, M., Slater, M., Bee, S., & Sasse, M. A. (2001). *The impact of eye gaze on communication using humanoid avatars*. Paper presented in Proceedings of SIGCHI.
- Garey, J. (Producer). (2011). Interview with Patty Rangel. Retrieved from <http://www.blogtalkradio.com/jason-garey/2011/01/14/interview-with-patty-rangel>
- Geduld, M. (2012). What makes acting believable? *Quora*. Retrieved from <http://www.quora.com/What-makes-acting-believable>
- Geertz, C. (1973). *The Interpretation of Cultures: Selected Essays*. New York: Basic.
- Geirland, J. (1996). Go With the Flow. *Wired*. Retrieved from http://www.wired.com/wired/archive/4.09/czik_pr.html
- Gibson, J. J. (1979). *The Ecological Approach to Visual Perception*. Boston: Houghton Mifflin.
- Gibson, W. (1984). *Neuromancer*. New York: Ace.
- Gibson, W. (1996). *Idoru*. New York: Berkeley.
- Gibson, W. (2007). *Spook Country*. New York: Penguin.
- Gibson, W. (2010). Google's Earth. *The New York Times*. Retrieved from http://www.nytimes.com/2010/09/01/opinion/01gibson.html?_r=0
- Gibson, W. (2011). Chicago Humanities Festival. B. Savage (Interviewer). Evanston, Ill.: Ethel M Barber Theater at Northwestern Univ.
- Glaser, B. (1978). *Theoretical Sensitivity*. Mill Valley, Calif.: Sociology Press.
- Glaser, B., & Strauss, A. (1967). *The Discovery of Grounded Theory*. Chicago: Aldine.

- Goetz, J., Kiesler, S., & Powers, A. (2003). *Matching robot appearance and behaviour to tasks to improve human-robot cooperation*. Paper presented at the In the 12th IEEE International Workshop on Robot and Human Interactive Communication, Lisbon, Portugal.
- Goffman, E. (1959). *The Presentation of Self in Everyday Life*. New York: Doubleday.
- Gold, A. (2004). Interview With Ron Dante. Retrieved from All But Forgotten Oldies website: <http://www.allbutforgottenoldies.net/interviews/ron-dante/>
- Goodale, G. (2012, April 17, 2012). Tupac Shakur hologram: how new technology is invading the real world., *Christian Science Monitor*.
- Gorini, A., Capideville, C. S., De Leo, G., Mantovani, F., & Riva, G. (2011). The role of immersion and narrative in mediated presence: the virtual hospital experience. [Randomized Controlled Trial]. *Cyberpsychol Behav Soc Netw*, 14(3), 99-105. doi: 10.1089/cyber.2010.0100
- Goulding, C. (2001). Grounded theory: A magical formula or a potential nightmare. *The Marketing Review*, 2(1), 21-33.
- Gracyk, T. (1996). *Rhythm and Noise: An Aesthetics of Rock*. Durham, N.C.: Duke Univ. Press.
- Graham, P. (2006). *Hypercapitalism: New Media, Language, and Social Perceptions of Value*. New York: Peter Lang.
- Grau, O. (2003). *Virtual Art: From Illusion to Immersion*. Cambridge, Mass.: MIT Press.
- Green, M. C., Brock, T. C., & Kaufman, G. (2004). Understanding Media Enjoyment: The Role of Transportation Into Narrative Worlds. *Communication Theory*, 14(4), 311-327.
- Greenfield, A. (2006). *Everyware: The dawning age of ubiquitous computing*. Berkeley, Calif.: New Riders.
- Grossberg, L. (2002). Reflections of a Disappointed Popular Music Scholar. In R. Beebe, D. Fulbrook & B. Saunders (Eds.), *Rock Over the Edge: Transformations in Popular Music Culture* (pp. 25-49). Durham, N.C.: Duke Univ. Press.
- Grotowski, J. (1968). *Towards a Poor Theatre*. New York: Simon & Schuster.
- Group, H. R. (1994-2003). Humanoid Robotics Group Publications Retrieved Jan. 5, 2013, from <http://www.ai.mit.edu/projects/humanoid-robotics-group/publications.html>

- guerillanation (Producer). (2013, Sept. 11). Virtual Performances - EPISODE 1. *Behind the Scenes*. Retrieved from <https://www.youtube.com/watch?v=VV88iUhZQvQ>
- Handelman, D. (2003). Towards the Virtual Encounter: Horton & Wohl's 'Mass Communication and Para-Social Interaction'. In E. Katz, J. D. Peters, T. Liebes & A. Orloff (Eds.), *Canonic Texts in Media Research* (pp. 137-151). Maden, Mass.: Polity.
- Haraway, D. (1991). A Cyborg Manifesto: Science, Technology, and Socio-Feminism in the Late 20th Century *Simians, Cyborgs and Women: The Reinvention of Nature* (pp. 149-181). New York: Routledge.
- Haringer, M., & Beckhaus, S. (2012). Adaptive Generation of Emotional Impact Using Enhanced Virtual Environments. *Presence, 21*(1), 96-116.
- Hayles, N. K. (1999). *How We Became Posthuman: Virtual Bodies in Cybernetics, Literature, and Informatics*. Chicago: Univ. of Chicago Press.
- Heeter, C. (2003). Reflections on Real Presence by a Virtual Person. *Presence, 12*(4), 335-345.
- Hjortsjö, C.-H. (1969). *Man's Face and Mimic Language*. Lund, Sweden: Studentlitteratur.
- Holm, F. (2004). Believe in Music NAMM Show 2004. *Computer Music Journal, 28*(3), 79-81.
- Holtmeier, L. (2000, Jan. 3). Mythology meets technology, *Lincoln Journal Star*.
- Hoorn, J. F., Konijn, E. A., & van der Veer, G. C. (2003). Virtual Reality: Do Not Augment Realism, Augment Relevance. *Upgrade: The European Online Magazine for the IT Professional, 4*, 18-26.
- Horowitz, R. F. (1983). History comes to life and You are there. In J. E. O'Connor (Ed.), *American History, American Television* (pp. 79-94). New York: F. Ungar.
- Horton, D., & Wohl, R. R. (1956). Mass Communication and Para-Social Interaction: Observations on Intimacy at a Distance. *Psychiatry, 19*(3), 215-229.
- Huhtamo, E. (2004). Elements of Screenology. *ICONICS: International Studies of the Modern Image, 7*, 31-82.
- Huhtamo, E. (2010). The Sky is (not) the Limit: Envisioning the Ultimate Public Media Display. *Journal of Visual Culture, 8*(3), 329-348. doi: 10.1177/1470412910364291

- Huhtamo, E. (2012). Screen Tests: Why Do We Need an Archaeology of the Screen? *Cinema Journal*, 51(2), 144-148. doi: 10.1353/cj.2012.0011
- Humphrey, M. (2012, June 26). Meet The Man Who Helped Resurrect Tupac ... And Maybe Hollywood. *Forbes*.
- Hustak, A. (1994, Nov. 27). Grand Hotel full of Pepper ghosts and poetry, *The Gazette*, p. F2.
- Iezzi, T. (2009). Curious?: Digital Domain EVP, Production/president, commercials division, Ed Ulbrich and VFX supervisor Eric Barba and director David Fincher on making The Curious Case of Benjamin Button. *Creativity*, 41.
- Ishii, H. (2001, Sept. 21-22, 2001). *Tangible bits: Designing seamless interface – between digital and physical*. Paper presented at the cast01 // living in mixed reality: Conference on Communication of Art, Science and Technology, Sankt Augustin (Bonn).
- Jackson, N. (2013). Rock the Bells Founder Chang Weisberg Explains How Eazy-E and ODB Avatars Were Made. Retrieved from http://blogs.ocweekly.com/heardmentality/2013/09/chang_weisberg_rock_the_bells_eazy_e_odb_holograms.php
- Jameson, F. (1993). *Postmodernism, or the Cultural Logic of Late Capitalism*. Durham, N.C.: Duke Univ. Press.
- Jana, R. (2007). Target's Holograms: The Innovation Angle. *Business Week*. Retrieved from http://www.businessweek.com/innovate/next/archives/2007/10/targets_hologra.html
- Janssen, D. (2001). Dan Janssen liner notes. *Jozine*. Retrieved from <http://donosdump.com/Jozine/DanJanssen.html>
- Jenkins, F. A., & White, H. E. (1976). *Fundamentals of Optics*: Nueva York, EUA : McGraw-Hill.
- Jenkins, H. (2006). *Convergence Culture: Where Old and New Media Collide*. New York: New York Univ. Press.
- Johnson, D. (2006, April 1). Peppaz Ghost. *Live Design*.
- Johnson, S. (2005, February). A Musical Head Trip. *Discover*, 26.
- Johnston, S. (2004). Telling Tales: George Stroke and the Historiography of Holography. *History and Technology*, 20(1), 29-51.

- Johnston, S. (2005). Attributing Scientific and Technological Progress: The Case of Holography. *History and Technology*, 21(4), 367-392. doi: 10.1080/07341510500198701
- Johnston, S. (2006). *Holographic Visions: A History of New Science*. Oxford: Oxford Univ. Press.
- Johnston, S. (2008). A Cultural History of the Hologram. *Leonardo*, 41(3), 223-229.
- Jones, M., & Alony, I. (2011). Guiding the Use of Grounded Theory in Doctoral Studies – An Example from the Australian Film Industry. *International Journal of Doctoral Studies*, 6, 95-114.
- jtroiden (Producer). (2008, Sept. 6, 2013). Best Buy Virtual Blueshirt. [Video] Retrieved from <http://www.youtube.com/watch?v=ZiVtj8fIPms&NR=1>
- Jung, D. (1989). Holographic Space: A Historical View and Some Personal Experiences. *Leonardo*, 22(3/4), 331-336.
- Jurgenson, N. (2012). When Atoms Meet Bits: Social Media, the Mobile Web and Augmented Revolution. *Future Internet*(4), 83-91.
- Kaufman, G. (2012). Exclusive: Tupac Coachella Hologram Source Explains How Rapper Resurrected. *MTV News*. Retrieved from MTV News website: <http://www.mtv.com/news/articles/1683173/tupac-hologram-coachella.jhtml>
- Kelly, J. L., & Lochbaum, C. C. (1962). *Speech Synthesis*. Paper presented at the Fourth International Congress on Acoustics.
- Kelts, R. (2006). *Japanamerica: How Japanese Pop Culture Has Invaded the U.S.* New York: Palgrave MacMillan.
- Kennedy, G. D. (2013a, Sept. 9). Review: 'Comeback' of Eazy-E and Ol' Dirty Bastard at Rock the Bells *The Los Angeles Times*. Retrieved from <http://www.latimes.com/entertainment/music/posts/la-et-ms-rock-the-bells-20130909,0,5829242.story>
- Kennedy, G. D. (2013b, Sept. 7). Rock the Bells 2013: Eazy-E, ODB brought back to life by their kids *The Los Angeles Times*. Retrieved from <http://www.latimes.com/entertainment/music/posts/la-et-ms-rock-the-bells-2013-eazy-e-and-odb-brought-back-to-life-by-their-kids-20130906,0,6603120.story>
- Kennedy, G. D. (2013c). Rock the Bells 2013: Eazy-E's 'comeback' caps Day 1 *The Los Angeles Times*. Retrieved from <http://www.latimes.com/entertainment/music/posts/la-et-ms-rock-the-bells-2013-eazy-e-comeback-20130908,0,5055838.story>

- KiddFuture. (2012). Dylan Brown On Producing Tupac Hologram, Directing 'Mac + Devin Go To High School'. *The Source*. Retrieved from The Source website: <http://thesource.com/2012/07/03/dylanbrownonproducingtupachologramdirectingmacdevingotohighschool/>
- Kim, M. (2013, June). Magical realism: A rookie director tries a new look for Pixar. *Wired*, 21.
- Kimoto. Dilad Screen Retrieved Sept. 11, 2013, from <http://www.diladscreens.com/>
- Kinsella, S. (1998). Japanese Subculture in the 1990s: Otaku and the Amateur Manga Movement. *Journal of Japanese Studies*, 24(2), 289-316.
- Knight, T. (Writer). (2013a). Ephemeral / Hologram / Weird [Video], *Mikumumentary*.
- Knight, T. (Writer). (2013b). Everybody's Voice / Icon [Video], *Mikumumentary*.
- Knight, T. (Writer). (2013c). VOCAROOM / Conversations / Community [Video], *Mikumumentary*.
- Kodera, M. (1992). Holography in Japan. *Leonardo*, 25(5), 451-455.
- Krammer, G. (2011). Ari Folman on the Genius of Stanisław Lem. *Culture.pl*. Retrieved from Culture.pl website: http://www.culture.pl/web/english/resources-film-full-page/-/eo_event_asset_publisher/eAN5/content/ari-folman-on-the-genius-of-stanislaw-lem
- Krueger, M. W. (1991). *Artificial Reality*. Reading, Mass.: Addison Wesley.
- Lajoie, M. (1996). Psychoanalysis in Cyberspace. In R. Shields (Ed.), *Cultures of the Internet: Virtual Spaces, Real Histories, Living Bodies* (pp. 153-169). London: Sage.
- Lamb, C. (2001). Prozzak Gives Us 'Saturday People'. *Teen Music*. Retrieved from <http://www.teenmusic.com/2001/02/09/prozzak-gives-us-saturday-people>
- Langer, E. J. (1989). *Mindfulness*. Reading, Mass.: Addison-Wesley.
- Lanier, J., & Biocca, F. (1992). An insider's view of the future of virtual reality. *Journal of Communications*, 42(4), 150-172.
- Laurel, B. (1991/1993). *Computers as Theatre*. Reading, Mass.: Addison-Wesley.
- Lee, K. M. (2004). Presence, Explicated. *Communication Theory*, 14(1), 27-50.

- Lentini, L. (1991). Private Worlds and the Technology of the Imaginary: Effects of Science and Technology on Human Representations and Self-Conceptions. *Leonardo*, 24(3), 333-339.
- Leon, L., Halawani, Y., Davies, D., & Sizemore, M. (2012). Eternal Descent - The Animated Series. *Indiegogo*. Retrieved Jan. 23, 2013, from <http://www.indiegogo.com/eternaldescent>
- Lipman, S. (1990). *Arguing for Music / Arguing for Culture*. Boston: Godine.
- Lombard, M., & Ditton, T. (1997). At the Heart of It All: The Concept of Presence. *Journal of Computer Mediated Communication*, 3(2).
- Louchart, S., & Aylett, R. (2003). Towards a narrative theory of Virtual Reality. *Virtual Reality*, 7(1), 2-9.
- Lucie-Smith, E. (1996). A 3D Triumph for the Future. *The Spectator*, 277(8777), 57-58.
- Lussy, M. M. (1882). *Musical expression: Accents, nuances, and tempo in vocal and instrumental music*. London: Novello.
- Macias, P. (2011). CRN Interview: The Creators of Hatsune Miku *Crunchy Roll*. Retrieved from Crunchy Roll website: <http://www.crunchyroll.com/anime-feature/2011/07/21/crn-interview-the-creators-of-hatsune-miku>
- Mak, T. (2011). Itoh & Sasaki Vocaloid Creators Interview *The O Network*. Retrieved from The O Network: Japanese Content Industry News website: <http://www.tono.net/Interview/Itoh-Sasaki-Vocaloid-Creators-Interview.html>
- Mallenbaum, C. (2013, Sept. 29). Meet Hatsune Miku, the 'crowd-sourced celeb', *USA Today*. Retrieved from <http://www.usatoday.com/story/life/music/2013/09/29/hatsune-miku-vocaloid-singer/2877767/>
- Manchester Airport Hologram Style Staff Start Duty Today. (2011). *3D Focus*. Retrieved from 3D Focus website: <http://www.3dfocus.co.uk/3d-news-2/manchester-airport-hologram/2061>
- Mania, K., & Chalmers, A. (2001). The Effects of Levels of Immersion on Memory and Presence in Virtual Environments: A Reality Centered Approach. *Cyberpsychology & Behavior*, 4(2), 247-264.
- Manovich, L. (2001). *The Language of New Media*. Cambridge, Mass.: MIT Press.
- Markman, R. (2013). Eazy-E And ODB At Rock The Bells: The Secrets Behind Their Holograms. *MTV News*. Retrieved from MTV News website:

- <http://www.mtv.com/news/articles/1713690/eazy-e-ol-dirty-bastard-rock-the-bells-hologram.jhtml>
- Markoff, J. (2006, July 31). Now Starring . . . Digital People, *The New York Times*, p. 1.
- Marsh, T., Wright, P., & Smith, S. (2001). Evaluation for the Design of Experience in Virtual Environments: Modeling Breakdown of Interaction and Illusion. *Cyberpsychology & Behavior*, 4(2), 225-238.
- Martin, I. (2012). Shibuya style with an Akihabara twist?: Indie acts embrace their inner otaku. *The Japan Times*. Retrieved from <http://www.japantimes.co.jp/text/fm20120126im.html>
- Martin, P. Y., & Turner, B. A. (1986). Grounded theory and organizational research. *The Journal of Applied Behavioral Science*, 22(2), 141-157.
- Martinho, C. A., Paiva, A., & Gomes, M. R. (2000). Emotions for a Motion: Rapid Development of Believable Pathematic Agents in Intelligent Virtual Environments. *Applied Artificial Intelligence*, 14, 33-68.
- Marx, C. (Writer). (1985). The Beginning [Television], *Jem & the Holograms*.
- Matsutani, M. (2009). Pop 'idol' phenomenon fades into dispersion. *The Japan Times*. Retrieved from <http://search.japantimes.co.jp/cgi-bin/nn20090825i1.html>
- McCartney, A. (2012). Tupac Hologram Leads The Way For Digital Resurrections Of Elvis Presley, Marilyn Monroe. *The Huffington Post*. Retrieved from The Huffington Post website: http://www.huffingtonpost.com/2012/08/21/tupac-hologram-elvis-presley-marilyn-monroe_n_1818715.html
- McCulloch, M. (2004). *Digital ground— architecture, pervasive computing, and environmental knowing*. Cambridge, Mass.: MIT Press.
- McGonigal, J. E. (2003, November 2003). *A Real Little Game: The Performance of Belief in Pervasive Play*. Paper presented at the Digital Games Research Association (DiGRA) "Level Up" Conference Proceedings., Utrecht, Netherlands.
- McGrath, P. (1980, July 19). Inside the Sleeve, *The Globe and Mail*.
- McKenzie, J. (1994). Virtual reality: Performance, immersion and the thaw. *TDR: The Drama Review: A Journal of Performance Studies*, 38(4), 83-106.
- McLuhan, M. (1964). *Understanding Media*. New York: McGraw-Hill.

- Meyers, C. (2012). She sings, she dances, she's ... not real. *Reuters*. Retrieved from <http://www.reuters.com/article/2012/03/09/us-japan-digital-diva-idUSBRE8280DO20120309>
- MikuChannel (Producer). (2013, May 12). [VOCALOID OPERA] "THE END" Artist Interview. [Video] Retrieved from <http://www.youtube.com/watch?v=Z1-YbcbAQ84>
- Milgram, P., & Colquhoun, H. (1999). A taxonomy of real and virtual world display integration. In Y. Ohta & H. Tamura (Eds.), *Mixed Reality: Merging Real and Virtual Worlds* (pp. 5-30). Secaucus, N.J.: Springer-Verlag.
- Milgram, P., & Kishino, F. (1994). A taxonomy of mixed reality visual displays. *IEICE Transactions on Information and Systems*, *E77-D*(12), 1321-1329.
- Miller, D. (2004, Aug. 2004). There's a new duo in town who never take a break. *Electronic Musician*, 90-98.
- minimericals (Producer). (2010, Sept. 6, 2013). Virtual Presenter now in Norway! [Video] Retrieved from <http://www.youtube.com/watch?v=MIg5FkBWoe4&NR=1>
- Minsky, M. (1980, June 1980). Telepresence. *Omni*, *2*, 45-52.
- Mistula in the Valley of the Dolls. (2004). *PhilMusic News Blog*. Retrieved from <http://web.archive.org/web/20060911164332/http://www.philmusic.com/blog/index.php?p=76>
- mistulavisions (Producer). (2008, Jan. 23, 2013). Mistula on 'Mel & Joey'. [Video clip] Retrieved from <http://www.youtube.com/watch?v=CQ9gnDMVjIw>
- Molderings, H. (1984). 'Life Is No Performance': Performance by Jochen Gerz. In G. Battcock & R. Nickas (Eds.), *The Art of Performance: A Critical Anthology* (pp. 166-180). New York: E.P. Dutton.
- Mori, M. (1970). The Uncanny Valley. *Energy*, *7*(4), 33-35.
- Morley, P. (1979, July 14). Devo: In the terminal zone. *NME*.
- Morrow, M. (1995, Dec. 29). Haunting illusions: New technique called 'virtual projection' creates an unusual blend of theatre and cinema, *Calgary Herald*.
- Munster, A. (2006). *Materializing New Media: Embodiment in Information Aesthetics*. Lebanon, NH: Univ. Press of New England.

- Murray, C. D., & Sixsmith, J. (1999). The Corporeal Body in Virtual Reality. *Ethos*, 27(3), 315-343.
- Music: Studio Killers. *TV Tropes* Retrieved Jan. 23, 2013, from <http://tvtropes.org/pmwiki/pmwiki.php/Music/StudioKillers?from=Main.StudioKillers>
- Musser, C. (1984). Toward a History of Screen Practice. *Quarterly Review of Film Studies*, 9(1), 59-69.
- Nash, E. B., Edwards, G. W., Thompson, J. A., & Barfield, W. (2000). A Review of Presence and Performance in Virtual Environments. *International Journal of Human-Computer Interaction*, 12(1), 1-41.
- Nass, C., & Moon, Y. (2000). Machines and mindlessness: Social responses to computers. *Journal of Social Issues*, 56(1), 81-103.
- Nelson, C. A., & Horowitz, F. D. (1983). The Perception of Facial Expressions and Stimulus Motion by Two- and Five-Month-Old Infants Using Holographic Stimuli. *Child Development*, 54(4), 868-877.
- Newman, J. (2013). Disastrous Sound Overshadows ODB Hologram at Wu-Tang's Rock the Bells Set. *Fuse TV*. Retrieved from Fuse TV website: <http://www.fuse.tv/2013/09/wu-tang-odb-hologram-rock-the-bells-2013>
- Nobahkt, D. (2005). *Suicide: No Compromise*. London: SAF Publishing.
- Noda, N. T. (2010). Copyrights Retold: How Interpretive Rights Foster Creativity and Justify Fan-Based Activities. *Seton Hall Journal of Sports and Entertainment Law*, 20(1), 131-163.
- Norris, M. (Writer). (2009). The Curious Face Of Benjamin Button [Radio], *All Things Considered*: National Public Radio.
- O'Rourke, L. The official unofficial Prozzäk FAQ Retrieved Jan. 23, 2013, from <http://prozzak.tripod.com/faq>
- Osborne, B. (2010). Hatsune Miku hologram performs to live audiences. Retrieved from Geek.com website: <http://www.geek.com/articles/geek-cetera/hatsune-miku-hologram-performs-to-live-audiences-20101115/>
- Overton, G. (2005, June 2005). Hollywood and holography: To be or not to be? *Laser Focus World*, 69-71.
- Pachal, P. (2012). MIT: Princess Leia Hologram 'Within a Year'. *Mashable*. Retrieved from <http://mashable.com/2012/10/08/mit-joi-ito-holograms/>

- Palmer, R. (2012, April 17, 2012). How Does The Coachella Tupac 'Hologram' Work?, *International Business Times*. Retrieved from <http://www.ibtimes.com/articles/329404/20120417/tupac-hologram-works-pepper-s-ghost-musion.htm>
- The Patent Ghost. (1863, July 21, 1863). *The Mercury*. Retrieved from <http://trove.nla.gov.au/ndp/del/article/8819348>
- Pato. (2012). Daniel Miller: Exclusive Interview. *Elektro Diskow*. Retrieved from <http://www.elektrodiskow.com/2012/04/daniel-miller-exclusive-interview-for.html>
- Patton, M. Q. (1990). *Qualitative Evaluation and Research Methods* (2nd ed.). Newbury Park, Calif.: Sage.
- Pavis, P. (1992). Theatre and the media: Specificity and interference (L. Kruger, Trans.) *Theatre at the Crossroads of Culture*. London: Routledge.
- Pennington, A. (2012). Holograms are fit for the home according to Musion. *3D Focus*. Retrieved from 3D Focus website: <http://www.3dfocus.co.uk/3d-news-2/holograms-fit-for-the-home-say-musion/8765>
- Pertaub, D.-P., Slater, M., & Barker, C. (2002). An experiment on public speaking anxiety in response to three different types of virtual audience. *Presence, 11*(1), 68–78.
- Pfeiffer, E. (2012). Reagan hologram is real, was planned for RNC debut. *Yahoo! News*. Retrieved from Yahoo! News website: <http://news.yahoo.com/blogs/ticket/reagan-hologram-real-planned-rnc-debut-203919642--election.html>
- Philip, R. (2004). *Performing Music in the Age of Recording*. New Haven, Conn.: Yale Univ. Press.
- Pimentel, K., & Texeira, K. (1993). *Virtual Reality: Through the New Looking-Glass*. New York: Windcrest/McGraw-Hill.
- Poster, M. (1998). What's the Matter with the Internet. *Learning Online, 154*(3), 477.
- Pranceatron. Jem Tapes. Retrieved Aug. 2, 2013, from <http://www.pranceatron.com/jem/jemtapes.htm>
- Proust, M. (1996). *Time Regained* (T. Kilmartin & A. Mayor, Trans.). London: Vintage.

- Rangel, P. (Producer). (2010, Dec. 2). Patty Rangel speaks at the Immersive Tech Summit 2010. Retrieved from <http://www.youtube.com/watch?v=1GuY7TUsv3w>
- Rangel, P. (Producer). (2011, May 7). Second Life Avatars on Holographic Stage (live/interactive). [Video] Retrieved from http://www.youtube.com/watch?v=_GErGFk8bIk
- Rangel, P. (Producer). (2012, Jan. 23). Patty Rangel on Holographic Projection for Avatars (U.N.) Retrieved from <http://www.youtube.com/watch?v=Qi4BqbgqOOQ>
- Reaney, J. (2000). Catchy toon. *Jam! Showbiz*. Retrieved from <http://jam.canoe.ca/Music/Artists/P/Prozzak/2000/03/06/748905.html>
- Reeves, B., & Nass, C. (1996). *The Media Equation: How People Treat Computers, Television, and New Media Like Real People and Places*. New York: Cambridge Univ. Press.
- Reinhard, E., Heidrich, W., Debevec, P., Pattanaik, S., Ward, G., & Myszkowski, K. (2010). *High Dynamic Range Imaging: Acquisition, Display, and Image-Based Lighting*. Burlington, Mass.: Morgan Kaufmann.
- Repp, B. H. (1992). Diversity and Commonality in Music Performance: An Analysis of Timing Microstructure in Schumann's "Traumerei". *Haskins Laboratories Status Report on Speech Research*(111/112), 227-260.
- Rheingold, H. (1991). *Virtual Reality*. New York: Summit.
- Richardson, J. (2005). "The Digital Won't Let Me Go": Constructions of the Virtual and the Real in Gorillaz' "Clint Eastwood". *Journal of Popular Music Studies*, 17(1), 1-29.
- Rideout, V. J., Foehr, U. G., & Roberts, D. F. (2010). Generation M2: Media in the Lives of 8-to 18-Years-Olds. *A Kaiser Family Foundation Study*.
- Riva, G. (1999). Virtual reality as communication tool: a socio-cognitive analysis. *Presence*, 8(4), 462-468.
- Riva, G. (2009). Is presence a technology issue? Some insights from cognitive sciences. *Virtual Reality*, 13(3), 159-169. doi: 10.1007/s10055-009-0121-6
- Riva, G., Mantovani, F., Capideville, C. S., Preziosa, A., Morganti, F., Villani, D., . . . Alcaniz, M. (2007). Affective interactions using virtual reality: the link between presence and emotions. [Research Support, Non-U.S. Gov't]. *Cyberpsychol Behav*, 10(1), 45-56. doi: 10.1089/cpb.2006.9993

- Roberts, M. N. (2007). *Complexity and aesthetic preference for diverse visual stimuli*. (Ph.D.), Universitat de les Illes Balears.
- Robertson, B. (1998, February). Meet Geri: The New Face of Animation. *Computer Graphics World*.
- Rock, J. (2012). ICT Summit: James Rock, Musion - Video, image recognition and augmented reality: YouTube.
- Rodriguez, S. (2013). CES 2013: Samsung shows off flexible, unbreakable smartphone screens. *The Los Angeles Times*. Retrieved from <http://www.latimes.com/business/technology/la-fi-tn-ces-samsung-flexible-oled-display-20130110,0,5524272.story>
- Rogers, J. (2013, Feb. 2). Stories of Holocaust survivors retold by holograms, *Associated Press*. Retrieved from <http://bigstory.ap.org/article/stories-holocaust-survivors-retold-holograms>
- Russell, J. A. (2003). Core affect and the psychological construction of emotion. *Psychological Review*, 110(1), 145-172.
- Russell, J. A., & Pratt, G. (1980). A description of the affective quality attributed to environments. *Journal of Personality and Social Psychology*, 38(2), 311-322.
- Rutherford, M. (2008). The Drooper Interview with Dan "Drooper" Winkless. *Doin' the Banana Split*. Retrieved from <http://bananasplits.4t.com/Drooper.html>
- Ryan, M.-L. (1994). Immersion vs. Interactivity: Virtual Reality and Literary Theory. *Postmodern Culture: An Electronic Journal of Interdisciplinary Criticism*, 5(1).
- Ryan, M.-L. (2001). *Narrative as Virtual Reality: Immersion and Interactivity in Literature and Electronic Media*. Baltimore: Johns Hopkins Univ. Press.
- Sample, I. (2013, March 20). Princess Leia hologram could become reality, *The Guardian*. Retrieved from <http://www.theguardian.com/science/2013/mar/20/princess-leia-hologram-3d-display>
- Sanden, P. (2012). Virtual liveness and sounding cyborgs: John Oswald's 'Vane'. *Popular Music*, 31(01), 45-68. doi: 10.1017/s0261143011000456
- Santos, C. (2011). The World Is Hers: How Hatsune Miku Is Changing Everything. *Anime News Network*. Retrieved from Anime News Network website: <http://www.animenewsnetwork.com/feature/2011-07-15>
- Sasso, L. (2004). Voices From the Machine. *Electronic Musician*, 20(3), 29-38.

- Scaldothepartymaster (Producer). (2012, Jan. 2, 2013). Hatsune Miku Panel at the 2011 NY Comic Con. Retrieved from http://www.youtube.com/watch?v=G_LX0wGI34o
- Schechner, R. (2006). *Performance Studies: An Introduction*. New York: Routledge.
- Schloerb, D. W. (1995). A quantitative measure of telepresence. *Presence*, 4(1), 64-80.
- Schröter, J. (2011). Technologies beyond the Still and the Moving Image: The Case of the Multiplex Hologram. *History of Photography*, 35(1), 23-32. doi: 10.1080/03087298.2010.496204
- Sciortino, K. (2011). Pixel Perfect: Meet Hatsune Miku, Japan's Pop Megastar. *Clash*. Retrieved from <http://slutever.com/virtual-pop-star-inspires-terrorism/>
- Scott. (2012). Vocalekt Visions. *MikuStar*. Retrieved from MikuStar: Hatsune Miku's World website: http://www.mikustar.com/Vocalekt_Visions.html
- Senpai, B. (2013). Miku Hatsune - An Anime Pop Star. Retrieved from <http://bubblegumsenpai.hubpages.com/hub/Miku-Hatsune-An-Anime-Pop-Star>
- Setoodeh, R. (2008, Nov. 24, 2008). Revenge of the rodent. *Newsweek*, 152.
- Shafer, R. (2010). Man of a thousand faces. *Innovations*, 4(7).
- Shagiev, M. (Producer). (2010, Sept. 6, 2013). Cisco hologram, virtual mannequin. [Video] Retrieved from <http://www.youtube.com/watch?v=4UqP5UVMhIM>
- Sheridan, T. B. (1992). Musings on telepresence and virtual presence. *Presence*, 1(1), 120-126.
- Sherman, W. R., & Craig, A. B. (2003). *Understanding Virtual Reality: Interface, Application and Design*. San Francisco, Calif.: Morgan Kaufmann.
- Shortman, M. (2004, Oct. 1). Greater than the sum of its parts. *Advertising Age's Creativity*, 43.
- Simmelkjaer, R. (Writer). (2007). Special Effects 101 [Television], *What's the Buzz?: ABC News*.
- Simpson, D. (2005). Gorillaz to tour — in 3D. *The Guardian*. Retrieved from <http://www.guardian.co.uk/music/2005/sep/08/gorillaz.popandrock>

- Slater, M., & Wilbur, S. (1997). A framework for immersive virtual environments (five): Speculations on the role of presence in virtual environments. *Presence*, 6, 603-616.
- Smith, E. (2012). Rapper's De-Light: Tupac 'Hologram' May Go on Tour, *The Wall Street Journal*. Retrieved from <http://online.wsj.com/article/SB10001424052702304818404577348243109842490.html>
- Sobchack, V. (2006). Final Fantasies: Computer Graphic Animation and the (Dis)Illusion of Life. In S. Buchan (Ed.), *Animated Worlds* (pp. 171-182). Bloomington, Ind.: Indiana Univ. Press.
- Søndergaard, K., Petersen, K. Y., & Parmerud, A. (2001, Sept. 21-22, 2001). *Augmented reality project – part 1: Situations for augmented relationships — 1998-2000*. Paper presented at the cast01 // living in mixed reality: Conference on Communication of Art, Science and Technology, Sankt Augustin (Bonn).
- Sontag, S. (1964). Notes on camp. In F. Cleto (Ed.), *Camp: queer aesthetics and the performing subject: a reader* (pp. 53-65). Ann Arbor, Mich.: Univ. of Michigan Press.
- Speer, L. (1989). Before Holography: A Call for Visual Literacy. *Leonardo*, 22(3/4), 299-306.
- Stahl, M. (2010). The Synthespian's Animated Prehistory: The Monkees, The Archies, Don Kirshner, and the Politics of "Virtual Labor". *Television & New Media*, 12(1), 3-22. doi: 10.1177/1527476409357641
- Stanislavski, C. (1988). *An Actor Prepares*. London: Methuen.
- Stein, E. (1989). *Form and Performance: The art of musical interpretation analyzed for the benefit of the professional and the amateur musician*. New York: Limelight.
- Steuer, J. (1993). Defining Virtual Reality: Dimensions Determining Telepresence. *Social Responses to Communication Technologies*(104), 1-25.
- Stoessner, J. (2009). From Muppetry to Puppetry. In J. C. Garlen & A. M. Graham (Eds.), *Kermit Culture: Critical Perspectives on Jim Henson's Muppets*. Jefferson, N.C.: McFarland & Co.
- Strasse, F. (2011). Fad Gadget: Part Two. Retrieved from <http://friedrichstrasse.blogspot.com/2011/01/fad-gadget-part-two.html>
- Strauss, A., & Corbin, J. (1998). *Basics of Qualitative Research Techniques and Procedures for Developing Grounded Theory*: Sage.

- Strauss, N. (1999). THE POP LIFE; These Two Singers Sure Are Animated. *The New York Times*. Retrieved from The New York Times website:
<http://www.nytimes.com/1999/08/19/arts/the-pop-life-these-two-singers-sure-are-animated.html>
- Studio Killers. Retrieved Jan. 23, 2013, from <http://studiokillers.tumblr.com/>
- Studio Killers. (2013) Retrieved Jan. 23, 2013, from <https://soundcloud.com/studiokillers>
- Sutherland, I. (1965). The ultimate display. Retrieved from
http://www.wired.com/beyond_the_beyond/2009/09/augmented-reality-the-ultimate-display-by-ivan-sutherland-1965/
- Takahashi, A. (2008). Want to be a creator to support the creator Crypton Future Media president Hiroyuki Ito [Translated]. *Internet Watch*. Retrieved from Internet Watch website:
<http://internet.watch.impress.co.jp/cda/president/2008/05/12/19477.html>
- Takahashi, D. (2013). How Pixar created the ultrarealistic animated film, The Blue Umbrella. *Venture Beat*. Retrieved from Venture Beat website:
<http://venturebeat.com/2013/04/24/how-pixar-created-the-ultrarealistic-animated-film-the-blue-umbrella-interview/>
- Ten questions for graphic artist Jamie Hewlett. (2012). *Phaidon Club*. Retrieved from
<http://www.phaidon.com/agenda/art/articles/2012/december/05/ten-questions-for-graphic-artist-jamie-hewlett/>
- thebots.net. The History of the Bots. *Thebots.net* Retrieved Jan. 23, 2013, from
<http://www.thebots.net/History.htm>
- theKKSshow (Producer). (2012, Sept. 1). Crypton Future Media Interview with Ms. Muraki. Retrieved from <https://www.youtube.com/watch?v=-Qqzi7f9DtA&list=PL27A1E8D9B1053814&index=6>
- Thomsen, D. E. (1969). Movies by Hologram. *Science News*, 95(19), 460-461.
- Thornton, C. (2010). Interview with Provision President & CEO Curt Thornton: Vimeo.
- Tobin, J. (1998). An American Otaku (or, a Boy's Virtual Life on the Net). In J. Sefton-Green (Ed.), *Digital Diversions: Youth Culture in the Age of Multi-media* (pp. 106-127). London: Routledge.
- Toffler, A. (1980). *The Third Wave*. New York: Bantam.

- Tupac hologram maker: 'I'd like to bring Elvis back to sing alongside Justin Bieber'. (2012). *NME*. Retrieved from NME website:
<http://www.nme.com/news/2pac/63453>
- Turkle, S. (1984). *The second self: Computers and the human spirit*. New York: Simon & Schuster.
- Ulbrich, E. (Producer). (2009, February). Ed Ulbrich: How Benjamin Button got his face *TED*. Retrieved from
http://www.ted.com/talks/ed_ulbrich_shows_how_benjamin_button_got_his_face.html
- Van Buskirk, E. (2010). Virtual Musicians, Real Performances: How Artificial Intelligence Will Change Music. *Wired*. Retrieved from
<http://www.wired.com/business/2010/03/virtual-musicians-real-performances/>
- van der Heijden, H. (2003). Factors Influencing the Usage of Websites - The Case of a Generic Portal in the Netherlands. *Information and Management*, 40(6), 541-549.
- van Doorn, N. (2011). Digital spaces, material traces: How matter comes to matter in online performances of gender, sexuality and embodiment. *Media, Culture & Society*, 33(4), 531-547. doi: 10.1177/0163443711398692
- Vandervliet, D. (2012). Eternal Descent to get animated. *Comic Booked*. Retrieved from
<http://www.comicbooked.com/eternal-descent-to-get-animated/>
- Varney, A. (2006). Immersion unexplained. *The Escapist*. Retrieved from
http://www.escapistmagazine.com/articles/view/issues/issue_57/341-Immersion-Unexplained
- VBirds. VBirds: Perfect *The Internet Movie Database*.
- Villani, D., Repetto, C., Cipresso, P., & Riva, G. (2012). May I experience more presence in doing the same thing in virtual reality than in reality? An answer from a simulated job interview. *Interacting with Computers*, 24(4), 265-272. doi: 10.1016/j.intcom.2012.04.008
- Vinayagamorthy, V., Steed, A., & Slater, M. (2005). *Building characters: Lessons drawn from virtual environments*. Paper presented at the Toward Social Mechanisms of Android Science, Stresa, Italy.
- Virtual Band. *Experience Festival / Global Oneness*.
- Virtual band of sisters created by real talent. (2003). *The Birmingham Post*. Retrieved from

- <http://www.thefreelibrary.com/Virtual+band+of+sisters+created+by+real+talent.-a097820146>
- VocaloidFR (Producer). (2013, July 9). 'Hatsune Miku English' Coming Together (Japan Expo 2013). [Video] Retrieved from <https://www.youtube.com/watch?v=b4Vo5PWltss>
- Vujnovic, M. (2012). Hypercapitalism *Wiley-Blackwell Encyclopedia of Globalization*.
- Walsh, B. (2007, March 1). Reconstructing Redenbacher. *Boards*.
- Wappler, M. (2012). I Sing the Body Electric: Teen Japanese pop sensation Hatsune Miku proves corporeal reality isn't necessarily a prerequisite for fame. *Los Angeles Times Magazine*. Retrieved from <http://www.latimesmagazine.com/2012/06/i-sing-the-body-electric.html>
- Waterworth, J., Waterworth, E. L., Mantovani, F., & Riva, G. (2010). On feeling (the) present: an evolutionary account of the sense of presence in physical and electronically-mediated environments. *Journal of Consciousness Studies*(17), 167-188.
- Weinstock, J. (2007). *The Rocky Horror Picture Show*. London: Wallflower Press.
- Weiser, M. (1991). The computer for the 21st century. *Scientific American*, 94-104.
- Weizenbaum, J. (1966). Eliza. *Communications of the ACM*(9), 36-45.
- Werde, B. (2003, Nov. 23, 2003). Could I Get That Song in Elvis, Please?, *The New York Times*.
- Wertheimer, L. (Writer). (1997). Hollywood's Computer Age [Radio], *All Things Considered*: National Public Radio.
- westfesttv (Producer). (2012, Oct. 21, 2012). Tupac Hologram Snoop Dogg and Dr. Dre Perform Coachella Live 2012. [Video] Retrieved from <http://www.youtube.com/watch?v=TGbrFmPBV0Y>
- Wikipedia. (2012a). Mistula, from <http://en.wikipedia.org/wiki/Mistula>
- Wikipedia. (2012b). One-T, from <http://en.wikipedia.org/wiki/One-T>
- Wikipedia. (2012c). Strawberry Flower, from http://en.wikipedia.org/wiki/Strawberry_Flower
- Wikipedia. (2013a). Crazy Frog, from http://en.wikipedia.org/wiki/Crazy_frog

- Wikipedia. (2013b). Eternal Descent, from http://en.wikipedia.org/wiki/Eternal_Descent
- Wikipedia. (2013c). Jeph Jacques, from <http://en.wikipedia.org/wiki/Deathmole>
- Wikipedia. (2013d). Mickael Turtle Retrieved Aug. 2, 2013, from http://en.wikipedia.org/wiki/Mickael_Turtle
- Wikipedia. (2013e). Pigloo Retrieved Aug. 2, 2013, from <http://en.wikipedia.org/wiki/Pigloo>
- Wikipedia. (2013f). Pikku Orava Retrieved Aug. 2, 2013, from http://en.wikipedia.org/wiki/Pikku_Orava
- Wilkinson, S. (2003, Aug. 2003). Humanoid or Vocaloid? *Electronic Musician*, 28.
- Wirth, W., Hartmann, T., Böcking, S., Vorderer, P., Klimmt, C., Scramm, H., & al., e. (2007). A process model of the formation of spatial presence experiences. *Media Psychology*, 9, 493-525.
- World, N. P. (2010). Festival Day Programming: 9/18. *J-Pop Summit Festival 2010* Retrieved Jan. 28, 2013, from <http://www.newpeopleworld.com/festival/festival-programs/>
- Wright, A. (2012, July 5, 2012). What a Mechanical Performance! Bravo!, *The New York Times*. Retrieved from <http://www.nytimes.com/2012/07/08/theater/robot-and-human-actors-take-bows-together.html?pagewanted=all>
- Yee, N., Bailenson, J. N., Urbanek, M., Chang, F., & Merget, D. (2007). The Unbearable Likeness of Being Digital: The Persistence of Nonverbal Social Norms in Online Virtual Environments. *Cyberpsychology & Behavior*, 10(1), 115-121.
- Yoshida, S. (2011). How to Generate Floating 3D Images on a Flat Tabletop Surface. *NICT News*, 5-6.
- Zagalo, N., & Torres, A. (2008). Character emotion experience in virtual environments. *The Visual Computer*, 24(11), 981-986. doi: 10.1007/s00371-008-0272-6
- Zec, P. (1989). The Aesthetic Message of Holography. *Leonardo*, 22(3/4), 425-430.

APPENDIX

A. Semi-structured interview questions

Virtual presentation designers and engineers

Character design

How are the tasks of artistic conceptualization and digital production/programming divided among designers? (Separate workers/teams, or individual artist-programmers?)

- Who makes the creative decisions?
- Who approves the creative decisions? Based on what criteria?

Take me through the design of this character from the beginning.

- Why this look?
- Why this gender?
- Why this race?
- Why this clothing?
- Why this technology (headset, hand-held microphone, etc.)?

How has race and gender been discussed in the decision-making regarding the appearance of this character?

Each of the Vocaloid characters is designed in a 2D style reminiscent of anime characters. Why?

- What are the sources of inspiration?
- Has a more photo-realistic design ever been pursued? Why/not?

Is the idea of the uncanny valley a stated concept in the design of these simulations?

- What specific decisions in the design process address the uncanny valley?
- What specific decisions in the design process have been altered or nixed because of the uncanny valley?

What designs have been rejected, and why?

What criteria are there for selecting voices for Vocaloid sampling?

- Has anyone been rejected, and why?

Presentation design

What was involved in crafting the original concert presentation?

Are these simulations at all performance-tested (focus groups, audience trials, etc.)?

How are venues chosen for presentation?

- What factors in the physical space of the concert venue affect the design and presentation of the simulation?

APPENDIX (continued)

How have the presentations changed and evolved from concert to concert?

- What specific changes have been made each time, and why?

What problems have you encountered in creating the live presentations, and how were they solved?

- The original technology for presenting characters on the Musion screen was overly sensitive to vibration from the music speakers. How was this issue solved?

In the performance, is total audience immersion a goal or do you consciously allow for audience awareness of the presentation technology?

(Describe Apter's analogy of the crowd, tiger and cage.) Where in the presentation do we see the "cage"?

Conceptual

What can human performers do that a digital agent could never accomplish?

How do you create an immersive experience credible enough to inspire this kind of elevated make-believe, but not so credible that it creates anxiety in its audiences?

(Describe McGonigal's "Pinocchio effect," the desire of the virtual to be real.) How does the design of this character support the perception of this desire?

Future

How can these presentations be made to be responsive and interactive in real time?

What is next?

- What is the future of the technology?
- What hurdles remain to be cleared in order to move beyond 2D presentations to actual 3D presentations?

Virtual presentation marketers and executives

Explain the decision to create a character for the marketing of this product.

Tell me the story of this character's birth and original application.

When did you realize the character could become something more than a face on a box, and what caused this realization?

- What executive and marketing decisions resulted directly from that realization?

What market forces have impacted the design and presentation of these characters and simulations?

APPENDIX (continued)

What commercial factors impacted the decision to move forward with creating a live presentation?

When was the moment you realized this simulation presentation was somehow unique, and why?

What is the marketing focus in the future: primarily on-screen products or primarily real-world presentations?

What future products and/or characters are planned?

What other technology platforms could/will these characters and presentations be designed and marketed for?

What are the plans for expanding marketing of these products and presentations outside of Asia?

- Why have these characters and presentations not yet entered the American market?
- (Description of K-pop’s “cultural technology.”) How will/would you alter design of the characters and simulations for the American market, and why?

Artists

Songwriters

(Describe McGonigal’s “Pinocchio effect,” the desire of the virtual to be real.) Several songs and videos express Hatsune Miku’s seeming awareness of her digital existence. How do your songs express and support the perception of this desire?

Tell me about your songwriting process.

- How has it changed or evolved in the course of writing for a digital persona?
- Are you writing to express something from yourself, or are you writing to express something from the character? To what degree of each?
- Have you written songs for other artists, before or after beginning work for a virtual star? If so, for whom?

Tell me about writing [SONG].

- What was your inspiration?

Tell me about the first song selected by Crypton for performance/distribution?

- How were you notified?
- What are the terms of your contract?

APPENDIX (continued)

How has awareness within the virtual pop star's fan community affected your life? Your creative production?

Voice actors

How were you selected for this process?

— Did you audition? What were you required to perform in the audition?

Why did you agree to this?

— Did you have any reservations? If so, what?

Tell me about the recording process.

How has this gig impacted or affected your other work or performances?

Performers

What was your reaction to the proposal of performing on stage with a virtual simulation?

How did you rehearse for the performance?

While on stage with the virtual simulation, what (if anything) in your performance was different from that of a human collaboration, and why?

Will you do this again?

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- Conner, T. (2007). "Getting Along: Woody Guthrie and Oklahoma's Red Dirt Musicians." In D. Joyce (Ed.), *Alternative Oklahoma: Contrarian Views of the Sooner State* (pp. 87-112). Norman, Okla.: Univ. of Okla. Press.
- Conner, T. (2002). "Dear Reader: A Pop Critic Responds to the Day's Mail." ARTicles, No. 7, pp. 138-149.
- Conner, T., Wooley, J. & Brown, M. (1999). *Forever Lounge: A Laid-Back Guide to the Languid Sounds of Lounge Music*. Iola, Wisc.: Antique Trader Publications.