VIRTUAL REALITY AND ADULT ENTERTAINMENT:

THE NEXT HIGH-TECH SYMBIOSIS

by

Erik Rochner Almklov

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ABSTRACT

Technology and pornography have a longstanding symbiotic relationship. Pornographers have historically relied on technology to distribute personalized sexual experiences to consumers. Emergent communication technologies have similarly found commercial success through the adult industry in the 20th and 21st centuries. A mutually beneficial sex-tech relationship now endures as the modern adult industry exerts significant influence over the fate of new communication technologies. In this paper, I examine the historical role that pornography has played in the mainstream integration of modern communication technologies. I next apply this analysis to one of the most discussed technologies on the market to date, Virtual Reality (VR), to argue that its mainstream adoption is similarly being influenced by porn. The adult industry's early monetization of 360º content, and relevant immersive innovations, are early indications that VR porn may be the next high-tech symbiosis.

INTRODUCTION

Pornography has an unglamorous history of censorship, criminal activity, and sexual exploitation. Yet the mega-industry built around sex is seldom credited for its prominent historical role in bringing emergent communication technologies to mainstream, commercial success. Pornographers are some of the unsung heroes of technological commercialization. As posited by Patchen Barss, author of *The Erotic Engine: How Pornography has Powered Mass Communication, from Gutenberg to Google*, "if it were not for the subject matter, pornography would be publicly praised as an industry that has successfully and quickly developed, adopted, and diffused new technologies" (5). Key contributions include the VCR, DVD, Cable TV, the Internet, and a swathe of other ubiquitous hardware devices and software that were catapulted into common household commodities thanks to pornography. At the core of this tech-sex interdependence is the adult industry's willingness to adopt and experiment with the new and unproven technologies. Under this historical proclivity, it has graduated from "smut peddler" to modern technological gatekeeper over the last few decades (Barss 19). The multibillion dollar industry now exerts significant influence over the fate of emergent communication technologies.

Technology and pornography have a longstanding symbiotic relationship. Pornographers have historically adopted new technologies before other media industries to skirt censorship, personalize the viewing experience, and innovate how sexual content is consumed by the masses. Similarly, new communication technologies have regularly incubated under the auspices of the adult industry to mature from niche products into

mainstream commodities. Pornography, defined here as the visual representation of the hard-core sexual act, can be traced back centuries before it was possible to mechanically reproduce reality with photography. "Hard-core" creative works, such as art and written narratives, existed long before pornography came to be defined as a sexually obscene genre of content. Technological innovation, however, gave it shape as expressed by Patchen Barss:

> Throughout history, across cultures, and in every part of the
> world, whenever a new means of communication emerged
> (with the possible exception of smoke signals), people
> adopted it and adapted it so as to find new ways to produce,
> distribute and consume pornography (3).

Inversely, the demand to create new types of sexual experiences may also be influencing technological innovation.

From cave-wall erotica to modern teledildonics (wirelessly controlled masturbators), a tech-sex relationship has advanced alongside human evolution. This tradition endures in the present as some of the most sophisticated technologies today are used to communicate and commoditize human sexuality. Pornography is therefore a product of technology as the gamut of sexual experiences is furthered by each new communication technology.

VR is at the cutting edge of communication technology. It functions to provide a simulated sense of presence through rotationally and positionally responsive head-mounted displays supported by motion tracking accessories (HMDs). The experience allows users to immerse themselves in distant places and foreign subjects with 360º 3-D, 2-D, computer-generated, and live-action content that mimics and deviates from reality.

With billions of smartphones powering the content, VR is predicted to play a major role in the future of digital entertainment.

VR launched commercially in 2016. As of the writing this paper, four premium, HMDs make up its official consumer launch: Oculus Rift, HTC Vive, PlayStation VR, Samsung Gear VR. New entertainment and education content channels are emerging in parallel to supplement the hardware, with sports and news outlets taking a special interest in the technology. Despite a rapidly growing infrastructure and the support from technology brands such as Sony, HTC, Google, GoPro, Samsung, and Facebook, however, VR is not yet mainstream. Horizon Media, "the largest and fastest growing privately held media services agency in the world," reported in a March 2016 study that two-thirds of Americans are unaware of the technology. This illustrates a unique challenge to the medium as commercial saturation requires large-scale consumer exposure to contextualize its practical applications. In other words, until mass consumers strap on a headset for the first time, VR will remain a niche technology.

Emergent technologies do not transform into consumer products overnight. The VCR incubated underground for a decade between the 1970's-1980's before it was inaugurated as a mainstream product. VR is at a similar introductory stage, tottering between disruptive-tech and bubble-bursting device. With less than 2 million HMDs in circulation to date, too few consumers own the hardware to inspire content producers to create compelling content ("People More Likely To Buy With Strategic Virtual Reality Use, According To New Study"). Inversely, consumers are unlikely to adopt HMD hardware without a library of compelling content to put their expensive devices to use:

the early VR market is analogous to owning an expensive gaming console without the content to play. The trajectory of the VR market is therefore economically uninspiring to most commercial businesses, with the exception of one opportunistic industry: pornography.

VR is predicted to revolutionize the ways in which consumers experience porn. In a 2016 poll conducted by Xbiz Research, the "leading authority in adult industry news and market research," 53% of 10,000 industry participants reported that VR will revolutionize the adult industry (2). The technological implications are readily apparent in an adult context. VR has the potential to transform traditionally passive viewership into an active experience by thrusting the user into the middle of the action.

The potential to revolutionize the viewing experience has incentivized the adult industry to embrace VR at an early stage. Since 2014, adult providers have been actively producing VR porn, and for good reason. Piper Jaffray, a financial management firm, released a 2015 industry report titled "Next Mega Tech Theme is Virtual Reality" which reflects the economic stakes. Its research suggests that by 2025 VR porn will be a $1 billion market, powered by 500 million VR devices (Munster, Jakel, Clinton, and Murphy 1). Hedging bets on market predictions like these, the adult industry has since positioned itself at the forefront of the VR movement. In doing so, it is taking an early development role in the technology's evolution, a relationship that is mutually beneficial to both the adult industry and the VR medium as a whole.

In this paper, I examine the historical and culture role that pornography has played in the mainstream integration of 20th and 21st century communication technologies

to illustrate an interdependent relationship between the adult industry and emergent

technologies. I then apply this analysis to VR to illustrate how the adult industry is

influencing its consumer adoption. Using past technological case studies that found

mainstream success through pornography, I argue that the adult industry is influencing

the commercialization of VR with its own brand of 360º video, live streaming content,

and interactive haptic accessories (haptic refers to virtual touch simulation). Citing three

leading pornographic content providers currently distributing VR porn, BaDoinkVR,

Virtual Real Porn (VRP), and Naughty America (NA), I identify how the adult industry is

mapping out commercially viable applications while contributing its own brand of

industry-relevant innovations.

ANCIENT XXX

The depiction of human sexuality is deep-rooted in cultural anthropology. Archeologists have uncovered "pornographic" artifacts that span millennia of time in geographically disparate locations. The earliest, documented instances belonged to Paleolithic cave dwellers who left behind depictions of female genitalia in France's Chauvet Cave 37,000 years ago, which are noted as some of the "World's Oldest Cave Art" (Balter). Several millennia later, "The World's Oldest Pornography" was uncovered in China in a 3,000 year-old, thirty-square-foot stone canvas depicting group sex, known as the Kangjiashimenji Petroglyphs (Mycio). More familiar "*scientia sexualis*" such as the *Vatsyanana Kamasutram*, better known as the *Kamasutra*, demonstrate a celebration of sexuality that has popularly persisted since the turn of the first millennium (Gautam). All of these sexual works culminate to reveal that there is no deep mystery to the sexual relics left behind by ancient civilizations: sexual expression is a product of human biology that has been creatively communicated by disparate cultures throughout history. Some of these cultural works, however, are considered pornographic which demonstrates significant deviations in how sexuality is interpreted.

DEFINING PORNOGRAPHY

Pornography is difficult to define because it is culturally and societally dependent. According to Walter Kendrick, author of *The Secret Museum: Pornography in Modern Culture*, anything from Pompeiian frescoes to Shakespeare have been deemed pornographic at one point in time (xii). To one culture, sexual depictions might be high art, and to another "smut." The boundaries that separate art from erotica from pornography are in no way objective or transparent and there is no universal consensus as to how it is categorized. Sex is often the face of pornography, but other factors are at play.

Sexuality is only a partial qualifier of a pornographic work. Titian's 1538 oil painting of the Roman Goddess of Love, *Venus of Urbino,* is not too dissimilar from tawdry nudes depicted on playing cards. Both glorify the female nude with sexual overtones. The differentiating quality is that *Urbino* has cultural significance while the latter does not. As Walter Kendrick posits, "content and viewing relations are not enough to distinguish porn as porn. Instead, it is the dirty, naughty, debasing and disgusting style or quality of porn that becomes the decisive factor" (Attwood 96).

It is in the treatment of sexuality, and the author's intention, that defines pornography.

TECH-SEX ORIGINS

The difference between contemporary and historical pornographic consumption is not a question of what is being depicted, but how and why. Technological advancements have enabled cultures to produce and disseminate sexual works to larger populations, in more advanced ways, and through a variety of intentions. Technology therefore influenced ideological shifts in how sexual expression is perceived, whether as legitimate art or pornography.

Before porn became porn, sexual materials fell under other categories of creative works. Ian Moulton, author of *Before Pornography: Erotic Writing in Early Modern England*, notes that "There was sexual stuff [pre-15th century], but if someone said, 'Show me your erotic books,' people would have looked at them like, 'Well what do you mean?'" (Barss 45). Sexual illustrations, manuscripts, engravings, paintings, and texts were simply works of their respective mediums. Wealthy social circles such as politicians, judges, and other members of high society were the only audiences who could afford to own them, which meant that "almost all written, drawn, or printed material was restricted…to the social elite" (Hunt 13). Among these elite demographics, erotic content was safe because it was contained by governing parties. It was not until the German blacksmith Johannes Gutenberg introduced the moveable type printing press in 1440 that sexual works became something other than art and literature.

Pornography came into being in the wake of the printing press and Enlightenment ideals that it fomented. The printing press provided a relatively quick and affordable way to distribute literary works beyond what hand-producing artisans could serve. It also

enabled almost anyone to learn to ready by the 19th century (Coopersmith 97).

Consequently, the democratization of information also meant that European political and

religious institutions could be challenged and slandered, which prompted fears of societal

disruption. The lower classes were of special concern. According to Laura Kipnis in

Bound and Gagged: Pornography and the Politics of Fantasy in America, "the fantasy

pornography consumer [was] a walking projection of upper-class fears about lower-class

men: brutish, animal-like, sexually voracious" (175).

Institutional anxieties of class corruption and opposition fomented reactionary

measures that prompted the literary censorship of lewd materials. One of the earliest

instances of censorship occurred in the 16th century when Pope Paul IV established the

Index Librorum Prohibitorui, a list of forbidden books that dealt with the "lascivious and

obscene" (Frederick Lane 8). The formal categorization of pornography was a gradual

process and would not come to be defined as a sexually obscene genre until

Enlightenment thinking, Puritanism, and the introduction of the novel all intersected in

England in the 19th century.

Memoirs of a Woman of Pleasure, *Fanny Hill*, a novel written by John Cleland in

1748, represents the emergence of a Victorian-era-understanding of pornography. At the

time, *Fanny Hill* was considered "the rankest pornography" in England. Its narrative

depicts the journey of a naïve young woman who is sexually corrupted in London in

every way possible, and it does so without literary integrity. Cleland was subsequently

arraigned in England for creating a pornographic work, and exonerated. *Fanny Hill*,

however, would live on in infamy to sell thousands of copies over the next two centuries,

eventually finding distribution and censorship in the United States (Stone 19). The mass distribution of lewd, sexual discourse introduced pornography in the public vernacular.

The public's exposure to titles such as *Fanny Hill* solidified pornography as an illegal and sexually obscene genre of content. By 1857, pornography was defined for the first time in the *Oxford English Dictionary* as the "writing of harlots," or "one who writes of prostitutes; a portrayer of obscene subjects" (Simpson and Weiner). The modern definition describes it as the depiction of "sexual organs or activity" for pleasure ("Pornography"). Appropriately enough, this formal categorization coincided with its leap from print to picture.

OBJECTIVE SEX

Photography introduced the next evolutionary step in pornographic demand and consumption. In 1839, Louis Daguerre introduced the daguerreotype process to the French Academy of Sciences, where it was revered as both a scientific and artistic instrument. Six years later, the first known erotic photographs were captured on silver-plated copper (Encyclopedia of Nineteenth-Century Photography 497). From the invention of the camera on, pornography was established as a visual medium grounded in reality.

The first pornographic media such as engravings, illustrations, paintings, and the first pornographic media were subjective in nature: each step of the creative process was directly influenced by the artist's imagination. Photography was innovative in that it provided a means to capture moments in time in a realistic manner. As described by film theorist Andre Bazin in *The Ontology of the Photographic Image*, "The photographic image is the object itself, the object freed from the conditions of time and space that govern it" (8). Overzealous testament's like Bazin's can be attributed to the photograph's uncanny ability to reproduce lifelike detail in print form. Even the best painters and illustrators could not recreate a comparable level of photo-realism. More importantly, the photograph provided a means to own snippets of reality, made possible through an "impartial", chemical capture process. This perceived objectivity had significant psychological and economical implications for all photographic studies, but especially those that were pornographic in nature.

 Pornography evolved into a sought after sexually "objective" genre of content

through photography. Photo-realism brought pornographic consumption one step closer to the real sex act, which ignited a new adult economy based on buying and selling illicit photographs. The medium's inherent realism was "the single most important event in the history of pornography" because producers discovered that adult consumers were willing to pay significant sums to own lifelike sexual depictions (Coopersmith 98). For the first time, complete strangers were empowered to gaze upon visceral sexual moments frozen in time, and had the opportunity to revisit the experience if desired. No other media fomented a similar voyeuristic draw as posited by Patchen Barss:

> A person buying such a photograph was paying for the
> opportunity to see real people in real situations— a kind of
> voyeurism that had never before been possible…a power
> that vastly increased the influence of erotica and
> pornography over the development of this new technology
> (59).

Sexual voyeurism, and the relative ease of reproducing multiple photographic prints, inspired an emerging adult industry in Paris.

Paris served as ground zero for the world's first erotic photography hub. The first Parisian photography studio opened in 1840, followed by an additional 350 over the next 20 years (Barss 62). Almost half of the public titles for sale were female nudes legitimized under an "artistic studies" euphemism while the truly pornographic prints were sold underground in some of the same spaces. As photography technology was democratized, and the cost to create and sell content reduced in the second half of the 19th century, pornographic content became more prevalent in Europe and elsewhere. Subsequent police raids contextualize the emerging demand that extended into the United Kingdom. In 1874, police raided Henry Hayler's London studio to confiscate 130,248

pornographic photos and 5,000 slides (Barss 28). The demand for sexual realism only intensified with the advent of film technology.

The photograph's lifelike portrayal of static subjects was ultimately championed by the heightened realism of moving pictures. Film theorist Christian Metz attributed motion as the fundamental difference between film and photography: "movement creates volume, and volume suggests life" (7). Prior to film, pornography was a product of volumeless instances that relied more heavily on the viewer's imagination to film in the narrative. Motion picture technology improved on photography's inherent stasis by enabling viewers to watch sexual encounters unfold over time with a beginning, middle, and end, or sexual climax. Film's temporal order therefore introduced a new level of sexual voyeurism by capturing the entirety of the sex act, and providing visual proof of how it unfolded frame-by-frame. While the imagination serves different types of sexual satisfaction, voyeurism is derived from witnessing real events, and no other media was more "real" than film. Capturing sex in 24 frames-per-second therefore became pornography's next technological evolution.

One of the first erotic motion pictures was captured just three years after Thomas Edison's *Fred Ott's Sneeze* (1894). *Après Le Bal* (1897), *After the Ball,* directed by George Méliès, depicts a woman removing her evening gown in a PG-13 striptease. Méliès' erotica portrayal was hardly pornographic to today's standards, but was nonetheless illustrative of an immediate appropriation of film technology for sexual representation. By the early 20th century, erotic cinema experiments evolved into hard-core stag films, which became the dominant pornographic film genre in the U.S. leading

into the 1970's; a tradition interrupted by feature length films such as *Deep Throat*.

Aside from the brief interlude of narrative-driven productions, known as the Golden Age

of Porn, the stag film otherwise dominated the adult film scene for most of the 20th

century.

The stag film had a sole function: the depiction of hard-core sex for pleasure. It

exuded a "filmic primitivism" beyond the absence of narrative or technical sophistication.

Rather, the stag film prioritized visual pleasure similar to Tom Gunning's classification

of the "cinema of attraction" (Williams 65). "Cinema of attraction" refers to an early,

non-pornographic era of filmmaking that ended around 1906, which prioritized

"exhibitionism" over narrative with a series of visual stunts. George Méliès called these

exhibitionist displays "trick films," a handful of which he contributed to as seen in *Le

Voyage Dans La Lune* (1902) (Gunning 383). The stag film followed a similar

exhibitionist formula, but never evolved beyond its own "cinema of attractions" stage.

Primitive examples include stag classics such as *A Grass Sandwich*, aka *A Free Ride*

(1915), which features a hitchhiking threesome unfolding on the roadside. They

portrayed a raw sexuality, no matter of how unrealistic the scenarios were, with a "get-to-

the-sex" mentality that persists today under the gonzo genre of adult entertainment.

Technically unsophisticated vignettes of hard-core sex dominate online porn

today ("Masturbation Month of May"). As evidenced with influential XXX websites

such as Pornhub, and its 60 million daily visitors, the Internet is inundated with amateur-

style films that use handheld point-of-view cameras to recreate a stag-like, rawness. The

cost to create such pornographic products explains in-part why this unpolished approach

is so prevalent. Equally important is the consideration that a low-budget production

value infers a faux realness, which has a powerful voyeuristic influence. For example,

rough handycam content infers an authenticity that highly produced porn does not. This

heightened "objectivity", when combined with the stag's raw sexual realism, inspired a

pornographic film economy that has since evolved into a variety of subgenres.

PORN ON TAPE

From the 15th to late 20th centuries, pornography was the product of technology. Innovations such as the printing press, photography, and film facilitated its production, and distribution in new and creative ways but the relationship was inverse of what it would become in the late 20th century; "it was technology affecting erotica rather than the other way around" (Barss 44). Pornography had yet to commercially influence mainstream technologies. It was not until more personalized means of media consumption were introduced in the second-half of the 20th century that the adult industry emerged as an economic driver of technology.

The VCR was the first major technology to be commercially influenced by pornography. Invented in the 1950's but not distributed as a consumer product until 1975, the VCR introduced the concept of personalized TV. Sony exclusively advertised Betamax as a "time-shifting" device that empowered consumers to watch TV flexibly (Barss 90). Home entertainment, personalized video, and video production were also realized as potential consumer applications. Despite these democratizing qualities, the VCR flailed upon initial commercial launch.

Cost, content, demand, and competing formats jeopardized the mainstream viability of the VCR. Exorbitant entry costs, while not uncommon to many new technologies, barred the general public from investing in a completely new and unproven technology. First run units such as Sony's Betamax cost $1,300 in 1975. A videotape could also cost as much as $300 (Frederick Lane 50). Its value as a consumer product was also misdirected in its marketing efforts. Sony led the Betamax advertising

campaign as a "time-shifting" product, a concept that preceded an actual demand and understanding of that benefit. Video stores were not established, and the home video rental economy which would eventually drive VCR sales was still undiscovered.

To compound any technological uncertainties, competing tape formats muddied consumer confidence. A format war broke out between Sony and JVC that left consumers waiting for a VCR standard to emerge (Barss 85). Sony's VHS and JVC's Betamax had different selling points in terms of quality and playback duration, similar to that of Blu-Ray and HD DVD, but picking the wrong format would sink a significant investment. Early VCR consumers were also tasked with creating their own libraries of content. Complex ergonomics, however, discouraged average consumers from investing the time to learn to program the VCR. "Time-shifting" TV was not worth the technical hassle, or the cost, and four years after the VCR hit the market in 1975, less than one per cent of American households owned one (Barss 92). The VCR as a home entertainment technology had yet to be realized by the mainstream. For adult consumers, however, it had a very specific benefit.

Predating the VCR, the XXX theater was the porn enthusiast's unelected house of congregation. They were a consequence of technical circumstance, but one of the few places that consumers could watch porn. The only alternative was owning a film projector and seeking out the content, which had its own legal risks. XXX theaters, however, carried their own set of social stigmas that necessitated a demand for more discreet consumption. For example, being caught walking into an adult theater could be damaging to one's reputation, especially for married men and women. XXX theaters

were also less than ideal places to masturbate. They were communal screening

environments that required the infamous trench coat to mask masturbatory activities. By

the 1970's, these and other evolving social pressures ultimately necessitated a more

personalized means of pornographic consumption.

The VCR enabled consumers to watch sex in privacy without the stigma of

walking into a adult theater. It was a social benefit that proved to be worth the exorbitant

cost of the VCR and related costs. Porn consumers were "willing to pay top dollar for

both the machines and the tapes" in exchange for privacy and home viewing

convenience:

> Every recent advance in technology has made media
> consumption more private and more convenient. It's small
> wonder that pornographers were early adopters of the VCR,
> which meant that customers no longer had to venture out to
> triple-X cinemas (Barss 2).

The VCR not only brought porn into the home, but it uncovered the commercial

videotape market to come. Audiences who purchased the VCR for adult consumption

were also the first consumers to avidly buy and rent videotape content.

X-rated content drove the first videotape market. In the late-1970's, more than

half of all videotape sales in the U.S. were pornographic with 900,000 videotapes sold in

1979, and 1,300,000 in 1980 (Hilderbrand 56). Videotapes, which cost between $50-

$300, were not a deterrent either. In an April 1979 *New York Times* interview, Arnie

Saltzman of Video Center New Jersey reaffirmed this emerging XXX demand stating,

"We're selling 50 times as many porno tapes as any of the other prerecorded material"

(Lindsey). By 1985, the X-rated video market was estimated at $1 billion, although the

commercial market was gaining traction. Consumer franchises such as Blockbuster, and

the Hollywood titles that they distributed, demonstrate that film studios were finally

supportive of a technology that initially had been feared as a cinema competitor

(Frederick Lane 51). As a result, by 1987, 87% of American households owned a VCR

marking a definitive mainstream transition of the technology (Barss 94). Hollywood

titles became the dominant content in the videotape economy, but only after the adult

industry had proven the market with its early adoption and monetization of VCR

technology.

CYBERSEX

"The Internet is for porn," according to the 2003 Broadway musical titled *Avenue Q.* Alexa.com, a leading Internet analytics provider, statistically reaffirms this popular awareness listing four of the one-hundred most visited websites as pornographic: #62. Pornhub.com, #78 Xvideos.com, #80 Xhamster.com, #85 Bongacams.com. The traffic that these sites drive is also on par with Facebook and Google. The most trafficked pornographic website, Xxvideos.com, reports roughly 4 billion page views per month (Alexa.com). Other sources corroborate the adult industry's web dominance. Optenet, a global IT security company, reported in 2010 study that 37% of all web content is pornography. The *Extreme Tech* technology blog also reported in 2012 that 30% of all web traffic is pornography (Anthony). It is no secret that porn is a cornerstone of Internet content. The reasons as to why, however, are less apparent in the mainstream.

Adult content became commonplace to the Internet a decade before commercial counterparts. One of the first transmissions of pre-Internet pornography occurred in 1980 on a videotext system called Prestel where a *Dirty Books Guide* was transmitted across a remote network (Coopersmith 109). Future file sharing occurred on computer-to-computer networks like Usenet, which connected isolated groups of people via remote servers. It was a primitive means to share any sort of digital content given the newness of personal computing, but like the VCR, porn managed to inundate the Internet at an early stage.

As with past media, sex served as a powerful motivator for consumers to get online. Patchen Barss describes the influence of adult content on the 1990's Internet revolution:

> Early cyberspace was a testament to the true power of
> pornography to draw people to a new technology….
> Learning how to get online, though, involved investing
> hours and hours of time in return for only the most
> grudging cooperation from the technology (124).

Online consumers had to navigate the complexities of external modems, dial-up services, and a general working knowledge of computers. Certain tools that make modern web browsing intuitive also had yet to be developed. The World Wide Web was not introduced commercially until 1990 and Microsoft's Internet Explorer was not released as a browsing tool until 1994. Technical barriers aside, the draw of experiencing entirely new types of sexual interactions fostered early web adoption among the adult community.

The Internet emerged as a democratizing haven for all demographics and sexual interests. As stated by Jonathan Coopersmith in *Pornography Technology & Progress*, "perhaps the greatest contribution of the Internet is the formation of community." It provided a space for friends to congregate virtually. More importantly, the Internet's sense of community facilitated the sharing of porn. Bulletin board systems (BBSs), predecessors of chatrooms, soon emerged as the first pornographic sharing platforms. By 1994, 40% of the most popular Usenet discussion boards were sexual in nature with 1.85 million contributors (Coopersmith 110). Droves of users were adopting the Internet as an improved means of adult consumption, similar to the VCR. The Internet, however,

improved on videotape technology by introducing a more efficient and interactive way to share sexual content.

A Carnegie Mellon University study contextualizes the prevalence of pornographic file sharing in the 1990's. The study found, with much controversy in the wake of its publication, that out of 900,000 images surveyed in 1995, 83.5% were pornographic (Elmer-DeWitt). As adult audiences expanded online, so did their demands for faster and improved ways to share content. The evolution of data-intensive content, such as images and video, necessitated more robust Internet connectivity. Frederick Lane, author of *Obscene Profits*, illustrates the influence that new digital formats had on the emerging Internet economy:

> BBS subscribers paid $100 million in fees, and required
> nearly five million new phone lines, which generated more
> than $850 million in revenues for local phone companies.
> Pornography was paying for the infrastructure of the
> information age (62).

BBS and Usenet groups were influencing Internet hardware markets intimately tied to the dissemination of adult content.

In three decades, spanning from the early-1980's to the present, connectivity speeds improved to accommodate adult content. Lewis Perdue reported in a 2001 *Wall Street Journal* article, "Few Talk About It, but Porn Plays Big Role in Web Economy," that porn consumers spent $2 billion on bandwidth that year. 50 Kbps dial-up modems would evolve to modern fiber optic speeds to support streaming video, video on demand, 4k content, and other data-intensive formats. More robust connectivity, however, meant that porn consumers had to buy the hardware to support it. Improved computing

hardware was required to push a variety of content across evolving social platforms: "faster servers, higher bandwidth, simpler file formats, easier interfaces— these were the keys to improving users' pornographic experiences, and subsequently the foundation for the mainstreaming of the Internet" (Barss 129). Hardware and access costs were therefore acting as the dominant Internet economies until content itself was commoditized in the mid-1990's.

Internet entrepreneurs such as adult model Danni Ashe were among the first to monetize online content. Hallmarked as "the Most Downloaded Woman on the Internet," *Danni's Hard Drive* launched in 1995, which was a subscription-based soft-core website featuring herself. At the apex of its services, *Danni's Hard Drive* had 3 million monthly visitors, 27,000 of which were actual paying subscribers, and generated $8 million annually. Concurrently, the adult industry as a whole was evaluated at around $2 billion (Barss 6). *Danni's Hard Drive* and other adult sites were therefore demonstrating a new way to commercialize the Internet beyond hardware and access services. They instigated a shift from gratis forum content to profit-driven, subscription-based libraries.

To date, online subscriptions remain one of the dominant pornographic business models; a large cross section of adult sites cost around $19.95 per month for access. The online adult economy, however, has more recently been disrupted by the same technology that enabled its rise to web prevalence. "Tube" sites, or free Youtube-like adult sites that host pirated content, have inundated the Internet with free porn. Youporn, Redtube, and other "tube" variants that host expansive libraries of free content, were reportedly responsible for a 30%-50% decline in DVD revenue at the height of the adult

recession in 2009 (Fritz). This decline directly correlates with the evolution of Internet

technology as faster connectivity, and enhanced download and upload speeds, enabled

greater degrees of piracy (Dickson). Consumers no longer have to pay for porn.

Emergent technology has since become the adult industry's main defense against

Internet piracy. By offering premium content not readily available on "tube" sites, the

adult industry maintains that it can reinvigorate its stagnant economy with cutting-edge

sexual experiences found nowhere else. Its goal: to incentivize consumers to once again

pay for porn. Live cam, 4k, streaming, and mobile formats are therefore modern

examples of this tech-based, economic revival strategy. VR in particular has become one

of the newest technological hopefuls to drive consumers back to pornographic

subscriptions with unique immersive experiences.

A BRIEF HISTORY OF VR

VR sits at the crossroads of human-computer interaction. The term classically describes fully immersive, computer-generated environments that users can spatially interact in while wearing a head-mounted display (HMD) and body-tracking sensors (Mandal 305). A purist would describe true VR as allowing six-degrees-of-freedom in a virtual environment, but its contemporary definition has broadened to include live-action 2D and 3D film experiences (live-action content does not offer the same range of interaction as computer-generated experiences). All forms of VR, however, work toward a common goal: simulated presence.

Presence refers to the ability to suspend disbelief with VR technology. In other words, users should feel as though they are an organic part of a virtual environment, whether that be a representation of a real or fictitious place. For example, a Grand Canyon VR experience should provide an experiential authenticity that mimics being there in-person. Presence, however, is technically complex to master given all the elements needed to authenticate real word sensations associated with sight, sound, motion, and touch. HMD factors such as content responsiveness, image resolution, graphics, field of view, spatial interaction, object physics, and other sensory cues that psychologically and somatically influence the user can heighten or detract from the virtual experience if not fine-tuned to mimic real world sensations. Modern HMD technology has yet to master presence, which echoes a history fraught with tenuous attempts at creating authentic VR experiences.

VR is not a new technology despite recent appearances in popular media. It was introduced fifty years ago at the dawn of the computer science revolution by Ivan Sutherland, an electrical engineer lauded for his developmental role in computer graphics. In 1968, Sutherland introduced the Sword of Damocles, which was the original HMD "realized in hardware, not in concept." Sutherland's headset was the first to incorporate positionally responsive, stereoscopic displays into wearable ergonomics, which served as the inspiration behind VR's iconic design (Mandal 305). Powered by primitive 1960's computer graphics, the Sword was a rudimentary archetype of modern VR devices that served as a proof-of-concept inspiration for the emerging medium.

Figure 1. Ivan Sutherland's Experimental 3-D Display. Photograph by Mark Richards.

VR did not make its first consumer appearance until the commercial convergence of computer graphics and home videogame systems in the 1990's. Leading up to the videogame revolution, the VR medium was occupied by a half-century of prototype HMDs that were too expensive for consumers, too experimental, or limited to industrial applications. New generation devices such as Virtuality, iGlasses, Nintendo Virtual Boy, Cybermaxx, and VFX-1 broke this trend by targeting gaming audiences with more

affordable devices that piggybacked on the wave of popular home gaming consoles such as the Super Nintendo, Sega Genesis, and Sony PlayStation. For example, the Nintendo Virtual Boy gaming headset sold 770,000 units in 1995 as an accessory to the popular Nintendo gaming console (Goldman Sachs 3). VR in the 1990's found tepid success, however, and did not have a lasting mainstream impact.

VR failed due to a combination of technical limitations that resulted in a poor user experience. 1990's VR devices still suffered from the same setbacks as predecessor HMDs such as low resolution, slow computer graphics, large form factor, poor latency (or head-tracking lag) and clumsy ergonomics, which all translated into a less-than-real virtual experience. As reminisced by Brendan Iribe, Oculus VR's chief executive officer, "VR is, essentially, a hack on the human sensory system" and in the 1990's, it was a primitive hack with clumsy equipment and inadequate computing power ("Virtual Reality: Grand Illusions"). These technical and economic setbacks fell well-short of a consumer-ready technology, which gave VR a short commercial run leading up to the 21st century.

CONTEMPORARY VR

Virtual Reality's second commercial release has been underway since 2014. Initiated by Facebook with its $2 billion acquisition of Oculus VR, a leading HMD manufacturer, VR has since been resurrected in the popular culture. Piper Jaffray analysts describe its recent resurgence as "the next mega tech theme in the U.S.," akin to the mobile phone industry 15 years ago (Munster, Clinton, Jakel, and Murphy 1). To date VR maintains a commercial momentum never experienced in its fifty-year history with major technology and venture capitalist support. The verdict, however, is still out on whether VR is going to have a mainstream impact this time around.

VR's 10-year outlook is seemingly positive in a commercial context. Goldman Sachs predicts that VR will be an $80 billion market with $45bn in hardware and $35bn in software by 2025 (14). Samsung, Google, Microsoft, and mobile manufacturers support the technology with their own brands of commercial HMDs. Still, the industry consensus is that consumer VR, and any mainstream impact, is at least a decade away.

VR is still largely unfamiliar to mainstream audiences. In 2015, YouVisit, a virtual tour company, surveyed 1,000 Americans to find that only 11% of respondents had exposure to VR. Of that sample size, 30% expressed interest in the technology but had no direct exposure to it (Reality 51 Team 6). These findings reflect that VR is still a niche technology and will remain that way until consumers overcome the medium's hardware threshold. Consumers have to buy and learn a new technology that is experientially more involved than other media. They also have to be convinced that strapping a headset to their face is worth the trouble. Brian Blau, research director at

Gartner Inc., agrees that its mainstream success depends on getting devices onto user's

heads and in mass numbers (Gaudiosi, "Virtual Reality Video"). VR will remain a niche

medium until this happens.

VR's success is contingent upon convincing consumers to dawn a headset for the

first time. Brian Blau identifies peer-to-peer hype, or mainstream "buzz", as the key to

mainstream adoption of any technology, which typically originates through a specific

industry or content sector. Analysts have therefore identified videogames, live events,

and film entertainment as three content sectors predicted to drive VR's adoption over the

next decade. By 2025, analysts such as Piper Jaffray and Goldman Sachs predict that the

gaming industry will lead VR content with $11.6 billion in sales, followed by live events

at $4.1 billion, concerts and sports, and film entertainment at $3.2 billion (7). Adult

content is also predicted to be a leading entertainment sector.

The maxim that "sex sells" holds true for past media examined in this paper, and

is benefitting VR in a similar way. Piper Jaffray predicts that adult content will lead VR

film entertainment with $1 billion in sales given the adult industry's historical proclivity

to experiment with new technologies. The firm notes in its 2015 VR report that "once

consumer ready VR headsets hit the market we expect the adult industry to bolster

adoption rates" (Munter, Clinton, Jakel, and Murphy 21). This is an understatement as

the adult industry has been driving both consumer adoption and innovation since VR's

commercial reintroduction in 2014. Some of the earliest media headlines on

contemporary VR were sensationalized stories about virtual porn, which seems to be a

recurring phenomenon in the popular press to date. The real influence, however, comes

from the adult industry's global reach and expansive fanbase. Adult consumers are a prime demographic for VR and its sexual implications, especially considering past technological case studies such as the Internet and VCR. The draw of virtual sex may equally convince mainstream demographics to dawn a headset for the first time given its portrayal in the popular press. VR porn is that fantastical that it may be worth seeking out, if only once.

VR PORN IS A THING

From print through photography to film, VR is predicted to be the next major evolution of adult content. Ian Paul, Chief Information Officer of Naughty America, reaffirms this stance observing that "the entire history of porn has been trying by whatever means available to arrive at this type of experience, and now [VR] is here" (Hess, "The Rise of VR Porn"). Virtual sex is the technological telos of the adult industry, as posited by Paul. Its early adoption of the technology, monetization of 360º content, and adult brand of immersive innovations are evidence that VR and pornography is the next high-tech symbiosis. No other technology has the potential to reinvent the pornographic viewing experience like VR.

Similar to the history of the VCR and Internet, adult producers adopted VR technology before commercial counterparts in 2014. Virtual Real Porn (VRP) represents the first instance of any adult provider creating a VR product, and the industry's claim to early adoption. On January 02, 2014, VRP released its first commercial film titled *Lesbian Jacuzzi*, which it described as "the first sexual experience with real actresses specifically designed for the Oculus Rift." VRP notes on its website www.VirtualRealPorn.com, however, that it started creating VR content in late 2013, which predates any significant commercial interest in the technology. Its foresight is more impressive when contextualized by the state of the technology at the time.

VR in 2014 mimicked the early days of the Internet: relevant hardware and software were far from any sort of commercial standard. It was a do-it-yourself mentality and producers had to develop their own proprietary technologies to create and distribute

360º content. Beta, content applications slowly trickled in starting with the Oculus

Platform and Oculus 360º Video in September 2014, followed by Samsung's MilkVR

app in December 2014. Mobile VR devices more common to date, such as the Samsung

Gear VR and Google Cardboard, had yet to penetrate the commercial space until late

2014, and Youtube and Facebook did not provide support for smartphone integration

until late 2015 and early 2016. Commercial entities, in short, were reluctant to invest in

VR given the newness of the medium.

HMDs were considered developer technologies until early 2016. Palmer Luckey

introduced the original Oculus Rift Developer Kit 1.0 (DK1) HMD in 2012, which was

the only, non-industrial device available to a limited number of Kickstarter supporters.

Even after the Oculus DK2 shipped in July 2014, which set off the contemporary VR

movement, the pool of users who owned Oculus devices was insignificant. Actual users

can be approximated at around 20,000 as only one-third of 60,000 DK2 preorders were

fulfilled by August 2014 (Ben Lane). Porn purveyors, however, were not dissuaded to

wait and see how the market developed despite VR's technical obscurity.

Adult providers began creating immersive content in anticipation of the market to

come. In doing so, they provided some of the first VR experiences available for public

consumption. VRP's first immersive experience, *Lesbian Jacuzzi*, was produced when

only one HMD was available in January 2014. Later in May, a *Venture Beat* article titled

"Strap on your Oculus Rift and get ready: Interactive porn is coming," cited adult film

company SugarDVD as creating an app that would "put viewers into their favorite adult

movies" (Grubb). Conversely, Samsung and Oculus did not release their own consumer

VR apps until the fall of that year. Other relevant 2014 milestones include VRP's Virtual

Real Player, which was a proprietary 360º player customized to display its own

stereographic (3-D) content. Prominent players such as BaDoinkVR, Kink.com, Naughty

America, and AliceX would introduce their own VR capabilities in 2015 followed by

others including, but not limited to: WankzVR, Virutal Porn 360º, Czech VR, AliceX,

HologirlsVR, VR Banders, Reality Lovers, Gamelink VR, Virtual Porn Desire, Virtual

Reality Bang VRsexperience, VixenVR, Vulva VR, Dorcel VR, MetaverseXXX. There

are also plenty of commercial brands that have since entered the VR space, and available

content is in no way weighted toward pornography. The real disparity is evident when

considering what types of content are actually profitable.

Despite a significant commercial presence in the VR space, live-action 360º

content has yet to be monetized. The Internet is saturated with branded, live-action

content from major media producers and TV networks, which receive promotional

support through mainstream content channels: New York Times, Discovery, National

Geographic, Hulu, Samsung, Marvel, HBO. In the wake of this commercial inundation,

only one category of content has been monetized so far: video games. The Oculus Store,

the flagship VR marketplace, provides proof that live-action 360º is literally a "free

market." The digital storefront hosts both VR video games and 360º live-action

experiences (live-action referring to non-computer generated 360º video) similar to the

Apple App Store or iTunes. It is the hub for content creators to distribute their products

online. A scan of available content, however, reveals an obvious marketplace disparity:

video games are the only content being sold, with prices ranging from $2-$60. While the

Oculus Store contains an expanding library of featured 360º video experiences, live-action content has yet to be monetized through subscriptions, ad-revenue, or one-off licensing fees. To date, live-action VR porn is the one exception.

Figure 2. Virtual Real Porn and other adult providers incorporate surrogate bodies for enhanced POV perspectives. Copyright Virtual Real Porn.

VIRTUALLY REAL PROFITS

As evidenced with photography, film, the VCR, and the Internet, the adult

industry has consistently monetized emergent technologies at an early stage. Senior

Analyst Gene Munster observes that:

> Whenever there's a shift in content conception, it's
> typically adult entertainment that's the first monetizeable
> app…History repeats itself and we've seen adult
> entertainment drive sales of VHS, DVD, Blu-ray, high
> definition, mobile, and online video over the years
> (Gaudiosi, "Why Porn is Virtual").

 It is true of the past, and is happening in the present with VR.

Adult content is predicted to be the third largest VR sector in the next decade. By

2025, it is expected to be a $1 billion industry (Munster, Clinton, Jakel, and Murphy 1).

Leading content producers such as Naughty America, BaDoinkVR, and Virtual Real Porn

are corroborating these estimations through their respective content services. Each offers

its adult VR library for some variation of $24.95 per month, $5 per day, or a reduced

annual commitment. This is relevant for two reasons: it represents the first instance of

monetized VR content through subscriptions, and demonstrates a milestone that no

commercial counterpart has fulfilled (commercial brands continue to offer their live-

action content for free). NA, VRP, and BaDoinkVR's subscription content, however, is

not evidence in itself that consumers are actually paying for adult VR. At the same time,

a high frequency of new content suggests that there is an economic incentive driving VR

porn production.

Adult providers are consistently updating their libraries with new live action, VR

experiences. Providers such as VRP average two new titles per week and have produced

over 100 sexual experiences to date (Virtual Real Porn). The important consideration is

that stereographic (3D) VR, which is the dominant format of high-end adult content, is

neither cheap nor quick to produce compared to traditional pornographic media. VR is

technically complex to create as it requires the stitching multiple synced cameras to

produce a single 360º video. Delivering content in 3D, opposed to 2D, increases the

intensity of a production as it requires a specialized post-production pathway, and an

experienced stereographer. It is not uncommon for 3D 360º films to take upwards of 8

weeks for turnaround. Given the time and technical complexities involved in VR

production, adult providers could not afford to frequently produce new content without a

consumer-base incentivizing it.

Consumers are also exhibiting unique behavior in how they subscribe to adult

VR. BaDoinkVR reported that more than 50% of subscribers opt for annual plans, which

is something it has not seen in twelve years of traditional pay sites. Similarly, Naughty

America (NA) reports that VR is the fastest growing format that it has tracked, including

streaming, mobile, and 4k content (Morris). NA's Chief Information Officer, Ian Paul,

predicts that by the end of 2016, 10-20 million people will be paying for adult VR,

providing a revenue boost of up to 10%. Other sources estimate 20-30 million adult

subscribers by the end of 2016 (Liberatore). Exact subscriber statistics are difficult to

track as adult providers are protective of their sales information, but industry reports

suggest that Adult VR is beating out other content in a commercial context.

While the gaming industry is predicted to lead VR content sales as the technology becomes more mainstream, market dominance appears to currently skew towards porn. Stacy Liberatore of *Daily Mail* reported that there were 3.2 million VR porn subscribers in October 2015. Conversely, virtual analysts such as KZero Worldswide reported that only 570,000 users paid for gaming content in 2015 ("VR Headset Sales Forecast and Market Penetration 2014-2018"). As reiterated by Ian Paul in a 2016 CES interview, "I don't know of any other content makers who are making money on VR, but we are. That's a sign that VR is here to stay. If adult is making money on it, you can't put the genie back in the bottle" (Morris). The disparity between porn's success and the economic stasis of other VR content relates to the hardware requirements inherent to each genre.

VR hardware remains one of the main barriers to consumer uptake. HMDs are a pre-requisite cost of the medium, which prevents some consumers from investing in VR. Stephanie Llamas, director of research at SuperData, confirms that "the problem the ecosystem faces is that the consumers who are most interested in Virtual Reality [18-year olds and younger] do not have the spending power necessary to support high-end devices" (Sinclair). To date, the consumer Oculus Rift is $599 and the HTC Vive is $799. The costs associated with these premium VR devices, however, extend beyond the "VR goggles" themselves. Gaming units such as Oculus and Vive are PC-based and require a powerful computer to operate them, which makes a complete videogame setup closer to a $2,000 total investment. Compared to traditional consoles such as the

PlayStation 4, at around $350, VR is less-than-affordable as a gaming platform. This

sentiment is reflected in recent polls.

Figure 3. The 2016 HTC Vive costs $799 and represents a premium class of gaming VR
HMDs. Copyright HTC Corporation.

Market research reflects that gaming HMDs are too expensive for general

consumers. In June 2016, Greenlight VR surveyed 1,300 consumers to find that price is

the dominant factor when purchasing a VR device. Similarly, Horizon Media reported in

March 2016 that 36% of American consumers are interested in owning a VR device, but

75% would not pay more than $250. To date, premium VR headsets priced between

$600-$800 are underperforming. SuperData research estimates that consumer Oculus

Rift and HTC Vive units will peak at an underwhelming 1.1 million sales by the end of

2016 (Sinclair). Gaming HMDs such as the Vive and Oculus are analogous to first run

VCRs in terms of cost: they are too unfamiliar and expensive to warrant mainstream

adoption. Silmilar to the VCR and predecessor technologies, HMDs will invariably

become more affordable over time. Until then, gaming content is unlikely to be

influential as an introductory consumer platform. Conversely, live-action porn is not

limited by the costly entrance barriers of premium gaming HMDs, and is much more accessible to general consumers because of its hardware flexibility.

Smartphone technology made the contemporary VR revolution possible with affordable viewing devices. Mobile VR now represents the dominant platform as anyone with a smartphone can experience 360º content. An AMD VR council recently estimated that 80% of all VR devices sold in 2016 will be smartphone-powered, which is predicted to grow to 90% in 2018 ("Projected Virtual Reality Headsets Unit Sales Worldwide in 2016 (in Million), by Device"). Mobile content is also much more accessible to general consumers as it does not require the same hardware demands of gaming content. When paired with cheap VR goggles, ranging from $4 to $250, mobile VR is a cost-effective entry platform for almost anyone with a smartphone. Its global ubiquity therefore positions mobile content as a key platform for mainstream VR adoption. By this same virtue, and the potential for billions of users, the adult industry is embracing the mobile VR platform.

Figure 4. The Samsung Gear VR represents a premium class of mobile HMDs with costs around $99. Copyright Samsung.

Figure 5. Google Cardboard represents cost-effective, mobile VR viewers. Copyright Slash Gear.

Web campaigns such as *Freevrgoggles.com* is one of marketing strategies that have exploited mobile VR for adult recruitment. Disguised as a free hardware giveaway, *Freevrgoggles.com* announced in June 2015 that it would give away 10,000 cardboard headsets on a first-come first-serve basis. In just twenty-four hours, all 10,000 cardboard goggles were claimed, followed by a second run of 20,000 units (Deamicis). It was a clever marketing tactic that featured a clean, commercial layout and stylish "how-to" infographics. Once users clicked on the front and center "Get Free VR Goggles" button they were redirected to the BaDoinkVR main page and ushered into the world of immersive porn.

The *Freevrgoggles.com* campaign demonstrated a successful means to generate consumer awareness around VR in general. At least 30,000 people were exposed to VR through the *Freevrgoggles.com* campaign who may not have had exposure to the technology otherwise. The stunt also generated consumer awareness around adult content, which served as some consumers' first exposure to VR. These sorts of adult

marketing strategies have since become a gateway between the mainstream population and VR.

Virtual sex has stirred the public's imagination, which has garnered mainstream publicity for the medium as a whole. A barrage of aptly named articles have surfaced in major media outlets over the last two years that disclose a disguised excitement for VR porn. In 2016, *CNET*, *CNBC*, and *Mashable*, among other news outlets reported headlines such as, "VR Porn lends a hand: Masturbation will never be the same," "Virtual Reality: Porn's next tech breakthrough," "VR Porn is here and it's scary how realistic it is," and "This is what an orgy looks like in VR." BaDoinkVR, Virtual Real Porn, and Naughty America have also been featured in mainstream publications such as *Fortune*, *Wired*, *New York Post*, *Maxim*, *Tech Crunch*, and *GQ*. Conversely, there are plenty of non-sexual VR headlines that demonstrate a similar mainstream exposure to the technology. Oculus and Samsung have been featured in *Time Magazine*, *Wall Street Journal*, *Forbes*, and most major publications numerous times. The sexually-explicit headlines, however, garner viral attention that extends beyond print media.

An expanding library of online videos documents this public awareness. A Youtube video titled *BaDoinkVR on the Street* features couples and individuals being interviewed while experiencing VR porn for the first time. *Buzzfeed* ran a similar 2015 social experiment called "People Try Virtual Reality Porn for the First Time" which documented users' first impressions. These risqué popular culture instances, and their mainstream shock value, can also be quantified through web search analytics.

Google Trends reveals that VR porn is on the rise. Between November 2014 and April 2016, the search term "VR porn" grew by 9,900% over a 17-month period (Liberatore). This increase correlates in part with the transition of prototype headsets into actual consumer products during that seventeen-month timeframe. Both Oculus and HTC launched consumer headsets in Q2 of 2016, which provided additional motivation for consumers to seek out pornographic applications. Partnerships between mega-XXX sites and adult providers, however, are also a contributing factor.

By synergizing the affordability of mobile VR with an already massive pornographic fanbase, the adult industry is establishing major conduits between millions of online consumers and VR. Pornhub is one of the most trafficked pornographic websites on the Internet, ranked 62nd according to Alexa.com. It is an influential Internet entity to say the least with a reported 60 million daily visitors. In March 2016 it announced a VR partnership with BaDoinkVR in addition to giving away 10,000 free VR goggles (Deamicis). While the free goggles giveaway was a simple marketing gesture, the partnership had a deeper significance. Pornhub drives substantial Internet traffic which provides ample exposure for adult providers such as BadoinkVR. At the same time, these types of partnerships expose millions of adult consumers to VR as a whole to help disseminate a general awareness around the technology. As reported by BadoinkVR, the partnership is significant because "it broadens mainstream awareness of Virtual Reality…[and] ushers in the majority of consumers" (Gaudiosi, "Pornhub Adds Free").

FUTURE GLIMPSE

VR hardware has rapidly improved since it was commercially reintroduced in 2014. In three years, HMDs have evolved from prototypes to consumer products, in addition to an array of interactive accessories that enhance the virtual experience. Among these next generation devices are touch-based technologies that advance VR beyond sight and sound.

Haptic-feedback technology enhances VR as a more complete sensory experience. NullSpace VR, Control VR, Gloveone, Phantom Omni, KOR-FX, and AxonVR are a handful of companies that are introducing virtual touch to gaming VR. Through gloves, vests, and full body exoskeleton contraptions, their devices function to enhance the sensation of presence in VR gameplay. A rumble-pack vest and gloves, for example, can be used to simulate first-person, shooter games. The adult industry, however, has launched its own brand of affordable, haptic technologies to add a physical dimension to virtual sex.

Figure 6. NullSpace VR's haptic vest and gloves for gaming VR.
Photograph by J. Adam Fenster/University of Rochester.

Teledildonics is a category of high-tech adult toys that use the synchronization of visual and physical cues to turn virtual sex into a more lifelike experience. They include a variety of products that wirelessly sync to computers, smartphones, or tablet devices for peer-to-peer, remote-controlled masturbation. Teledildonics have traditionally been used to connect distant partners sexually, but the adult industry is currently marrying it with VR to create a new level of immersive pleasure. "Now you can feel the real sex," as quoted by Virtual Real Porn on its digital storefront. Through vibrations and pulsations that are synced between adult toy, VR device, and user, teledildonic toys add physical simulations to virtual porn. Tenga's VR sex suit demonstrates just how committed adult companies are to furthering this effort.

Figure 7. Tenga's popular VR sex suit consists of a male masturbator and synthetic breasts as haptic extensions of adult content. Copyright Tenga.

Teledildonics integrated with VR heighten sight, sound, and touch and take virtual sex one step closer to replicating the real act. Companies such as Kiiroo and Lovense have since partnered with VRP and BaDoinkVR to offer the "World's first sex toys integrated with VR porn," which are compatible with all existing HMDs. Products such as Lovense's masturbators provide "contractions [in] sync with the actresses' speed" and "vibrations [that] sync with body-to-body contact…to make you feel like your favorite porn stars are actually touching you" (Virtual Real Porn). Despite the novel strangeness of haptic sex, the application is not new nor unique to the adult industry. Haptic devices have existed as gaming accessories longer than as masturbatory aids. The adult industry is unique in that it is advancing virtual touch into commercially unexplored 360º applications especially in a live-action context.

Flirt4Free partnered up with adult toy manufacturer Kiiroo to integrate live stream 360º content with its haptic-teledildonic devices. It announced the "groundbreaking" news in an August 2015 press release titled "Lisa Ann Makes Adult Webcam History With Her First Interactive Live Show" (Kimpot). Kiiroo's fleshlight (a male masturbator) combined with Flit4Free's live stream technology demonstrated one of the first interactive 360º, live cam experiences. Adult enthusiasts were invited to join adult superstar Lisa Ann on October 21, 2015 at 5pm EST:

> [Lisa Ann] will now allow her immense fan base to
> virtually "feel" her via the wonders of the internet…fans
> will feel her every movement in real time via their partner
> device, the Kiiroo Onyx male masturbator (Kiiroo.com).

The Lisa Ann interactive experience was not the first 360º content to be live streamed. Commercial counterparts such as NextVR have streamed immersive sporting

content since 2014. It was, however, one of first interactive experience to integrate

haptic devices with live VR content. The significance is that adult technologies are

enabling consumers to interact both physically and visually with other people, and in real

time, which foreshadows the medium's potential as an immersive social platform

(Facebook likely bought Oculus in part to develop VR as a social platform, but has yet to

offer any consumer applications).

The adult webcam revolution began with Jennifer Ringley in her dorm room in

1996 (Barss 175). Today, adult companies such as Kiiroo, Flirt4Free, and AliceX are

initiating live streaming technology's next pornographic evolution as a 360º, social

platform. AliceX is a leading adult, video chat service described by the following

mission statement as follows:

> AliceX is an easy-to-use VR cam service, providing adults
> everywhere an instant and intimate connection with
> beautiful, live models…the future of sex has arrived with
> AliceX, as the site transports users into a virtual room
> where they are face-to-face with real passionate women
> (AliceX.com).

When stripped of the sex, it functions as a 360º social platform that can be streamed

directly to a HMD or smartphone device. More importantly, 360º services such as these

have been monetized in a way that deviates from traditional entertainment subscriptions

or ad revenue. For example, users can interact face-to-face with models in locations of

their choosing, which range from space to sunny beaches: AliceX models are filmed on a

green screen and composited into 360º environments as requested by the client. In

addition to voice interaction, it provides for a customizable, live experience (Hess, "The

Rise of VR Porn). Consumers also pay according to varying degrees of personalized

interaction, which is a sale model that provides commercial insights into how live entertainment such as sports and concerts may be monetized in the future.

Live entertainment such as concerts and sports are anticipated to be the leading commercial VR sectors by 2025. The streaming sector has yet to be monetized, but some early experiments include NBC's 360º "live VR coverage" of the Summer Olympics in 2016 (NBCoylmpics.com). Conversely, adult cam providers such as AliceX have monetized face-to-face virtual experiences with webcam models. Adult cam sales are based on virtual exclusivity, with access fees range from $5-15/min depending on the level of "intimacy." Consumers can opt for Spy, Private, or Exclusive services, which are tiered experiences analogous to communal seating versus VIP privileges at a strip club. The Spy package parallels stage seating while the Exclusive package represents the backroom lap dance. As with any live event, cost directly correlates with access: the best seats in the house are always the most expensive, and the same principle is being applied to similar virtual experiences.

Adult cam platforms such as AliceX and Flirt4Free foreshadow an emerging VR economy based on virtual exclusivity. VR services will be monetized according to tiered access to live events, similar to how actual event tickets are priced. The sales model will undoubtedly be adopted by commercial counterparts and will represent a whole new way to commercialize NFL, NBA, and other live events broadcast in VR. Virtual users may eventually have to pay top dollar for center court seating, just as they would if they actually went to the game. The adult industry shares this same foresight in its own sexual arena. A 2015 Xbiz poll reported that 42% of 10,000 participants believe 360º live

content to be the dominant adult VR application in the next decade (2). The future of VR

may therefore be a social experience, whether it be to attend live events or masturbate

face-to-face with web models.

CONCLUSION

What will it take to convince everyday consumers to strap on VR goggles for a few minutes of novel 360º exploration? It can be argued that less-than-engaging content in conjunction with poor headset ergonomics, such as size, weight, low resolution, latency, are holding back the technology's potential. Michael Abrash, Oculus VR's Chief Scientist, reiterated this industry-wide ambivalence in a 2015 interview, admitting that content is currently not compelling enough to get people to use VR day after day (Stark). Other aforementioned analysts agree that content is imperative to consumer adoption. As posited by Piper Jaffray Senior analyst Gene Munster:

> We believe one of the adoption hurdles for VR headsets today is sharing how VR feels with someone who hasn't tried it yet–in other words, generating buzz or word of mouth. In order to truly understand VR and its diverse applications people need to try it (6).

VR adoption is therefore contingent upon hardware accessibility, affordability, and compelling content to entice new users. Its future as a consumer product remains uncertain until mainstream awareness inspires a tenable commercial marketplace. Conversely, adult VR is demonstrating a positive trajectory with the monetization of multiple virtual applications.

Pre-recorded live-action porn, 360º live cams, and haptic devices are showing commercial viability thanks in part to the adult industry's global fanbase, which continues to play an important role as an emergent technology adopter. Adult consumers have historically discovered commercial qualities that were either too expensive, too obscure, or too complex for the everyday consumers to support. The VCR fulfilled a

demand for privacy through personal viewing and distribution technology. As a result, it became the mainstream standard for home entertainment. The Internet provided a global portal for adult enthusiasts to interact, share, and download content anonymously which stimulated early hardware and e-commerce economies. The newest emergent technology builds on all of this with an immersive factor that puts consumers in the middle of their sexual fantasies. Companies like Virtual Real Porn, Naughty America, and BaDoinkVR are now mapping out commercial applications that are simultaneously driving consumer VR adoption through sexual content.

VR porn's bizarre and futuristic implications are helping to close the audience-hardware gap that currently exists in the marketplace. This is corroborated by a 2015 poll conducted by Vivid Entertainment and Xcritic.com, which reported that 60% of adult fans would buy a VR device specifically to watch adult VR (Xbiz 4). With roughly 72 million global consumers spending $3 million per second on online content, as reported in a 2006 adult industry study, mass scale adoption is certainly possible through porn (Roberts). The VCR and Internet both demonstrated that adult consumers are willing to go to great lengths for improved sexual experiences. Immersive technology is the logical next step in that sexual conquest.

If the axiom is true that "wherever adult entertainment goes, consumers follow," the future of VR will not be without immersive sex (Taves). VR technology is uniquely tailored to pornographic consumption as it encompasses the best traits of past pornographic media: point-of-view sexual experiences set in private spaces (users are cutoff from reality in a headset environment), with frenetic sexuality captured in high

quality stereographic formats, all of which can be enhanced by interactive, haptic accessories. These conditions create the ultimate viewing experience that adult photographers and filmmakers having been working toward since it was mechanically possible to capture "objective" reality. VR's uniqueness, however, lies in its potential to depart from traditional pornographic voyeurism in lieu of greater degrees of virtual interaction. Users are fully immersed in the story rather than watching it unfold on a window-like screen as with traditional media. In this regard, VR redefines how users experience digital media through active viewership, and the ability to explore a 360º space.

In this paper, I have argued adult VR as a positive reflection of immersive technology. In doing so, I have completely omitted its potential dark side. Immersive technology poses obvious legal and ethical questions that will only intensify as VR is popularized. Child pornography, sex trafficking, and illegal subgenres will no doubt find an outlet just as they have with other media. While pornography is sexually democratizing to the diverse interests that it serves, from face-sitting to furverts (people who have sex in animal costumes), some fetishes are more injurious to the subjects involved than others.

To date, VR is technically limited to a small pool of more sophisticated content producers who cater to predominantly heterosexual, male demographics. There are not enough consumers or headsets in circulation to incentivize highly specific, illegal content production such as child pornography. Once VR technology is standardized, however, the floodgates will open to the sexual predators who deface the adult industry. The ethics

of VR technology and its societal impacts as a mainstream pornographic medium

therefore require further exploration in a separate text.

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