Permissionless Innovation and Immersive Technology

Public Policy for Virtual and Augmented Reality

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Abstract

Immersive technologies such as augmented reality, virtual reality, and mixed reality are finally taking off. As these technologies become more widespread, concerns will likely develop about their disruptive social and economic effects. This paper addresses such policy concerns and contrasts two different visions for governing immersive tech going forward. The paper makes the case for permissionless innovation, or the general freedom to innovate without prior constraint, as the optimal policy default to maximize the benefits associated with immersive technologies. The alternative vision—the so-called precautionary principle—would be an inappropriate policy default because it would greatly limit the potential for beneficial applications and uses of these new technologies to emerge rapidly. Public policy for immersive technology should not be based on hypothetical worst-case scenarios. Rather, policymakers should wait to see which concerns or harms emerge and then devise ex post solutions as needed.

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Permissionless Innovation and Immersive Technology:

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Introduction

After many years of hype, immersive technology—which includes augmented reality (AR), virtual reality (VR), and mixed reality (MR) technology—appears poised for potentially explosive growth. With the recent product launches of several VR devices, immersive technology could soon become ubiquitous in society. If immersive technology becomes widespread, however, a variety of social and economic concerns will likely arise, some of which might lead to calls for regulation of AR, VR, and MR. In light of those concerns, what approach should be used to govern immersive technology?

This paper seeks to accomplish three goals. First, it discusses the basics about AR and VR technology, what separates them and unifies them, their market potential, and various anticipated uses.

Second, it notes that immersive technologies may generate certain social or economic concerns that could give rise to a debate over the future regulation of immersive technologies. It argues that—consistent with the way in which debates about other modern disruptive technologies have unfolded—two governance visions for immersive tech will become evident in fairly short order. Those governance visions are *permissionless innovation*, or the general freedom to innovate without prior constraint, and the *precautionary principle*, which generally seeks to limit new innovations until creators can demonstrate that the innovations will cause no harm. The paper also explores some specific concerns that might prompt calls for precautionary

principle policies for immersive technology, including privacy, security, safety, and intellectual property issues.

Third, this paper explains why the permissionless innovation model should be the policy default for immersive technology. It also explains why the opposite policy default—the precautionary principle—would be inappropriate. The problem with ex ante precautionary controls on new immersive technologies is that such preemptive restraints will greatly limit the potential for beneficial applications and uses of these new technologies to emerge rapidly. Instead, policymakers should allow rapid innovation and devise ex post solutions for any actual harms caused by new technologies. Toward that end, this paper presents a 10-point checklist that policymakers can follow to ensure that VR, AR, and MR innovation is not thwarted but that policy concerns are still addressed.

Background

VR and AR are related technologies, but there are differences between them. VR immerses users in virtual environments via two simultaneous displays that are slightly offset. A user views the displays through a special lens; doing so creates a stereoscopic effect that adjusts itself to the movements of the user's head.[1] This effect immerses the user in a fully digital world by emulating the way that vision works to create depth. More generally, therefore, *virtual reality* can be defined as "a real or simulated environment in which a perceiver experiences telepresence."[2] Similarly,

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[1] "How Virtual Reality Works," The Economist Explains, *Economist*, September 1, 2015.
[2] Jonathan Steuer, "Defining Virtual Reality: Dimensions Determining Telepresence" (Social Responses to Communication Technologies Paper 104, Stanford University Department of Communication, Stanford, CA, October 15, 1993), 7. *Telepresence* is a sensation of being elsewhere.

VR head-mounted displays (HMDs) are being used to view other content as well, such as 360-degree photos and videos.

AR differs from VR in that it takes digital information, among other stimuli, and displays the information over the user's natural environment in real time.[3] In other words, AR supplements the natural environment users see around them; it does not completely replace the natural environment in the way that VR does.[4]

Currently, most AR and VR services require the use of some sort of HMDs, although AR apps without the use of an HMD do exist.[5] An integration of these two technologies into what immersive technology experts call *mixed reality* is also being researched.[6]

A Brief History of AR and VR

Although the term *virtual reality* was not coined until 1987 by engineer Jaron Lanier,[7] the American cinematographer Morton Heilig had begun research on the first VR devices in the 1950s.[8] Heilig received the patent for the first VR HMD, the Telesphere Mask, in 1960.[9] He went on to receive a patent for the Sensorama in 1962[10] and another patent in 1969 for the more advanced Experience Theater. Both the Telesphere Mask and the Sensorama used stereoscopic effects in tandem with other stimuli via sound, smell, and touch to immerse users in a cinematic

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[3] Dena Cassella, "What Is Augmented Reality (AR): Augmented Reality Defined, iPhone Augmented Reality Apps and Games and More," *Digital Trends*, November 3, 2009.
[4] Ryan Calo et al., "Augmented Reality: A Technology and Policy Primer" (white paper, Tech Policy Lab, University of Washington, Seattle, 2016), 3 (noting that "there is no easy definition of 'augmented reality'; AR is best understood as a class or family of technologies that tend to have certain common and distinguishing features").
[5] John Corpuz, "Best Augmented Reality Apps," *Tom's Guide*, February 17, 2016.
[6] Eric Johnson, "What Are the Differences among Virtual, Augmented and Mixed Reality?," *Recode*, July 13, 2016.
[7] Henry E. Lowood, "Virtual Reality (VR)," *Encyclopaedia Britannica Online*, May 14, 2015.
[8] Chris Payatagool, "Theory and Research in HCI: Morton Heilig, Pioneer in Virtual Reality Research," *Telepresence Options*, September 19, 2008.
[9] Morton L. Heilig. Stereoscopic-television apparatus for individual use. US Patent 2,955,156, filed May 24, 1957, and issued October 4, 1960.
[10] Morton L. Heilig. Sensorama simulator. US Patent 3,050,870, filed January 10, 1961, and issued August 28, 1962.

experience, as if they were present in the film. These HMDs were inspired by the popular stereoscopes of the late 1800s, invented by Sir William Brewster in 1850.[11]

Around the same time that Heilig was doing his research, computer scientist and University of Utah professor Ivan Sutherland, with student Bob Sproull, developed the "Sword of Damocles," an HMD so large it hung from wires in the ceiling.[12] This device was a prototype for the HMDs that pilots would later use to display data on "virtual" heads-up displays. In the late 1970s, the US military would adopt VR technology to train pilots.[13] This would not be the last use of VR by the US government.

After the largely disappointing false start of consumer VR in the early 1990s, NASA began training astronauts to conduct complex repairs on the Hubble Space Telescope by using VR HMDs and swimming pools (separately, of course) to simulate space.[14] In 1992, a research team from the University of Illinois at Chicago developed and demonstrated the first cave automatic virtual environment (CAVE), which used stereoscopic glasses and rear-projection walls in a cube-shaped room to simulate 3-D environments.[15]

A series of consumer VR products appeared in the early 1990s, from the failed Sega VR[16] and weak-selling Nintendo Virtual Boy[17] to the short-lived arcade VR units developed by Virtuality.[18] The VR HMDs of the 1990s were initially a commercial failure because technological limitations prevented them from meeting consumer expectations. However, they

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[11] Lisa Spiro, "A Brief History of Stereographs and Stereoscopes," CNX.org, August 19, 2006.
[12] "The Sword of Damocles and the Birth of Virtual Reality," *Simpublica*, March 19, 2014.
[13] National Center for Supercomputing Applications, "Virtual Reality: History," Science for the Millennium Online Expo, 1995.
[14] Erin Carson, "How NASA Uses Virtual Reality to Train Astronauts," *TechRepublic*, May 19, 2015.
[15] Margaret Rouse, "CAVE (Cave Automatic Virtual Environment)," WhatIs.com, March 2011.
[16] Matt Hill, "The Sega VR Headset That Never Was," *Gizmodo UK*, November 21, 2014.
[17] Steven Boyer, "A Virtual Failure: Evaluating the Success of Nintendo's Virtual Boy," *Velvet Light Trap* 64 (Fall 2009): 23–33.
[18] Kyle Fowle, "A Look Back at the Doomed Virtual Reality Boom of the 90s," *Kill Screen*, January 28, 2015.

led to the reemergence of VR in 2012, when a young entrepreneur named Palmer Luckey launched a Kickstarter funding campaign for his VR prototype, the Oculus Rift. Luckey raised approximately $2.5 million and received major endorsements.[19]

In 2014, Luckey's company, Oculus VR, caught the attention of social media giant Facebook, which purchased Oculus for $2.3 billion.[20] Since then, a plethora of competitors have flooded the market with new and innovative VR HMDs that can be powered by traditional high-end PCs,[21] video game consoles,[22] or even smartphones.[23]

AR HMDs find common ground with VR because their origins also date back to Sutherland and Sproull. AR technologies are still used by pilots today,[24] but they are also finding less militarized uses in the form of devices such as Google Glass, which debuted in 2013.[25] Glass was considered a developer's kit; it came in the form of a wire frame with clear lenses and a seemingly bulky processing unit attached to the side. Ultimately, Glass did not catch on in the popular wearable technology category, but it did attract a lot of negative attention from privacy advocates[26] and those who thought its wearers just looked odd—factors we believe partially led to its failure to become widely adopted. Exclusive purchasing rights and a $1,500 price barrier to entry certainly did not help Google's cause, either.[27]

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[19] Greg Kumparak, "A Brief History of Oculus," *TechCrunch*, March 26, 2014.
[20] Erin Griffith, "Facebook Buys Oculus VR, a Virtual Reality Gaming Company, for $2 Billion," *Fortune*, March 25, 2014.
[21] "Spec Comparison: The Rift Is Less Expensive than the Vive, But Is It a Better Value?," *Digital Trends*, April 5, 2016.
[22] Samit Sarkar and Allegra Frank, "PlayStation VR's Launch Lineup Is Shaping Up Nicely," Polygon, April 8, 2016.
[23] Paul Lamkin, "The Best Smartphone Headsets for VR Apps," *Wareable,* February 8, 2016.
[24] "When a HUD Won't Cut It, Pilots Turn to Helmet-Mounted," *Defense Tech,* July 12, 2012.
[25] Claire Cain Miller, "Google Looks to Make Its Computer Glasses Stylish," *New York Times*, February 20, 2016.
[26] Aileen Graef, "Tech and Privacy Advocates Clash over Possibilities for Google Glass," PBS NewsHour Extra, August 9, 2013.
[27] Mat Honan, "I, Glasshole: My Year with Google Glass," *Wired*, December 30, 2013.

But Google subsequently developed Google Cardboard, an inexpensive VR viewer that is marketed by Google and other developers for as little as $15 as of late 2016 (but also requires a smartphone to use).[28] Competition in the market for wearables continues to be intense. Joining major players such as Google and Oculus are smartphone giant Samsung, which has developed a $99 Samsung Gear VR headset for use with its most popular smartphones; Sony, which has created PlayStation VR for use with its PlayStation 4 gaming console; and HTC, which offers the HTC Vive. It remains unclear which firms and platforms (smartphones, gaming consoles, stand-alone platforms, or PCs) will win out.[29]

Other market segments are likely to emerge as technologies and sectors evolve and converge. For example, the relationship between AR–VR and wearables is a close-knit one. Google Glass, Microsoft HoloLens, and Meta's Meta 2 glasses are merely a beginning for the category of wearables. Offerings in this category will undoubtedly improve and fall in price as their current developer kits become consumer models.[30] For example, in late 2016, Snap Inc. (the company that created Snapchat) released Spectacles—a $129 pair of video-recording sunglasses with functionality similar to that of Google Glass.[31]

Soon, the plethora of AR applications that permeate mobile app stores will spawn new AR and MR wearables (such as smart contact lenses).[32] That relationship will wed immersive technologies with a growing sector of interconnected devices in the Internet of Things, which is

[28] "Get Your Cardboard," Google, last accessed December 15, 2016.
[29] "Which Gaming Company Will Dominate the Virtual-Reality Market?," *Economist*, October 14, 2016.
[30] Jeffrey M. O'Brien, "The Race to Make Virtual Reality an Actual (Business) Reality," *Fortune*, April 27, 2016.
[31] Xavier Harding, "The Snapchat Spectacles Craze, Explained," *Vox*, December 14, 2016.
[32] My Nguyen, "Augmented Reality: Will 2016 Be the Year of Smart Contact Lens?," WT-Wearable Technologies, February 26, 2016.

the emerging world of Internet-connected devices and appliances.[33] So far, Google,[34] Magic

Leap,[35] Sony,[36] and Samsung have all filed patents for AR and MR "smart contacts." The Sony

and Samsung models would include a camera in the design.[37]

Market Potential for Immersive Tech

The market potential for immersive technologies is growing rapidly, so much so that some

bullish technology entrepreneurs believe that VR technology in particular could soon become

"more ubiquitous" than smartphones.[38] In a 2014 report, Sophic Capital estimated that the VR

market will reach $7 billion by 2018—$2.3 billion in hardware sales and $4.7 billion in software

(games and apps).[39] Sophic Capital made this prediction in November 2014, eight months after

Facebook's $2.3 billion purchase of Oculus.

In February 2016, the MR hardware developer Magic Leap received $800 million in

funding, putting its valuation at around $4.5 billion.[40] With this steady increase of investment in

VR and AR startups, Goldman Sachs released a report that forecasted estimates of the VR

market generating as much as $182 billion in revenue by 2025—$110 billion in hardware sales

and $72 billion in software.[41]

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[33] Adam Thierer, "The Internet of Things and Wearable Technology: Addressing Privacy and Security Concerns without Derailing Innovation," *Richmond Journal of Law and Technology* 21, no. 2 (2015).

[34] Quinten Plummer, "Google Smart Contact Lens to Hit the Market Soon?," *Tech Times*, June 28, 2015.

[35] Kia Kokalitcheva, "Magic Leap Files for a Big Pile of Patents, Including for a Sci-Fi Contact Lens," *Fortune*, September 1, 2015.

[36] "Sony Filed a Patent for Video-Recording Contact Lens," *Huffington Post*, April 28, 2016.

[37] Todd Jaquith, "Sony Just Patented Contact Lenses That Can Secretly Record What You See," *Business Insider*, May 3, 2016; Raymond Wong, "Samsung Patents Smart Contact Lenses with a Built-in Camera," *Mashable*, April 5, 2016.

[38] Arjun Kharpal, "VR Will Be 'More Ubiquitous' Than Smartphones: Oculus," CNBC, November 3, 2015.

[39] Sean Peasgood, *Virtual Reality: A Virtual Goldmine for Investors* (Toronto: Sophic Capital, 2014), 4.

[40] Ian Sherr, "Magic Leap Has Something Better Than a Product: Potential," *CNET*, February 3, 2016.

[41] Ian Hamilton, "Nearly 6 Million Wired VR Headsets Could Ship in 2016, Analyst Says," *UploadVR*, January 19, 2016.

Regarding diffusion of VR and AR hardware, in early 2017, the Consumer Technology Association predicted that VR headset unit sales would reach 2.5 million units (a 79 percent increase over 2016) and $660 million in revenues (a 43 percent increase) in 2017.[42] Additionally, Piper Jaffray expects sales of VR headsets to reach 100 million units by 2020 and 500 million units by 2025, the majority of which will be wireless HMDs.[43] MarketsandMarkets, a market research firm, reports that in 2015, the global AR market was valued at $2.35 billion and the VR market was valued at $1.37 billion.[44] In figure 1, BI Intelligence forecasts shipments of smartphone-powered HMDs to reach 38 million units by 2022; when all global VR headsets are counted (including gaming consoles and PCs), the total rises to 55 million units. Between 2016 and 2022, the firm projects compound annual growth rates of 76 percent for AR and 58 percent for VR.[45]

Those accelerating trends are powered by Moore's Law, the principle named after Intel cofounder Gordon E. Moore, which predicts that processors will roughly double in power every 18 months while shrinking in size and remaining relatively constant in price. This effect as applied to smartphone processors has been a boon to VR hardware developers, who are integrating the processors into headsets for computing and display.[46] The Gartner Hype Cycle, a graphic detailing the cycle of adoption for new technologies, has VR leaving the "trough of disillusionment" and steadily approaching the "slope of enlightenment," with AR quickly progressing not far behind.[47]

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[42] Consumer Technology Association, "Record Year Ahead: Consumer Enthusiasm for Connectivity to Propel Tech Industry to Record-Setting Revenues, Says CTA," news release, January 3, 2017.

[43] Gene Munster et al., *Next Mega Tech Theme Is Virtual Reality* (Minneapolis, MN: Piper Jaffray, May 2015).

[44] Markets and Markets, *Augmented Reality and Virtual Reality Market by Device Type, Component, Vertical, and Geography: Global Forecast to 2022* (Magarpatta City, India: Markets and Markets, May 2016).

[45] Ibid.

[46] David Pierce, "The Future of Virtual Reality Is Inside Your Smartphone," *Wired*, March 6, 2015.

[47] Gartner, "Gartner's 2015 Hype Cycle for Emerging Technologies Identifies the Computing Innovations That Organizations Should Monitor," press release, August 18, 2015.

Figure 1. FORECAST: Global VR Headset Shipments
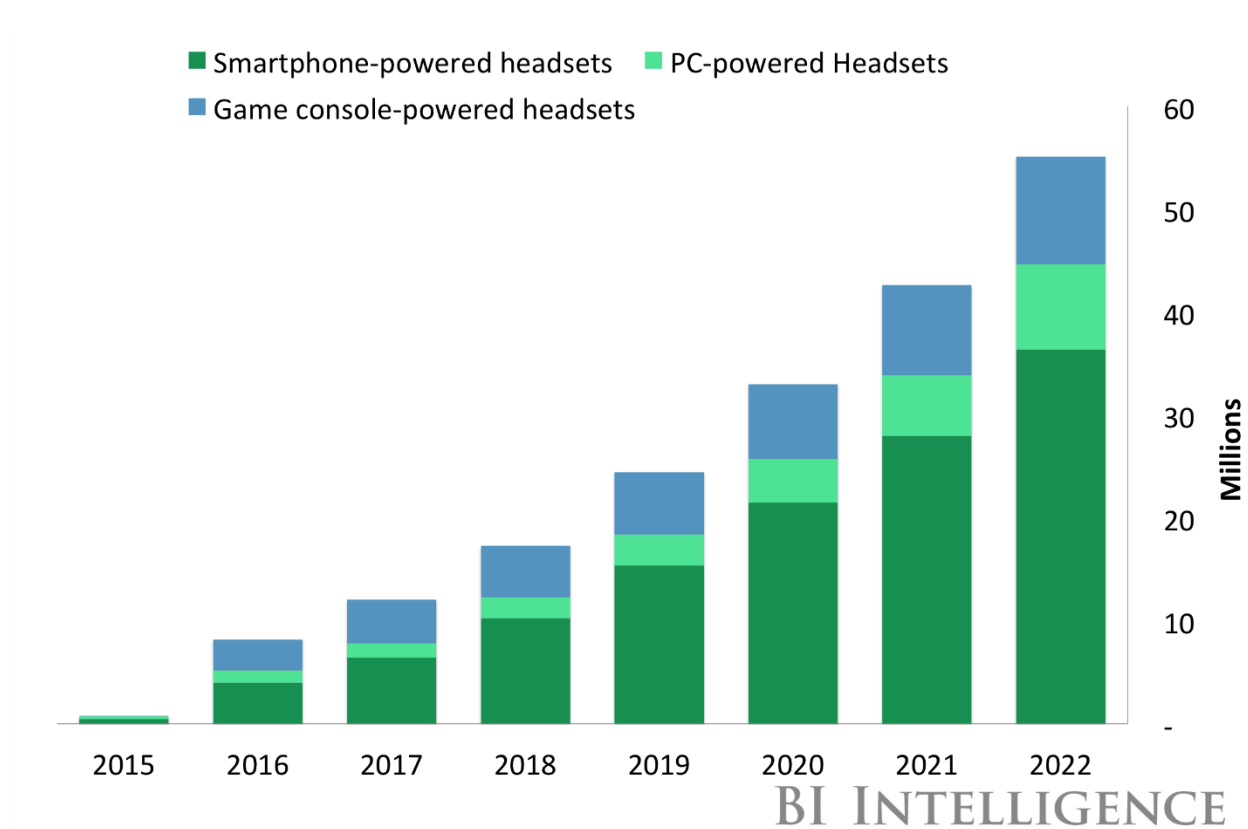
Source: BI Intelligence Estimates

Even with Moore's Law behind VR technology, naysayers in the media have gloomily predicted hard times for adoption of VR gear because of either an early lack of high-quality content[48] or the higher-than-expected product pricing.[49] "Our biggest failing was assuming we had been clear enough about setting [price] expectations," observed Oculus Rift founder Palmer Luckey following launch of his company's product.[50] Yet even though price expectations were

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[48] Christopher Mims, "Why the Virtual-Reality Hype Is about to Come Crashing Down," *Wall Street Journal*, May 23, 2016.
[49] James Pinnell, "The Oculus Rift's Price Is Bad for VR," *PC & Tech Authority*, January 7, 2016.
[50] Ben Gilbert, "Oculus Founder Says the $600 Oculus Rift Is 'Obscenely Cheap for What It Is,'" Tech Insider, *Business Insider*, January 7, 2016.

not quite met, Oculus Rift headsets sold out in the preorder offering within 14 minutes of being made available.[51]

Sectoral Applications and Implications

Virtual environments and virtual data of all kinds will see many uses—and create a lot of disruption—along the road to VR's widespread adoption.[52] In this process, AR and VR technologies could revolutionize many sectors and professions,[53] including the following:

- *Gaming.* VR and AR are changing the way gaming is experienced. Immersive titles that place the player inside the game are being released on dedicated distribution platforms such as the Oculus Store and well-known gaming platforms such as Steam, PlayStation Network, Google Play, and the iOS App Store. The July 2016 release of Niantic's Pokémon GO, an AR game in which users collect imaginary Pokémon characters in public spaces, spawned a global phenomenon.[54] Just two weeks after its release, the game had amassed 21 million users in the United States alone and had become the top-grossing smartphone gaming app.[55]

- *Movies and events.* VR 360-degree short films, which are emerging at the Sundance Film Festival as among the bigger-budget producers in Hollywood, also experiment with the medium.[56] Additionally, Oculus has introduced a "virtual theater" that is rendered in VR

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[51] Rhiannon Williams, "Oculus Rift Sells Out in 14 Minutes after $599 Price Announced," *Telegraph*, January 6, 2016.

[52] Richard Bennett, "The Year of Augmented Reality," *High Tech Forum*, December 6, 2016.

[53] Eric Lancheres, "Virtual Reality Is Coming and It Will Change the World in 2016," *Engadget*, November 15, 2015.

[54] Alex Hern, "Pokémon Go Becomes Global Craze as Game Overtakes Twitter for US Users," *Guardian*, July 12, 2016.

[55] Bret Swanson, "The 5G-Pokémon Moment," TechPolicyDaily.com, July 22, 2016.

[56] Ashley Leiva, "How VR Experiments at Sundance Are Bringing Our Bodies into the Picture," Wareable, January 27, 2016; Richard Bennett, "Augmented Reality Drama," *High Tech Forum*, December 8, 2016.

and allows users to purchase or rent 2-D movies and then view them, among other content, in a virtual movie theater.[57] Other providers are also experimenting with similar immersive viewing systems,[58] using the systems to broadcast live events such as the Olympic games.[59]

- *Museums.* Around the world, museums such as the Metropolitan Museum of Art in New York, the Illinois Holocaust Museum and Education Center, and the Natural History Museum in London are adopting VR and AR technologies to enhance their visitors' educational experience. Visitors can view famous works of art in interactive 3-D, converse with a Holocaust survivor using "natural language" technology, and explore fully rendered virtual environments of Cambrian Period oceans.[60]

- *Education.* VR is finding its way into education in significant ways. Google's Expedition Pioneer Program allows teachers to control 360-degree imagery tours of famous landmarks and ruins, displayed using Google Cardboard.[61] Various other documentary-style productions are being filmed in 360-degree video, such as Discovery Channel's VR app.[62] Meanwhile, "a growing crop of filmmakers, policymakers, researchers, human rights workers and even some law enforcement officials see a broader societal purpose in the emerging medium's stunning ability to make people feel as if they have experienced an

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[57] Erich Schwartzel, "Virtual-Reality Movies: Get Ready for the VR Revolution," *Wall Street Journal*, March 4, 2016; Michal Addady, "Oculus Teams Up with 20th Century Fox to Bring Virtual Reality to Movies," *Fortune*, September 27, 2015.

[58] Todd Spangler, "Netflix, Hulu to Launch Virtual-Reality Apps," *Variety*, September 27, 2015; "Chinese Film Director Jia Zhangke to Experiment with Virtual Reality Film—a Romance," *South China Morning Post*, June 20, 2016.

[59] Joan E. Solsman, "Juiced for Olympics in VR? Better Grab a Samsung Headset," *CNET*, June 30, 2016.

[60] Ellen Gamerman, "A Look at the Museum of the Future," *Wall Street Journal*, October 16, 2015.

[61] For more information, see the Expeditions Pioneer Program's website at https://www.google.com/edu/expeditions.

[62] Janko Roettgers, "Sharks, Survival and Surfing: Discovery Goes Virtual Reality with New Apps," *Variety*, August 27, 2015.

event firsthand."[63] Using VR, these individuals aim to engage viewers' empathy for other individuals or groups. Also, in late 2016, the Obama administration released a new AR app for smartphones that allows users to focus their cameras over a dollar bill and then experience an interactive 3-D video about life at the White House.[64]

- *Healthcare.* Traditional 2-D imaging techniques such as CT scans and MRIs are being converted into 3-D models. Doctors view the models through HMDs such as Google Cardboard to facilitate surgery in cases that were once thought inoperable.[65] In late 2016, a surgeon in the United Kingdom became the first doctor to use Snap's Spectacles to record a routine hernia repair, with the goal of teaching others about the procedure.[66] Doctors are also using VR to treat phantom-limb pain,[67] lower-limb complex regional pain syndrome,[68] post-traumatic stress disorder (PTSD),[69] phobias,[70] burns,[71] and eye disorders such as amblyopia (lazy eye).[72] Therapists are using AR to help autistic children recognize and react appropriately to emotions.[73] In November 2016, the world's first VR medical training facility opened in London.[74] More generally, immersive technology could be used to encourage greater physical activity through gamification of routine tasks or traditional

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[63] Elizabeth Dwoskin, Michael Alison Chandler, and Brian Fung, "Auschwitz, Sex Assault and Police Shootings: Where Virtual Reality Is Going Next," *Washington Post*, November 11, 2016.

[64] Josh Earnest, "How to See the White House on a Dollar Bill," *White House Blog*, December 1, 2016,.

[65] Edgar Cervantes, "Google Cardboard Helps Doctor Save Baby's Life," Android Authority, December 30, 2015.

[66] Andrew Dalton, "Re-live the First Surgery Recorded via Snapchat Spectacles," *Engadget*, December 15, 2016.

[67] Tanya Lewis, "Virtual Reality Treatment Relieves Amputee's Phantom Pain," LiveScience, February 25, 2014.

[68] Andrea Stevenson Won et al., "Two Virtual Reality Pilot Studies for the Treatment of Pediatric CRPS," *Pain Medicine* 16, no. 8 (2015): 1644–47 ("Our results demonstrate that VR therapy is safe and feasible for pediatric patients suffering from CRPS").

[69] Christina Couch, "Healing Minds with Virtual Reality," *Nova Next*, PBS, April 2, 2015.

[70] David Cox, "Virtual Reality Can Help People Conquer Their Phobias," *Guardian*, October 16, 2014.

[71] "Easing Pain for Burns Victims Using Virtual Reality," BBC News, January 31, 2011.

[72] Diane Tsai, "This Virtual Reality Game Could Help Treat Lazy Eye," *Time*, January 5, 2016; Kent Bye, "Using VR to Treat Lazy Eye with 'Vivid Vision,'" *Road to VR,* April 20, 2016.

[73] Nitish Kulkarni, "Stanford Researchers Treat Autism with Google Glass," *TechCrunch*, October 19, 2015.

[74] Kris Kolo, "Mativision Launches World's First Virtual Medical Reality Training Facility," VR/AR Association, November 3, 2016.

activities. Games such as Pokémon GO and the smartphone running app Zombies, Run!
encourage players to become more active as they pursue rewards.[75]

- *Worker training and systems monitoring.* VR industrial simulators such as ForgeFX are
  being used to help train workers to master a variety of complex tasks before they are
  confronted with equivalent real-world scenarios.[76] Farmers can also use AR systems to
  help with crop management remotely.[77]

- *Engineering and interior design.* Virtual modeling technology is being combined with
  VR HMDs to make 3-D renderings of vehicles,[78] buildings,[79] and already-built homes
  and businesses[80] and to allow people to view and tour these structures (to scale) virtually
  in 360 degrees. Such technology can help lower the cost of manufacture, construction,
  and design.[81]

- *Real estate.* Virtual modeling and 360-degree media are changing the way prospective
  homeowners view possible real estate options. Buyers can view property and design
  options from anywhere, thereby eliminating the expense of traveling to properties.[82]
  Similarly, vacationers can preview their destinations in VR[83] or MR[84] before making
  reservations.

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[75] Rachel Bachman and Sarah E. Needleman, "Want to Exercise More? Try Screen Time," *Wall Street Journal*, December 17, 2016.

[76] Erin Carson, "How Virtual Reality Gets Industrial Training Simulators Closer to Real Life than Ever Before," *TechRepublic*, May 25, 2016.

[77] Jeff Kavanaugh, "How Mixed Reality and Machine Learning Are Driving Innovation in Farming," *TechCrunch,* November 17, 2016.

[78] Leo King, "Ford, Where Virtual Reality Is Already Manufacturing Reality," *Forbes*, March 3, 2014.

[79] Sam Lubell, "VR Is Totally Changing How Architects Dream Up Buildings," *Wired*, November 9, 2016; John Gaudiosi, "This Company Is Redesigning How It Works with Virtual Reality," *Fortune*, September 2, 2015.

[80] Sonia Schechter, "Virtual Reality for Retail: Lowe's Holoroom Rolls Out to US Retail Locations," Marxentlabs, October 29, 2015.

[81] Kate Murphy, "Your New Home: Ready to See Now, via Virtual Reality," *New York Times*, May 10, 2016.

[82] John Gaudiosi, "Now You Can Shop for Luxury Homes in Virtual Reality," *Fortune*, September 9, 2015.

[83] Robin Burks, "How Drones and Virtual Reality Will Change Tourism," *Tech Times*, June 1, 2015.

[84] See the webpage for Microsoft's product HoloLens at https://www.microsoft.com/microsoft-hololens/en-us/apps.

- *Journalism.* VR is changing the paradigm of how stories can be told in media other than entertainment. Journalists have leveraged the technology to create immersive stories and documentaries.[85] In May 2016, the *New York Times* launched NYTVR, a smartphone app that lets users "experience stories reported by award-winning journalists, all told in an immersive, 360-degree video experience."[86]

- *Driving.* AR heads-up windshield displays are becoming more prevalent in automobiles today.[87] These displays provide drivers with supplementary information about speed, directions, turns, and warning signals, as well as personal communications such as phone calls or text messages.[88]

- *Advertising.* VR will enable new advertising platforms such as Immersv, which "wants to help game makers and app designers with discovery while also providing them with a way to generate revenue. The idea is to enable studios to insert video commercials into their VR experiences."[89]

- *Government.* NASA has used VR technology since the early 1990s, but as newer, more powerful consumer-grade VR HMDs come out at a fraction of the cost of older military-grade systems, the potential for space aeronautic training is growing.[90]

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[85] Angela Watercutter, "This Ebola Documentary Shows VR Film's Radical Potential," *Wired,* August 1, 2015.
[86] See the webpage for NYTVR at http://www.nytimes.com/marketing/nytvr; also see Erin Griffith, "Can Virtual Reality Save Journalism?," *Fortune*, May 2, 2016.
[87] Ronan Glon, "Distracted behind the Wheel? Try One of These Aftermarket Heads-Up Displays," *Yahoo! Tech*, February 13, 2017.
[88] Cuong Tran, Karlin Bark, and Victor Ng-Thow-Hing, "A Left-Turn Driving Aid Using Projected Oncoming Vehicle Paths with Augmented Reality," in *Proceedings of the 5th International Conference on Automotive User Interfaces and Interactive Vehicular Applications, October 28–30, 2013* (New York: Association for Computed Machinery, 2015), 300–307.
[89] Jeff Grubb, "Immersv Enables Virtual Reality Developers to Advertise Their Games in Other VR Apps," VentureBeat, March 10, 2016.
[90] Erin Carson,"NASA Shows the World Its 20-Year Virtual Reality Experiment to Train Astronauts: The Inside Story," *TechRepublic*, April 13, 2016.

- *Military.* Military uses of VR harken back to the 1990s and continue today through combat simulations, medic training, flight simulators, vehicle simulators, and even recruitment campaigns, to name a few.[91] Additionally, the Office of Naval Research (within the US Department of the Navy) funded a new VR program called Bravemind, which built on standard exposure therapy techniques to help reduce the PTSD symptoms felt by 20 military personnel with an average eight years of service.[92]

Again, despite immersive technology's many potential uses and benefits, some critics doubt that the technology will ever achieve widespread adoption.[93] But there has been similar skepticism of past technologies, as Jason Brush, executive vice president of creative and user experience at Possible, notes:

> Every medium that permeates our lives was once attacked as being, at best, impracticable or, at worst, immoral. Each succeeded solely because of dedicated advocates and acolytes who fought to prove the merit of what others said was folly. They saw past technical challenges, low fidelity and—perhaps most crucially—beyond the status quo's preconceptions of what was possible in order to investigate the potential of something unproven.[94]

How Should Immersive Tech Be Governed?

Like computers, the Internet, and mobile phones before them, immersive technologies hold the potential to become a major disruptive technological platform within our lifetimes.[95] Although AR and VR technologies clearly have enormous potential, it is also likely that they will give rise

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[91] "Virtual Reality in the Military," *Virtual Reality Society,* January 9, 2016.
[92] Tanya Lewis, "Virtual-Reality Tech Helps Treat PTSD in Soldiers," *Live Science,* August 8, 2014.
[93] "Why VR/AR May NOT Be the Next Big Thing," *Arovia,* August 18, 2016.
[94] Jason Brush, "Why Virtual Reality Matters," *Recode*, June 28, 2016.
[95] "The first technological platform to disrupt a society within the lifespan of a human individual was personal computers. Mobile phones were the second platform, and they revolutionized everything in only a few decades. The next disruptive platform—now arriving—is VR." Kevin Kelly, *The Inevitable: Understanding the 12 Technological Forces That Will Shape Our Future* (New York: Viking, 2016), 231.

to some policy concerns about the use, or potential *mis*use, of these new tools.[96] In November 2016, the US Senate Committee on Commerce, Science, and Transportation hosted the first congressional hearing on AR technology and the policy issues it might give rise to.[97]

This section provides a brief sketch of some of the likely concerns about immersive tech that could lead to calls for public policy interventions. Of course, many other theoretical harms could also be considered, including both abstract psychological harms and more concrete technical concerns. Here, the focus is on those theoretical harms that are most likely to lead to calls for regulatory intervention in the short term. Specifically, the focus is on privacy, safety, and intellectual property–based concerns.

After briefly outlining some of those potential concerns, the section discusses two possible visions for how public policy toward immersive tech might be crafted. The section concludes with a brief word about the importance of social acclimation and adaptation with regard to new technologies such as these.

Privacy and Security

The privacy and security of digital devices and networked platforms has become a major policy concern in recent years.[98] In terms of privacy issues, fears usually involve the collection and use of personal information by governments or corporations. In terms of security, hacking and data breaches have become an increasing concern. These tensions have been exacerbated by the

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[96] See Anne Hobson, "Reality Check: The Regulatory Landscape for Virtual and Augmented Reality" (Policy Study 69, R Street Institute, Washington, DC, September 2016).

[97] Exploring *Augmented Reality*: *Hearing Before the US Senate Committee on Commerce, Science, and Transportation*, 114th Cong. (November 16, 2016).

[98] Kacy Zurkus, "FTC Says Data and Privacy Are Top Security Concerns," *CSO*, September 14, 2015.

combination of massive increases in processing power, "always on" connectivity, growing storage capacity, and the ongoing miniaturization and digitization of products and services.[99]

These new technological realities have already prompted calls for regulation of data collection practices for big data[100] and the Internet of Things,[101] which depend on data-driven innovations to offer the public new and better services. In the process of creating those new services, many privacy and security vulnerabilities become possible, prompting calls for preemptive controls on new innovations.[102]

Similar privacy and security concerns could eventually become an issue for immersive technologies.[103] Already, AR technologies such as Google Glass[104] and other wearables like the (now defunct) Narrative clip-on camera[105] have raised privacy concerns. These and similar lifelogging technologies allow ongoing, real-time photographic or video collection of interactions and other experiences.[106]

Even though these products have not been widely adopted—in fact, Google Glass failed as a consumer-grade product and is now available only for industrial uses—the potential for products such as these to allow surreptitious recordings in private places or eavesdropping on confidential conversations has raised privacy and security flags.[107] Immersive technologies will

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[99] Adam Thierer, "The Pursuit of Privacy in a World Where Information Control Is Failing," *Harvard Journal of Law and Public Policy* 36, no. 2 (2013): 424–36.

[100] Edith Ramirez, "The Privacy Challenges of Big Data: A View from the Lifeguard's Chair" (presented at the Technology Policy Institute Aspen Forum, Aspen, CO, August 19, 2013).

[101] Scott R. Peppet, "Regulating the Internet of Things: First Steps toward Managing Discrimination, Privacy, Security, and Consent," *Texas Law Review* 93, no. 1 (2014): 85–176.

[102] Adam Thierer, "Privacy Law's Precautionary Principle Problem," *Maine Law Review* 66, no. 2 (2014): 473–79.

[103] "The introduction of always-on recording devices into public and private spaces may cause societal expectations to shift in ways that further diminish privacy recourse." Calo et al., "Augmented Reality," 3.

[104] Clive Thompson, "Googling Yourself Takes On a Whole New Meaning," *New York Times*, August 30, 2013.

[105] Benny Evangelista, "Narrative Wearable Camera: Valuable Tool or Little Brother?," *San Francisco Chronicle,* April 21, 2016.

[106] Kevin Sintumuang, "This Pocketable Camera Gear Will Change the Way You Take Travel Photos," *Wall Street Journal*, June 30, 2016.

[107] Rachel Metz, "Google Glass Is Dead; Long Live Smart Glasses," *MIT Technology Review*, November 26, 2014.

likely exacerbate those concerns as they gain more widespread use because they open the door to even more data collection about individuals and the people around them.[108]

This will be particularly true if immersive technologies include biometric capabilities, as they are likely to. Biometric technologies can help identify individuals by using unique personal attributes, such as facial recognition, voice patterns, eye movements, and fingerprints, the last of which are the oldest and most common biometric identifiers. Biometric technologies and capabilities have already raised privacy flags,[109] and some states, such as Illinois, have moved to limit the use of biometrics.[110] In an instance of market self-regulation, Google officially stated that it would not approve certain biometric applications, such as facial-recognition software, for use on Google Glass unless strong privacy protections were in place.[111]

Finally, following the launch of Pokémon GO, Sen. Al Franken (D-MN) voiced concerns about the company's data collection policies. He expressed those concerns in a letter to John Hanke, the CEO of Niantic, maker of the game.[112] The use of the Pokémon GO app by many teens and preteens also prompted questions about the applicability of the Children's Online Privacy Protection Act, which regulates data collection practices on online sites and services and requires parental consent for data collected from children under the age of 13.[113]

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[108] "As we build immersive media experiences—whether for business or entertainment—the need to secure them grows exponentially, for the very reason that they are so immersive and thus persuasive. Imagine a hacker or unfriendly nation-state gaining control of our in-goggle experiences." Tim Weber, "How Real Is Virtual Reality," *Techonomy*, December 19, 2016.

[109] Claire Gartland, "Biometrics Are a Grave Threat to Privacy," *New York Times*, July 5, 2016.

[110] Biometric Information Privacy Act, 740 Ill. Comp. Stat. 14 (2008).

[111] Charles Arthur, "Google 'Bans' Facial Recognition on Google Glass—But Developers Persist," *Guardian*, June 3, 2013; Jon Brodkin, "Google Forbids Facial Recognition Apps on Glass in the Name of Privacy," *Ars Technica*, June 3, 2013.

[112] Letter from Senator Al Franken to John Hanke, CEO of Niantic, July 12, 2016, https://www.franken.senate.gov /files/letter/160712_PokemonGO.pdf.

[113] Rachel Atkinson, "Lessons Learned in Data Privacy Compliance from Pokemon Go," *Driven*, September 27, 2016.

Safety (Distraction and Addiction)

Immersive technologies will also raise some safety-related concerns. These safety concerns can be classified as either physical or psychic in character.

A rather obvious physical concern associated with immersive tech involves the dangers posed (either to users or to those around them) by the use of AR or VR gear while operating machinery or perhaps even just moving about in public. By definition, immersive tech adds another layer of experience or information to a user's sensory input. If users are excessively distracted while using immersive tech, even walking on a sidewalk or down a crowded staircase could become somewhat riskier. Some recent news stories have already documented the dangers of texting on a smartphone while walking on sidewalks.[114] The global Pokémon GO craze prompted concerns about individuals or crowds creating dangers to themselves or others by playing the AR-based game in certain public spaces.[115] More obviously, operating machinery could be supplemented by certain types of immersive technology, but doing so could also become more dangerous in other ways if the added technology led to distraction.[116]

Addiction is a related safety concern. "Immersion comes at a cost," says Jeremy Bailenson, the director of Stanford's Virtual Human Interaction Lab. "It takes you out of your environment, it's perceptually taxing at times, and it's not something that we can use the way we use other media, for hours and hours and hours a day."[117] *New York Times* technology columnist Farhad Manjoo likens VR experiences to "a kind of prison." Immersive experiences may be too taxing for many people, he suggests, because "V.R. is a prison of fantastical sights and sounds

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[114] Geoffrey A. Fowler, "Texting while Walking Isn't Funny Anymore," *Wall Street Journal*, February 17, 2016.
[115] Lenore Skenazy, "Beware of Pokémon Go. Also, Rollerskates," *Wall Street Journal*, July 17, 2016.
[116] Calo et al., "Augmented Reality," 2.
[117] Quoted in Farhad Manjoo, "Tripping down a Virtual Reality Rabbit Hole," *New York Times*, June 22, 2016.

and one that is at moments irresistibly exciting, but it's a prison nevertheless. And before long, it will leave you yearning for escape."[118]

Of course, information overload has been a major concern for many years now, and in many other contexts.[119] As far back as 1971, the Nobel Prize–winning economist and psychologist Herbert A. Simon foresaw the paradoxical dilemma of a world of information abundance. "What information consumes is rather obvious: it consumes the attention of its recipients," he said. "Hence a wealth of information creates a poverty of attention, and a need to allocate that attention efficiently among the overabundance of information sources that might consume it."[120] However, an abundance of information and sensory inputs is probably preferable to a world of information scarcity. Balancing informational inputs nonetheless remains challenging.

Some might worry about immersive environments breeding isolation. But, as Kyle Russell (a partner with the venture capital firm Andreesen Horowitz, also called a16z) notes, it is possible that "virtual reality will be the most social computing platform yet."

The future of immersive virtual reality is often depicted as a dystopian view of millions of people spending hours alone each day, with huge gadgets stuck to their face, enraptured by fantastical worlds. But it's going to be millions of people spending time together—with friends, family, colleagues, and new acquaintances—experiencing moments together no matter the physical distance between them.[121]

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[118] Ibid.

[119] Information overload has been a concern since the earliest days of cyberspace. In a 1995 *New York Times* column, Russell Baker complained of cyberspace, "Day and night it is assaulted by a ceaseless flow of information. Often so much information arrives so swiftly that no one can digest it, make sense of it or judge whether it's information worth having." See Russell Baker, "Observer: A Little Cyber Grouch," *New York Times*, May 25, 1995.

[120] Herbert Simon, "Designing Organizations for an Information-Rich World," in *Computers, Communications and the Public Interest*, ed. Martin Greenberger, (Baltimore: Johns Hopkins Press, 1971), 40–41.

[121] Kyle Russell, "Why Virtual Reality Will Be the Most Social Computing Platform Yet," *Virtual and Augmented Reality*, Andreesen Horowitz, June 20, 2016.

Another safety concern, which is specific to children, relates to the nature of the content being viewed, such as pornographic or violent content.[122] The photorealism and simulated interactions of some hyperviolent games, such as the *Resident Evil* series (a series of zombie horror games), will likely raise concerns about heightened anxieties during game play.[123] And VR games involving guns, including sniper simulators,[124] will probably prompt worries about VR games becoming "murder simulators," a complaint also voiced about earlier, non-VR video games.[125]

More generally, the concern about children and immersive tech could be related to distraction or even addiction. It would not be surprising if safety concerns ended up driving some policy proposals as critics grow concerned about the psychological implications of people (especially children) spending more and more time in immersive virtual environments. In that circumstance, there might be a replay of the earlier debates over violent video games and video game addiction.

Finally, harassment or trolling could become a concern in certain interactive immersive environments, just as it already is for online sites[126] and interactive video games.[127] Trolling refers to a variety of activities that range from "clever pranks to harassment to violent threats."[128]

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[122] Jeff Grubb, "What Oculus Rift and Virtual Reality Mean for Sex, Death, Violence, and Identity," *VentureBeat*, February 2, 2016; Ben Kuchera, "How Should Parents Treat Violence in Virtual Reality?," *Polygon*, February 26, 2016; Stephen Balkam, "The New Realities: Virtual, Augmented and Mixed," *Huffington Post*, May 3, 2016; Darrell M. West, "The Ethical Dilemmas of Virtual Reality," *TechTank*, Brookings Institution, April 18, 2016.

[123] Dennis Scimeca, "Resident Evil 7 in Virtual Reality Is a Heart Attack Waiting to Happen," *Daily Dot*, June 24, 2016.

[124] Sam Machkovech, "Ars Tests *The Nest*, the HTC Vive's First VR Sniper Simulator," *Ars Technica*, June 2, 2016.

[125] Dave Grossman, "Videogames as 'Murder Simulators,'" *Variety*, 2013.

[126] Whitney Phillips, *This Is Why We Can't Have Nice Things: Mapping the Relationship between Online Trolling and Mainstream Culture* (Cambridge, MA: MIT Press, 2015).

[127] Scott Thacker and Mark D. Griffiths, "An Exploratory Study of Trolling in Online Video Gaming," *International Journal of Cyber Behavior, Psychology and Learning* 2, no. 4 (2012): 17–33.

[128] Joel Stein, "How Trolls Are Ruining the Internet," *Time*, August 18, 2016.

Some fear that the trolling problem "will be worse than ever [before]" because of the more

interactive and realistic nature of VR technology.[129]

Intellectual Property

Immersive technologies might also give rise to certain intellectual property concerns and lead to

corresponding calls for policy interventions.[130] If immersive technologies become more

widespread and these technologies are democratized to the same extent as other digital

technologies, the general public will be empowered to use VR and AR to self-generate new types

of information and entertainment in their surroundings.

This scenario raises the thorny legal issue: Who owns experiences? Or, more concretely,

who owns the recorded representations of certain experiences? As with traditional cameras,

citizens generally will be free to create and record their own unique immersive experiences. But

when those experiences are happening on others' private property or in "secure" areas, they

might prompt policy-related concerns.

Consider the 2013 horror movie *Escape from Tomorrow*, a recent example of guerilla

filmmaking. The entire movie was shot secretly by an independent film crew at the Walt

Disney World Resort in Orlando, Florida. The cast and production crew rehearsed scenes off-

site but filmed the movie on Disney property—without knowledge or permission from

Disney.[131] Discussion ensued about whether the filming somehow infringed Disney's

copyrights or trademarks, or whether it constituted an artistic fair use that could not be

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[129] Conor Cawley, "In Virtual Reality, Trolls Will Be Worse than Ever," Tech.co., February 8, 2017.
[130] Calo et al., "Augmented Reality," 3. ("The always-on recording of everyday life will inevitably capture work that is protected by copyright, trademark, or other intellectual property laws.")
[131] Matthew Carey, "Why Disney Might Want to 'Escape from Tomorrow,'" CNN, January 24, 2013.

prosecuted.[132] But although some lawyers initially predicted that the film was "never going to see the light of day,"[133] surprisingly, Disney—a company that usually vigorously defends its intellectual property rights—never even bothered responding to the film, and the controversy fizzled out quickly.

Regardless, as immersive technology becomes more widespread and democratized, it is likely that potential intellectual property–related problems like those discussed here will increase—just as they have as citizens have used smartphones and other devices to upload videos to YouTube and other video-hosting platforms. Some of those problems will cause copyright and fair use tensions, just as many YouTube videos already have.[134]

Trademark-related concerns might also arise. *World Trademark Review* recently noted that VR apps are already appearing that offer "VR experiences taken from popular entertainment titles such as Games of Thrones, Harry Potter, Minecraft, Super Mario, Legend of Zelda and Final Fantasy. However, these apps are available at no cost, which could prove to be a dilemma for mark owners."[135] Similarly, VR-oriented domain names have already been registered for many of these same brand names (for example, MinecraftVR.com and HarryPotterVR.com), even if most do not yet offer any commercial content. Such registration could complicate traditional trademark enforcement efforts, which usually hinge on commercial applications of protected brand names.

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[132] Cory Doctorow, "More on 'Escape from Tomorrow,' the Guerrilla Art-House Movie Shot at Walt Disney World and Disneyland," *Boing Boing*, January 21, 2013; Tim Wu, "It's a Mad, Mad, Mad, Mad Disney World," *New Yorker*, January 22, 2013.
[133] Jonathan Franklin, "'Escape from Tomorrow' a Disney's Lawyers Nightmares," *Law Offices of Jonathan Franklin Blog*, January 19, 2013.
[134] Steven Seidenberg, "Copyright in the Age of YouTube," *ABA Journal*, February 2, 2009.
[135] Tim Lince, "Virtual Reality Is Set to Emerge as a New Trademark Battleground, Brand Owners Are Warned," *World Trademark Review*, May 12, 2016.

Beyond commercial brands, the question of personality rights or infringement of likeness could become an issue with immersive tech in the future.[136] If, for example, amateur developers create VR experiences involving celebrity figures and then attempt to sell those experiences, they will likely become subject to lawsuits based on infringement of likeness. Such issues have already come up in the context of video games that used the likenesses of notable actors or athletes.[137] Finally, trade secrets could be compromised if immersive technologies are used in the workplace in inappropriate or even inadvertent ways.[138]

Alternative Governance Visions for Immersive Technology

It remains to be seen whether concerns such as these will animate public policy discussions about immersive technology and lead to calls for preemptive laws and regulations to address them. If they do, such legislation would be an example of what is known as *precautionary principle–based policymaking*.

This scenario represents one of two major visions that could govern the future of immersive technology.[139] *Precautionary principle reasoning* refers to the belief that new innovations should be curtailed or disallowed until their developers can demonstrate that the innovations will not cause any harm to individuals, groups, specific entities, cultural norms, or various existing laws or traditions.[140]

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[136] "Using the Name or Likeness of Another," Digital Media Law Project, last accessed December 19, 2016, http://www.dmlp.org/legal-guide/using-name-or-likeness-another.

[137] Stephen McArthur, "Right of Publicity in Video Games: How You Can Legally Include a Celebrity in Your Game," *Gamasutra*, November 17, 2014.

[138] Calo et al., "Augmented Reality," 7.

[139] Adam Thierer, *Permissionless Innovation: The Continuing Case for Comprehensive Technological Freedom,* 2nd ed. (Arlington, VA: Mercatus Center at George Mason University, 2016).

[140] Ibid.

The alternative vision of *permissionless innovation* refers to the idea that "experimentation with new technologies and business models should generally be permitted by default. Unless a compelling case can be made that a new invention will bring serious harm to society, innovation should be allowed to continue unabated and problems, if they develop at all, can be addressed later."[141]

The tension between those two dispositions dominates almost all modern technology policy debates. A recent book published by the Mercatus Center at George Mason University, *Permissionless Innovation: The Continuing Case for Comprehensive Technological Freedom* (now in its second edition), discusses the two policy paradigms in more detail.[142] The book also documents how the embrace of permissionless innovation by a nonpartisan coalition of US policymakers in the 1990s was a major driver of the rapid growth of the Internet and the Digital Revolution.[143] America's policy toward the Internet, online services, and digital technology helped propel the rapid growth of the information technology sectors in the United States.[144] By contrast, Europe handcuffed its information tech sector with far more precautionary regulatory policies, thereby limiting the potential for digital innovators to produce the range of goods and services seen in the United States.[145]

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[141] Ibid, vii.
[142] Ibid.
[143] Ibid., 51–56.
[144] Adam Thierer, "Embracing a Culture of Permissionless Innovation," *Cato Online Forum*, November 2014.
[145] Adam Thierer, "How Attitudes about Risk and Failure Affect Innovation on Either Side of the Atlantic," *Plain Text*, June 19, 2015. See also Stephen Ezell and Philipp Marxgut, "Comparing American and European Innovation Cultures," in *Shaping the Future: Economic, Social, and Political Dimensions of Innovation*, 157–99 (Austrian Council for Research and Technology Development, August 2015), 193. ("Cultural aspects have a significant impact on innovation and inform how entrepreneurial countries, organizations, and people can be. The United States maintains the world's most vibrant innovation culture, where risk and failure are broadly tolerated, inquiry and discussion are encouraged, and the government's role in business plays a less prominent role. . . . There are elements in the European innovation culture that need improvement: a simpler regulatory environment, a broader availability of risk capital, and more tolerance of risk and change being critically important.")

The Problem with the Precautionary Principle as the Default Position

It is unclear which policy default—permissionless innovation or the precautionary principle—will guide the future of immersive technology. Thus far, not much legislative or regulatory attention has been devoted to the issue. However, policymakers can help immersive technologies succeed by embracing the same sort of policy vision that powered the Digital Revolution.

In an interview with *Forbes* magazine, Adam Thierer describes the problem with making the precautionary principle the policy lodestar for new technologies like AR and VR:

> It poses a serious threat to technological progress, economic entrepreneurialism, social adaptation, and long-run prosperity. If public policy is guided at every turn by the precautionary principle, technological innovation is impossible because of fear of the unknown; hypothetical worst-case scenarios trump all other considerations. But we lose something important when we regulate against imaginary problems. Social learning and economic opportunities become far less likely, perhaps even impossible, under such a regime. In practical terms, the precautionary principle results in fewer services, lower-quality goods, higher prices, diminished economic growth, and a decline in the overall standard of living.[146]

In an article on the *Cato Institute Online Forum*, Thierer elaborates:

> Moreover, it is only through such ongoing experiments that people and institutions learn how to do things better—that is, more efficiently and more safely. Ongoing experimentation, risk-taking, and even a certain amount of failure must be tolerated, even if it disrupts certain business models or social norms because it is the key to social and economic progress and prosperity.[147]

Social Acclimation to New Technology

That last point—that ongoing experimentation must be tolerated—has important ramifications for disruptive new technologies such as AR and VR. It may take time for individuals and

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[146] Jared Meyer, "Entrepreneurs Should Be Innocent Until Proven Guilty," *Forbes*, May 19, 2016.
[147] Thierer, "Embracing a Culture of Permissionless Innovation." See also Adam Thierer, "Failing Better: What We Learn by Confronting Risk and Uncertainty," in *Nudge Theory in Action: Behavioral Design in Policy and Markets,* ed. Sherzod Abdukadirov (Basingstoke, UK: Palgrave Macmillan, 2016), 65–94.

institutions to adjust to new technologies, but usually social norms *do* adjust over time. As a

result, many of the concerns about the misuse of new technologies may not materialize because

attitudes change as new tools and services are adopted and assimilated into our lives.[148]

In this sense, social pressures and private norms of acceptable use and etiquette often act

as a regulator of the uses (and misuses) of new technologies because "norms dissuade many

practices that are feasible but undesirable."[149] This is particularly true for privacy-related

concerns, as history shows. In the late 1800s, for example, the emergence of the camera raised a

variety of privacy concerns. In a famous law review article on privacy and the camera, published

in 1890, Samuel Warren and Louis Brandeis stated,

> Instantaneous photographs and newspaper enterprise have invaded the sacred precincts of
> private and domestic life; and numerous mechanical devices threaten to make good the
> prediction that "what is whispered in the closet shall be proclaimed from the house-tops."[150]

The public's response to the camera turned out to be quite different. Many people

purchased their own cameras, which turned the device into the ubiquitous tool it has become

today. At the same time, however, social norms and etiquette evolved to discourage the most

privacy-intrusive uses of cameras in public spaces.[151]

That does not mean cameras did not give rise to some of the very problems that Warren

and Brandeis feared. Indeed, many people today continue to use cameras in inappropriate ways,

and sometimes laws—such as "Peeping Tom" statutes or antipaparazzi laws—have been needed

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[148] Adam Thierer, "Muddling Through: How We Learn to Cope with Technological Change," *Technology Liberation Front*, June 30, 2014.

[149] Daniel Castro and Alan McQuinn, "The Privacy Panic Cycle: A Guide to Public Fears about New Technologies," (report, Information Technology and Innovation Foundation, Washington, DC, September 10, 2015). Also see Cass Sunstein, "Social Norms and Social Roles," *Columbia Law Review* 96 (1996): 903–968; Cristina Bicchieri, *The Grammar of Society: The Nature and Dynamics of Social Norms* (Cambridge, UK: Cambridge University Press, 2006).

[150] Samuel D. Warren and Louis D. Brandeis, "The Right to Privacy," *Harvard Law Review* 4 (1890): 193–220, 195.

[151] Thierer, "Internet of Things and Wearable Technology."

to address egregious violations of privacy involving cameras.[152] Moreover, the common law

evolved in response to the concerns that Warren and Brandeis raised. Privacy-related torts,

including those pertaining to public disclosure of private facts and especially intrusion upon

seclusion, can be used to address inappropriate uses of photographic technology.[153]

The important lesson from the history of the camera and public photography is that laws

and norms were given time to address those problems *as they manifested themselves*. Prior

restraints were not imposed on cameras on the basis of hypothetical concerns about their

potential misuses. Instead, a "wait-and-see" approach became the policy default, allowing time

for legal responses to be formulated as needed. Importantly, however, those legal norms also

reflected the evolution of societal norms about the use of cameras in society.

Thus, as they have in the past, social norms associated with AR and MR capabilities

(included the use of facial recognition or other biometric identifying capabilities such as unique

voice patterns or eye movements) will likely adjust as people become more familiar with them

and new social norms of acceptable use develop.

If enough people feel differently, however, AR and VR may never catch on as

mainstream technologies. Some critics argued that Google Glass did not become popular because

the headset looked "dorky," and they maintained that HMD technology will need to become

more fashionable if it is to be widely adopted.[154] Privacy concerns might also have limited

consumers' acceptance of Google Glass. Even early adopters of Google Glass suggested that

wearable technologies became less useful to them over time because of the unease of others.

James Katz, the director of emerging media studies at Boston University's College of

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[152] Thierer, "The Pursuit of Privacy in a World Where Information Control Is Failing," 452.
[153] Ibid., 451.
[154] "It will take a while before their form factor is worked out and they look fashionable and feel comfortable."
Kelly, *The Inevitable*, 105.

Communication, remarked that "it tended to disturb people around me that I have this thing."[155]Snap appears to have heeded that lesson before launching its Spectacles video-recording sunglasses.[156] As Xavier Harding of *Vox* writes,

> [Google Glass] didn't catch on with consumers. A big reason was that owners garnered insults like "glasshole" from people who didn't like having a camera shoved in their faces all the time. But Spectacles have not garnered the same hostility, and a big reason is because they're simpler and more transparent. Spectacles are simply an extra set of eyes for your Snapchat account. You can tell if a pair of Spectacles is recording video by looking for the white spinning light in the top-left corner on the glasses' facade—if that light is off, you're not being filmed. The limited feature list and transparency of Spectacles could be a boon for social acceptance.[157]

By making Spectacles' recording action transparent to others, Snap may help overcome privacy concerns associated with wearable recording devices and, as Harding suggests, help facilitate social acceptance of such technologies.

Intellectual property norms will likely evolve as well. As noted, immersive technology will likely give rise to concerns about who owns certain types of experiences, such as a visit to a theme park or concert. But this is nothing new, really. Even before the rise of the Internet, digital recording technologies, and online sharing platforms, fans were using analog tape recorders to create "bootlegs" of live concert performances. The legality of such recordings was a heated matter for many years, but some bands turned a blind eye to the practice and a few even encouraged it. Today, however, sharing concert experiences is a widely accepted practice. Smartphones make it easy to record and instantly share live performances, and the prevalence of these devices would make it extremely challenging to police recording practices all the time. Moreover, social attitudes and norms about such activities have adjusted fairly rapidly; no one even refers to the recording of

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[155] Quoted in Metz, "Google Glass Is Dead."

[156] Seth Stevenson, "Snapchat Releases First Hardware Product, Spectacles," *WSJ Magazine*, September 24, 2016.

[157] Xavier Harding, "The Snapchat Spectacles Craze, Explained," *Vox*, December 14, 2016.

performances as "bootlegging" anymore. Similarly, immersive experiences captured by the general public will likely become widely available to others in the future.

But as with cameras and public photography, social norms for immersive technology will likely be supplemented by the common law and perhaps even by targeted statutes dealing with truly thorny problems that persist. By giving norms and other solutions time to evolve and address concerns, policymakers will be better able to identify what constitutes those persistent and hard problems while also allowing continued innovation and experimentation with immersive technologies.

A Permissionless Innovation Policy Blueprint for Immersive Tech

The permissionless innovation policy disposition described earlier can be applied more broadly beyond the Internet,[158] and other essays have already outlined how this vision can help guide the development of policy paradigms for the Internet of Things,[159] wearable devices, smart cars,[160] commercial drones,[161] Bitcoin,[162] 3-D printing,[163] robotics,[164] advanced medical devices and applications,[165] and the many other new technologies that are just now beginning to emerge. To

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[158] Eli Dourado, "'Permissionless Innovation' Offline as Well as On," *Ümlaut*, February 6, 2013.

[159] Thierer, "Internet of Things and Wearable Technology."

[160] Adam Thierer and Ryan Hagemann, "Removing Roadblocks to Intelligent Vehicles and Driverless Cars" (Mercatus Working Paper, Mercatus Center at George Mason University, Arlington, VA, September 17, 2014).

[161] Jerry Brito, Eli Dourado, and Adam Thierer, "Federal Aviation Administration: Unmanned Aircraft System Test Site Program Docket No: FAA-2013-0061" (Public Interest Comment, Mercatus Center at George Mason University, Arlington, VA, April 23, 2013); Eli Dourado, "The Next Internet-Like Platform for Innovation? Airspace. (Think Drones)," *Wired*, April 23, 2013; Adam Thierer, "Filing to FAA on Drones and 'Model Aircraft,'" *Technology Liberation Front*, September 23, 2014.

[162] Jerry Brito and Andrea O'Sullivan, *Bitcoin: A Primer for Policymakers* (Arlington, VA: Mercatus Center at George Mason University, May 3, 2016).

[163] Adam Thierer, "The Right to Try, 3D Printing, the Costs of Technological Control and the Future of the FDA," *Technology Liberation Front*, August 10, 2015.

[164] Adam Thierer, "Problems with Precautionary Principle-Minded Tech Regulation and a Federal Robotics Commission," *Technology Liberation Front*, September 22, 2014.

[165] Richard Williams, Robert Graboyes, and Adam Thierer, "US Medical Devices: Choices and Consequences" (Mercatus Working Paper, Mercatus Center at George Mason University, Arlington, VA, October 21, 2015).

make permissionless innovation the basis of public policy toward immersive technology, policymakers should adopt the following 10-part blueprint:[166]

1) Articulate and defend permissionless innovation as the general policy default.

2) Identify and remove barriers to entry and innovation.

3) Protect freedom of speech and expression.

4) Retain and expand immunities for intermediaries from liability associated with third-party uses.

5) Promote education and empowerment solutions, and be patient as social norms evolve to solve challenges.

6) Rely on existing legal solutions and the common law to solve problems.

7) Wait for insurance markets and competitive responses to develop.

8) Push for industry self-regulation and best practices.

9) Adopt targeted, limited legal measures for truly hard problems.

10) Evaluate and reevaluate policy decisions to ensure they pass a strict benefit-cost analysis.

Each recommendation will be discussed in more detail and applied to immersive technology.

Articulate and Defend Permissionless Innovation as the General Policy Default

The first and most obvious step that policymakers should take to encourage the rapid development and diffusion of immersive technology tools and apps is to assure entrepreneurs that they can innovate without prior restraint. Policymakers can accomplish this goal by announcing a policy framework for immersive technology that makes it clear that innovators in this space will be given wide leeway to develop and deploy AR and VR technologies.

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[166] Adam Thierer, *Permissionless Innovation and Public Policy: A 10-Point Blueprint* (Arlington, VA: Mercatus Center at George Mason University, 2016).

The key to this framework is that policy for immersive technologies not be shaped by hypothetical worst-case scenarios and preemptive regulatory planning. Rather, innovators and average citizens alike generally should be left at liberty to experiment with immersive technologies, and any problems that develop should be addressed in an ex post fashion.[167] To accomplish this formally, policymakers should build on the Clinton administration's 1997 *Framework for Global Electronic Commerce*, which became America's policy vision statement for the Internet and digital commerce.[168] The *Framework* was a succinct, market-oriented vision for cyberspace governance that recommended reliance on civil society, contractual negotiations, voluntary agreements, and ongoing marketplace experiments to solve information-age problems.[169] The *Framework* included the following principles:

- The private sector should lead, and the Internet should develop as a market driven arena, not a regulated industry.[170]

- Governments should avoid undue restrictions on electronic commerce.[171]

- Parties should be able to enter into legitimate agreements to buy and sell products and services across the Internet with minimal government involvement or intervention.[172]

- Where government involvement is needed, its aim should be to support and enforce a predictable, minimalist, consistent, and simple legal environment for commerce.[173]

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[167] Ithiel de Sola Pool, *Technologies of Freedom: On Free Speech in an Electronic Age* (Cambridge, MA: Harvard University Press, 1983), 231. Regarding regulation of information markets, Pool stressed that "enforcement must be after the fact, not by prior restraint" and that "regulation is a last recourse. In a free society, the burden of proof is for the least possible regulation of communication."
[168] White House, *The Framework for Global Electronic Commerce*, July 1997, http://clinton4.nara.gov/WH/New /Commerce.
[169] Adam Thierer, "15 Years On, President Clinton's 5 Principles for Internet Policy Remain the Perfect Paradigm," *Forbes*, February 12, 2012.
[170] White House, *Framework for Global Electronic Commerce*.
[171] Ibid.
[172] Ibid.
[173] Ibid.

The Clinton administration's embrace of permissionless innovation for the Internet and e-commerce helped power the digital revolution.[174]

More recently, policymakers have suggested a similar sort of vision for the Internet of Things.[175] In March 2015, the US Senate passed Senate Resolution 110, which stated in part that the United States should [1] develop a strategy to incentivize the development of the Internet of Things in a way that maximizes the promise connected technologies hold to empower consumers, foster future economic growth, and improve our collective social well-being; . . . [2] recognize the importance of consensus-based best practices and communication among stakeholders; [and] . . . [3] commit itself to using the Internet of Things to improve its efficiency and effectiveness and cut waste, fraud, and abuse.[176] The resolution also "calls on U.S. innovators to commit to improving the quality of life for future generations by developing safe, new technologies aimed at tackling the most challenging societal issues facing the world."[177]

A similar framework for immersive technologies would make it clear that it is the policy of the United States that AR and VR technologies be governed by the same flexible, market-oriented framework that helped fuel the Digital Revolution. In other words, "innovation allowed" should be the default policy position for immersive tech.

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[174] Thierer, *Permissionless Innovation*, 12–16.

[175] Good examples of how legislators can promote permissionless innovation in their policy pronouncements can be found in some of the speeches of Senators Cory Booker (D-NJ), Deb Fischer (R-NE), and Kelly Ayotte (R-NH). See Adam Thierer, "A Nonpartisan Policy Vision for the Internet of Things," *Technology Liberation Front*, December 11, 2014; Adam Thierer, "What Cory Booker Gets about Innovation Policy," *Technology Liberation Front*, February 16, 2015. Similarly, no regulator in recent memory has done more to promote permissionless innovation as a policy guidepost than Maureen K. Ohlhausen, a commissioner with the Federal Trade Commission. See Adam Thierer, "FTC's Ohlhausen on Innovation, Prosperity, 'Rational Optimism' and Wise Tech Policy," *Technology Liberation Front*, September 25, 2015.

[176] "A resolution expressing the sense of the Senate about a strategy for the Internet of Things to promote economic growth and consumer empowerment," S. Res. 110, 114th Cong. (2015).

[177] Ibid.

Identify and Remove Barriers to Entry and Innovation

Once policymakers have established a clear policy vision for immersive technology, they should identify any preexisting barriers to greater innovation in this arena. Often, the most serious barriers to permissionless innovation are the well-intentioned but counterproductive laws and regulations of the past.

Occupational licensing laws and regulations are a prime example. Many state and local governments have established licensing regimes for various professions and technologies in the name of protecting consumers from a variety of supposed dangers. Unfortunately, although they are obviously enacted with the best of intentions, those licensing regimes often end up creating perverse incentives and unintended consequences. Specifically, economists and political scientists have documented that licensing regimes often raise prices, limit competition, and undermine new forms of life-enriching innovation that could better serve the public.[178] Thus, even if those regulations could once be justified on consumer protection grounds, that does not mean that the regulations actually accomplished those goals or that they are still needed today.[179]

Even more problematic is the tendency for licensing regimes to be "captured" by incumbent operators who oppose increased competition and seek to use old rules (especially licensing laws[180]) to limit new entrants in the name of fairness.[181] Making sure all rivals compete

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[178] Steve Horowitz, "Breaking Down the Barriers: Three Ways State and Local Governments Can Get Out of the Way and Improve the Lives of the Poor" (Mercatus Research, Mercatus Center at George Mason University, Arlington, VA, July 21 2015). See also Brief for Antitrust Scholars as Amici Curiae Supporting Respondent, NC State Bd. of Dental Exam'rs v. FTC, 574 U.S. ___ (2015) (No. 13-534), 2. ("Occupational licensing has been abused by incumbent market participants to exclude rivals, often in unreasonable ways, and to raise prices. This disturbing trend already costs consumers billions of dollars every year and impedes job growth.")

[179] Veronique de Rugy, "Occupational Licensing: Bad for Competition, Bad for Low-Income Workers," (Mercatus Working Paper, Mercatus Center at George Mason University, Arlington, VA, March 25, 2014), 1. ("Licensing can become a powerful tool to limit innovation and competition and act to limit upward mobility.")

[180] Maureen K. Ohlhausen and Gregory P. Luib, "Brother, May I?: The Challenge of Competitor Control over Market Entry," *Journal of Antitrust Enforcement* 4, no. 1 (2015): 1–23.

[181] George J. Stigler, "The Theory of Economic Regulation," *Bell Journal of Economics and Management Science* 2, no. 1 (1971): 3–21; Sam Peltzman, "Toward a More General Theory of Regulation," *Journal of Law and Economics*

under a common set of rules is usually a worthy policy objective, but it is unwise to achieve such parity by simply rolling old regulatory regimes onto new competitors. Such practice discourages new entrants, raises prices, and denies consumers choices.

This is precisely the problem experienced today by "sharing economy" companies (i.e., "any marketplace that brings together distributed networks of individuals to share or exchange otherwise underutilized assets"[182]). Such companies face volumes of old licensing rules and other regulations from a different era.[183] Fortunately, liberalization is gradually occurring throughout the United States as localities essentially level the playing field by "deregulating down" to put everyone on equal footing instead of "regulating up" to achieve parity.[184]

Deregulating down is the wise approach, and it can serve as a model for immersive technologies as well. For example, licensing restrictions represent a barrier to telemedicine or "virtual medicine" efforts. Patients seeking access to care remotely can take advantage of virtual health firms (for example, Doctor on Demand, RetraceHealth, MedZed, MDLIVE, American Well, and First Opinion) in some states.[185] But licensing restrictions could limit the ability of such services to reach their fullest potential. Meanwhile, at the federal level, overly precautionary Food and Drug Administration regulations could also hold back many new advanced medical technologies.[186] Although some precautionary licensing restrictions will undoubtedly remain in

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19, no. 2 (1976): 211–40; Ernesto Dal Bó, "Regulatory Capture: A Review," *Oxford Review of Economic Policy* 22, no. 2 (2006): 203–25.

[182] Christopher Koopman, Matthew Mitchell, and Adam Thierer, "The Sharing Economy and Consumer Protection Regulation: The Case for Policy Change" (Mercatus Working Paper, Mercatus Center at George Mason University, Arlington, VA, December 8, 2014), 4.

[183] Koopman, Mitchell, and Thierer, "The Sharing Economy and Consumer Protection Regulation"; Michael Farren, "Taxis and TNCs: How Platform Firms Self-Regulate Better than Bureaucrats," *Concentrated Benefits*, January 12, 2016.

[184] Christopher Koopman, Matthew Mitchell, and Adam Thierer, "The 'Sharing' Economy: Issues Facing Platforms, Participants, and Regulators" (Public Interest Comment, Mercatus Center at George Mason University, Arlington, VA, May 26, 2015).

[185] Melinda Beck, "Startups Vie to Build an Uber for Health Care," *Wall Street Journal*, August 11, 2015.

[186] Williams, Graboyes, and Thierer, "US Medical Devices."

place to protect against potentially seriously harms to health, it is important to revisit such policies periodically to ensure that they are not deterring life-enriching innovation.

Protect Freedom of Speech and Expression

For immersive technologies to reach their full potential, developers and users of AR and VR tech must have wide leeway to express themselves and enjoy those technologies as they wish. As is the case with almost all modern networked technologies, immersive technologies are what the late political scientist Ithiel de Sola Pool called "technologies of freedom," in that they enhance speech or expression in some fashion. In his 1983 book, *Technologies of Freedom: On Free Speech in an Electronic Age*, Pool set forth several "Guidelines for Freedom" to ensure that new information technologies could realize their full potential. He asserted that "regulation is a last recourse. In a free society, the burden of proof is for the least possible regulation of communication."[187]

That same principle can and should be applied to immersive technologies, which also enhance human communication and creativity. Policymakers should do so by making it clear that speech and expression facilitated by VR and AR technologies are fully protected by the First Amendment.[188]

This guideline could become pertinent should legislatures seek to enact content-based restrictions on VR technologies, especially as more "adult" content becomes available for VR devices. As noted, policymakers might become concerned about underage access to "virtual

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[187] Pool, *Technologies of Freedom*, 246.
[188] Jonathan W. Emord, *Freedom, Technology, and the First Amendment* (San Francisco: Pacific Research Institute, 1991).

porn," for example.[189] Violently themed VR experiences might also raise concerns and lead to calls for regulation. These concerns are not new; the same worries drove legislative enhancements in the 1990–2010 period for the Internet, and for video games before that.[190] If policymakers seek to impose content-based restrictions on an immersive technology, such enactments would likely be challenged in court and overturned. That action would be a logical extension of modern free speech jurisprudence for the Internet[191] and video games,[192] both of which now enjoy robust First Amendment protections thanks to a series of major court decisions over the past two decades.

Moreover, even privacy-related restrictions on VR and AR technology might raise First Amendment scrutiny. Eugene Volokh, a law professor at the University of California, Los Angeles, has noted that "my right to control your communication of personally identifiable information about me . . . is a right to have the government stop you from speaking about me."[193] Thus, an effort to regulate information gathering facilitated by immersive tech could violate the First Amendment, "which generally bars the government from controlling the communication of information (either by direct regulation or through the authorization of private lawsuits), whether the communication is 'fair' or not."[194]

Similarly, in a recent analysis of mobile streaming video technologies (MSVTs), two communications scholars found that

> the advance of First Amendment–based protection for photography and video recording
> in [recent court cases] makes any new regulation likely to face legitimate challenges in

[189] Raymond Wong, "VR Porn Is Here and It's Scary How Realistic It Is," *Mashable*, January 8, 2016.
[190] Hobson, "Reality Check," 2. ("These fears in many cases parallel those that have been voiced since the earliest video games in the 1970s; most do not appear to justify either new laws or new regulations.")
[191] Reno v. ACLU, 521 U.S. 844 (1997).
[192] Brown v. Entertainment Merchants Association, 564 U.S. 08–1448 (2011).
[193] Eugene Volokh, "Freedom of Speech and Information Privacy: The Troubling Implications of a Right to Stop People from Speaking about You," *Stanford Law Review* 52, no. 5 (2000): 1051.
[194] Ibid.

court when the regulation is aimed at anything occurring in public places. Furthermore, such restrictions would conflict with the newsgathering and public information benefits of MSVTs, which enrich citizens in a democracy and provide a valuable check on state power as journalism becomes more a product of its citizens than of institutional and corporate sources.[195]

By extension, it is equally likely that courts would overturn restrictions on information gathering facilitated by immersive technology headsets and devices, although such a decision might depend on the nature of privacy violation that the law seeks to address.

Retain and Expand Immunities for Intermediaries from Liability Associated with Third-Party Uses

As noted earlier, US policymakers embraced permissionless innovation as the foundation of digital policy in the mid-1990s. Perhaps the most important decision lawmakers made at the time was to shield online intermediaries from onerous liability for the content and communications that traveled over their electronic networks.

That legal immunity was created through section 230 of the Telecommunications Act of 1996,[196] which let online speech and commerce flow freely over digital platforms and online sites.[197] Many of today's most popular online sites and services likely would not exist without section 230 because they might have been hit with huge lawsuits for the content and commerce that some critics (especially companies) did not approve of on those platforms.[198] For example,

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[195] Daxton R. "Chip" Stewart and Jeremy Littau, "Up, Periscope: Mobile Streaming Video Technologies, Privacy in Public, and the Right to Record," *Journalism and Mass Communication Quarterly* 93, no. 2 (2016): 11–12.

[196] 47 U.S.C. § 230 (1996).

[197] Adam Thierer, "The Greatest of All Internet Laws Turns 15," *Forbes*, May 8, 2011.

[198] David Post, "A Bit of Internet History, or How Two Members of Congress Helped Create a Trillion or So Dollars of Value," Volokh Conspiracy, *Washington Post*, August 27, 2015. ("It is impossible to imagine what the Internet ecosystem would look like today without [section 230]. Virtually every successful online venture that emerged after 1996—including all the usual suspects, viz. Google, Facebook, Tumblr, Twitter, Reddit, Craigslist, YouTube, Instagram, eBay, Amazon—relies in large part (or entirely) on content provided by their users, who number in the hundreds of millions, or billions.")

sites such as eBay, Facebook, Wikipedia, Angie's List, Yelp, and YouTube all depend on section

230's protections to shield them from potentially punishing liability for the content that average

Americans post to those sites. But section 230 protects countless small sites and services just as

much as those larger platforms.[199]

Relatedly, online intermediaries are also immunized from copyright infringement

liability, provided that they follow certain rules established under section 512 of the Digital

Millennium Copyright Act (DMCA) of 1998. Intermediaries must promptly block access to

alleged infringing material (or remove such material from their systems) when they receive

notification of an infringement claim from a copyright holder or the copyright holder's agent.[200]

As long as online intermediaries abide by these DMCA takedown notices, they generally will be

granted what is known as a *safe harbor exemption* from copyright liability.[201]

These two immunization regimes could have relevance for the legal treatment of

immersive technology. AR and VR hardware makers could use section 230's legal protections to

shield themselves from lawsuits alleging privacy violations or other infractions caused by the

actions of third-party users. Similarly, DMCA's safe harbor provisions could be tapped by AR

and VR intermediaries (such as app store providers) that might offer platforms for users to

upload immersive content that certain copyright holders deemed infringing.

Immunizing intermediaries in this fashion is important if policymakers hope to avoid the

chilling effect that excessive litigation can have on life-enriching innovation.[202] Advocates of

regulation often seek to "deputize the middleman" and force intermediaries to police their

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[199] Ibid.
[200] 17 U.S.C. § 512.
[201] Electronic Frontier Foundation, "DMCA," last accessed February 29, 2016.
[202] Adam Thierer, "When the Trial Lawyers Come for the Robot Cars," *Slate*, June 10, 2016.

networks, systems, or devices for any number of things that those regulatory advocates do not like.[203] But such counterproductive proposals should be extremely limited because they can significantly hinder both speech and commerce. It is usually more sensible to address those problematic users directly and hold them accountable for their actions instead of punishing intermediaries for the alleged misdeeds of third parties.[204]

Promote Education and Empowerment Solutions and Be Patient as Social Norms Evolve to Solve Challenges

Although immersive technologies are likely to offer the public many benefits, they will also create new social challenges—especially privacy and safety concerns. Use of AR or VR headsets in some environments could raise anxieties or even dangers. For example, concerns have already been raised about how AR technologies and other wearables might be used in bathrooms,[205] classrooms,[206] and boardrooms.[207]

Targeted legal solutions may be needed to address the most problematic uses of immersive tech devices—for example, potential penalties for wearing HMDs while operating vehicles.[208] It is not possible, however, to predict every potential negative use of a new technology, and that includes immersive technologies.

Consider the benefits of first using "educate and empower" approaches, rather than "legislate and regulate" responses, to deal with the risk associated with new technologies.

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[203] Adam Thierer and Berin Szoka, "Eric Goldman on New Threats to Sec. 230," *Technology Liberation Front*, March 27, 2010.

[204] Adam Thierer, "A Section 230 for the 'Makers' Movement," *Technology Liberation Front*, March 1, 2016.

[205] Danny Sullivan, "Google Glass and the Men's Room Urinals," *CNET*, May 18, 2013.

[206] Rosemary Counter, "New Frontiers in High-Tech Cheating," *Maclean's News*, October 19, 2014.

[207] Lin Grensing-Pophal, "Banning Wearable Tech at Work?," *Human Resource Executive Online*, August 26, 2014.

[208] Freeman Klopott and William Selway, "Google Glass Faces Bans as States Move to Bar Use," *Bloomberg*, February 25, 2014.

"Legislate and regulate" strategies can be costly, complicated, and overly constraining.[209] Moreover, such preemptive approaches to concerns about safety, security, or privacy are increasingly challenged by the sheer pace of technological change.[210] By contrast, "educate and empower" approaches can address concerns about emerging technologies in an evolutionary fashion and offer the public useful strategies that can "help build individual resilience and ensure proper assimilation of new technologies into society."[211]

For that reason, education, technology literacy, and "digital citizenship" efforts represent excellent strategies for addressing concerns about the misuse of immersive technologies. Such educational approaches are focused on encouraging better social norms, proper use guidelines, and coping strategies.[212] Educational efforts are already under way to address concerns about privacy and security in related areas. In 2014, the Obama administration issued a report on the benefits and concerns surrounding big data.[213] The report included a short section on the need to "recognize digital literacy as an important 21st century skill" and defined it as "understanding how personal data is collected, shared, and used."[214] The report stated,

> In order to ensure students, citizens, and consumers of all ages have the ability to adequately protect themselves from data use and abuse, it is important that they develop fluency in understanding the ways in which data can be collected and shared, how algorithms are employed and for what purposes, and what tools and techniques they can use to protect themselves.[215]

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[209] Thierer, *Permissionless Innovation*, 120.
[210] Ibid., 110. See also Adam Thierer, "Wendell Wallach on the Challenge of Engineering Better Technology Ethics," *Technology Liberation Front*, April 20, 2016.
[211] Thierer, *Permissionless Innovation*, 112.
[212] Marsali Hancock, Rebecca Randall, and Alan Simpson, "From Safety to Literacy: Digital Citizenship in the 21st Century," *Threshold Magazine*, Summer 2009.
[213] Executive Office of the President, *Big Data: Seizing Opportunities, Preserving Values* (Washington, DC: White House, May 2014).
[214] Ibid., 64.
[215] Ibid.

For those reasons, the administration concluded, digital literacy "should be recognized as an essential skill in K–12 education and be integrated into the standard curriculum."[216]

The educational approach that the administration recommended for big data is relevant to immersive technology, too, especially because some of these technologies will be gathering a great deal of information about users and others around them. And it is not just governments that should be engaging in such educational efforts. In addition, as noted in the section of this paper on industry self-regulation, private companies, trade associations, and nonprofit institutions all can help educate both the public and the producers of immersive technology about its proper and improper uses. It is hoped that these educational efforts and solutions will also assist parents who are seeking to craft more sensible ground rules for their children's use of immersive technologies in their homes.[217]

Education may also be needed to address concerns about distraction or addiction. Or, if the problem is more serious, counseling or behavioral therapy efforts may be needed. South Korea, where 80 percent of teens own a smartphone[218] and 14 percent of teens are addicted to said devices or the Internet,[219] is one nation that has tackled electronic addiction with therapy. Dr. Lee Tae Kyung, an addiction specialist, has developed a clinic specifically for those addicted to video games, smartphones, or other digital media. His rehabilitation program, Happy Off to Recovery Autonomy (HORA), uses *Momo,* a 1970s fantasy novel by German author Michael

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[216] Ibid.

[217] Kuchera, "How Should Parents Treat Violence in Virtual Reality?" See also Balkam, "The New Realities." ("But just like pinball, rock n' roll and video games . . . there will likely be a lot of handwringing and worry that peters out to nothing. The real threats to our children almost never come from their entertainment. . . . The best practices I've found with video games and movies work just as well with VR devices.")

[218] "Four out of Five Teens Own Smartphones," Korea Bizwire, March 5, 2014.

[219] Kim Se-jeong, "14 out of 100 S. Korean Teens Addicted to Internet or Smartphones," *Korea Times,* May 28, 2015.

Ende, in tandem with set daily schedules and mental stimulation via music to break the cycle of dependency that addicts face.[220]

Finally, it is important to recall the power of social norms as a regulating force for new technologies. Kevin Kelly has argued that for many immersive technologies, "We'll quickly invent social norms and technological innovations to navigate the times when lifelogging is appropriate or not."[221] When combined with educational efforts, social norms can help develop powerful forms of etiquette for the appropriate use of new tech. For example, Kelly reminds us that when cell phones became widely available in the 1990s, "there was a terrible cacophony of ringers" that were always loudly going off "on trains, in bathrooms, in movie theaters," and elsewhere. Although such interruptions have not disappeared entirely, undesirable ringing is less likely today thanks in part to social norms and etiquette that discourage it, but also in part because of the rise of near-silent vibrators, which let phones "ring" without making much noise.[222] Such "social conventions and technical fixes" will evolve to cover newer technologies such as AR and VR gear, Kelly believes.[223]

After reviewing Snap's new Spectacles—which are similar to Google Glass—*Wall Street Journal* technology columnist Joanna Stern proposed a "Camera Wearer's Code," a set of rules for how to use AR technologies appropriately in both public and private spaces.[224] These rules include admonitions against sharing footage of people who do not want it to be shared, recording in private spaces, and just recording excessively.

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[220] John Power, "Inside the South Korean Rehab Clinic That Treats Gaming Addicts with a German Sci-fi Novel," *Vice,* September 22, 2015.
[221] Kelly, *The Inevitable*, 250.
[222] Ibid.
[223] Ibid.
[224] Joanna Stern, "Snapchat Spectacles Review: Wearing a Camera Is Cool . . . and Creepy," *Wall Street Journal*, November 29, 2016.

Similarly, following the release of Pokémon GO and the intense craze that followed, some concerns were raised about users playing the game at sensitive sites such as the Auschwitz-Birkenau Memorial and Museum or the Holocaust Memorial Museum in Washington, DC.[225] This problem may be best addressed through a combination of (1) educating users about when it is inappropriate to use immersive technology and (2) providing voluntary private guidelines or restrictions about where and when to do so. Alternatively, museums might use immersive tech to build greater empathy and understanding of historical tragedies. For example, in December 2016, the Newseum, a museum in Washington, DC, dedicated to celebrating free expression and the First Amendment, held a VR exhibit that let users experience what it felt like to be present at Pearl Harbor when the naval base came under attack in 1941.[226]

Rely on Existing Legal Solutions and the Common Law to Solve Problems

Educational efforts may not be enough, however. If immersive technologies give rise to more serious problems, legal remedies may be necessary. That does not mean, however, that those remedies must be preemptive and precautionary in character. Existing laws and legal remedies might already exist that could address concerns after the fact.[227]

For example, as noted, some of the privacy concerns raised about AR technologies might go away over time or be addressed through social norms or informal rules.[228] But more serious

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[225] Aviva Rutkin, "Pokémon Go Away: Who Owns the Augmented Reality We Play In?," *New Scientist*, July 14, 2016.

[226] Brian Fung, "How Virtual Reality Is about to Take You to Pearl Harbor and the Berlin Wall," *Washington Post*, December 1, 2016.

[227] "To ensure a balanced approach when contemplating new policy solutions addressing these technologies, I think it is important to take a full accounting of existing frameworks, some of which can be more applicable than might initially be apparent." *Hearing on "The Disrupter Series: The Fast-Evolving Uses and Economic Impacts of Drones," before the House Subcommittee on Commerce, Manufacturing, and Trade*, 114th Cong. (November 19, 2015) (testimony of John Villasenor), 8.

[228] "Health and safety concerns that do arise from AR and VR likely would best be governed within the existing framework of tort law, product-liability law and product-safety standards." Hobson, "Reality Check," 2.

invasions of privacy might be legally actionable under existing privacy torts. In the American

common law system, the four privacy torts are (1) public disclosure of private facts, (2) intrusion

upon seclusion, (3) false light, and (4) appropriation of name or likeness. Although they evolved

fairly recently compared with other common law torts, privacy torts might continue to evolve in

response to technological change in ways that would provide more avenues of recourse to

plaintiffs seeking to protect their privacy rights.[229]

The most important thing about the privacy-related torts is that they are constantly

evolving to address new circumstances and cultural norms. As AR technologies become more

widespread and give rise to novel controversies, it is likely that privacy-related claims by

aggrieved parities will lead to new privacy tort standards. There also exist targeted laws, such as

"Peeping Tom" laws, that address specific types of surreptitious surveillance. They, too, will

likely cover "snooping" violations when AR technologies are involved.

Property and contract law can help resolve many controversies that arise from new

technologies, including AR and VR. If individuals are using immersive technologies in certain

private environments—including workplaces—in violation of stated conditions of visitation or

employment, then property rights and contractual obligations may be implicated and may

become legally actionable.

Finally, do not forget that federal and state agencies already exist that have general

regulatory powers over immersive technologies and other technologies. "The Consumer Product

Safety Commission (CPSC) would be the entity empowered to enforce federal product safety

standards applicable to VR and AR devices," notes Anne Hobson, a technology policy fellow at

the R Street Institute.[230] For example, the CPSC has broad authority to recall defective and

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[229] Thierer, "Pursuit of Privacy," 451–52.
[230] Hobson, "Reality Check," 2.

potentially dangerous products, as it did in September 2016 with Samsung Galaxy Note7

smartphones (some of whose batteries caught fire because they overheated).[231]

Also, the Federal Trade Commission possesses broad consumer protection powers under

section 5 of the Federal Trade Commission Act,[232] which prohibits "unfair or deceptive acts or

practices in or affecting commerce."[233] And state attorneys general also play a similar role in

enforcing consumer protection statutes. Thus, if creators of immersive technology devices and

apps are somehow betraying the trust of their consumers, plenty of legal remedies already exist

to address those problems through consumer protection statutes and standards.

Wait for Insurance Markets and Competitive Responses to Develop

Every emerging technology creates new risks. As noted, common law remedies or other

solutions typically emerge to address those risks. Insurance markets also evolve in response to

new technology. Insurance contracts are developing to cover risks associated with other

emerging technologies such as driverless cars,[234] drones,[235] and 3-D printers.[236] For immersive

technologies, insurance products will likely be crafted to help guard against intellectual

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[231] Consumer Product Safety Commission, "Samsung Recalls Galaxy Note7 Smartphones Due to Serious Fire and Burn Hazards," Recall 16-266, September 15, 2016.

[232] See J. Howard Beales III, "The FTC's Use of Unfairness Authority: Its Rise, Fall, and Resurrection," Federal Trade Commission, June 2003; J. Thomas Rosch, "Deceptive and Unfair Acts and Practices Principles: Evolution and Convergence," speech at the California State Bar, Los Angeles, May 18, 2007; Andrew Serwin, "The Federal Trade Commission and Privacy: Defining Enforcement and Encouraging the Adoption of Best Practices," *San Diego Law Review* 48 (2011).

[233] 15 U.S.C. § 45(a).

[234] "One opportunity for the industry could be selling more coverage to carmakers and other companies developing the automated features for cars. While the new systems could reduce accidents significantly, they won't be perfect." Noah Buhayar and Peter Robison, "Can the Insurance Industry Survive Driverless Cars?," *Bloomberg Businessweek*, July 30, 2015.

[235] Vikki Stone, "Rise of the Drones," *Risk and Insurance*, March 3, 2014. See also "Market for Drone Insurance Expected to Take Off in Next 5 Years," *Insurance Journal*, May 15, 2015.

[236] Hannah Rose Mendoza, "Insuring 3D Printing, an Industry about to Expand?," 3DPrint.com, September 23, 2014; Graeme Newman, "The New Age of Technology: 3D Printing," *Insurance Journal*, May 6, 2013.

property–related claims for products or experiences that are alleged to violate existing copyrights, patents, or trademarks.

It is likely that these insurance policies will be quite varied, depending on the nature of the risk associated with each immersive technology application. It is important that policymakers exercise patience and caution as these insurance instruments gradually adjust to accommodate various risks, many of which will be difficult to envision preemptively.

While these new insurance products are developing, it is equally likely that new firms will be emerging, offering different levels of service in terms of both safety and security. Already, many Internet companies compete by adopting different privacy and security standards and stressing that their systems are more private or secure than those of their rivals.[237] In a similar way, some immersive tech providers may find a competitive advantage in catering to segments of the market that demand different experiences, such as "kid-friendly VR" or "privacy-protecting AR."

Push for Industry Self-Regulation and Best Practices

In its *Framework for Global Electronic Commerce*, the Clinton administration recommended that governments "encourage industry self-regulation and private sector leadership where possible."[238] Industry self-regulation can include many different governance models; among them are best-practice guidance for developers, private codes of conduct, corporate labeling and transparency efforts, and third-party certification and accreditation of devices or their standards.

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[237] Dina Gerdeman, "Why Companies Should Compete for Your Privacy," *Working Knowledge*, Harvard Business School, May 19, 2014; Jennifer Valentino-DeVries, "Can Search Engines Compete on Privacy?" Digits, *Wall Street Journal*, January 25, 2011.
[238] White House, *Framework for Global Electronic Commerce*.

Such self-regulatory efforts may be useful in the context of immersive technologies, especially as a complement to the sorts of educational efforts mentioned earlier. Many of these self-regulatory efforts will build on, or better formalize, the "privacy by design," "safety by design," and "security by design" efforts that are already under way in many different companies and sectors.[239]

Privacy by design, for example, refers to efforts to "embed privacy into the architecture of technologies and practices" for organizations.[240] Various trade associations have already worked with other entities (including government agencies) to formulate privacy and security "by design" best practices for online advertising,[241] connected cars,[242] and personal wellness devices,[243] to name just three examples. And many online safety best-practice or code-of-conduct efforts have been implemented over the past two decades.[244]

Importantly, in June 2016, the National Telecommunications and Information Administration, which is part of the US Department of Commerce, issued "Privacy Best Practice Recommendations for Commercial Facial Recognition Use."[245] A multistakeholder group came up with best practices that included transparency requirements, good data management practices, limitations on data use, security safeguards, and redress methods when problems develop. The report noted that these best practices were "intended to provide a flexible and evolving approach

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[239] Ira S. Rubinstein, "Regulating Privacy by Design," *Berkeley Technology Law Journal* 26, no. 3 (2011): 1409; Peter Schaar, "Privacy by Design," *Identity in the Information Society* 3, no. 2 (2010): 267.

[240] Ann Cavoukian, "2011: The Decade of Privacy by Design Starts Now," *IT Business*, January 15, 2011.

[241] Digital Advertising Alliance, "The DAA Self-Regulatory Principles," last accessed January 7, 2016.

[242] Alliance of Automobile Manufacturers and Association of Global Automakers, "Consumer Privacy Protection Principles: Privacy Principles for Vehicle Technologies and Services," November 12, 2014.

[243] Consumer Technology Association, "Association Unveils First-of-Its-Kind, Industry Supported Principles on Wellness Data Privacy," press release, October 26, 2015.

[244] Adam Thierer, *Parental Controls and Online Child Protection: A Survey of Tools and Methods* (Washington, DC: Progress & Freedom Foundation, 2009).

[245] National Telecommunications and Information Administration, "Privacy Best Practice Recommendations for Commercial Facial Recognition Use," US Department of Commerce, Washington, DC, June 15, 2016.

to the use of facial recognition technology, designed to keep pace with the dynamic marketplace surrounding these technologies."[246] Privacy and safety professionals in immersive technology companies will need to work with others to devise similar best practices for their devices and applications as privacy, safety, or security flags are raised.

Adopt Targeted, Limited Legal Measures for Truly Hard Problems

The policy framework identified here generally counsels patience and humility in the face of rapid technological change. It is premised on the belief that ongoing experimentation with new technologies should generally be permitted unless it can be shown that the technologies could give rise to harms that are immediate, irreversible, and catastrophic in character.

Generally speaking, however, immersive technologies do not raise such extreme risks. Therefore, innovators and consumers should be free to experiment with new immersive technologies without prior restraints.

To the extent that any problems *do* develop that require legal intervention, consistent with the Clinton administration's *Framework for Global Electronic Commerce*, the aim of government involvement "should be to support and enforce a predictable, minimalist, consistent and simple legal environment for commerce."[247] But such interventions should be ex post in character and should be adopted only to address serious harms and only after all other options have been exhausted.

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[246] Ibid., 1.
[247] White House, *Framework for Global Electronic Commerce*.

Evaluate and Reevaluate Policy Decisions to Ensure They Pass a Strict Benefit-Cost Analysis

Finally, if new laws or regulations are proposed to address targeted concerns associated with immersive technologies, those rules should be subjected to a strict benefit-cost analysis to determine whether they will achieve the desired goal without imposing excessive burdens on the economy and society.[248] Benefit-cost analyses help policymakers formally identify the tradeoffs associated with regulatory proposals and, to the maximum extent feasible, quantify those benefits and costs.[249]

Conclusion

In his book *The Innovators*—a magisterial history of modern computing, digital networks, and the visionaries who made it all possible—Walter Isaacson concludes by reminding readers of the following:

> New platforms, services, and social networks are increasingly enabling fresh opportunities for individual imagination and collaborative creativity. . . . This interplay between technology and the arts will eventually result in completely new forms of expression and formats of media. This innovation will come from people who are able to link beauty to engineering, humanity to technology, and poetry to processors.[250]

There are perhaps no better candidates for a new technology that could achieve this ambitious goal than immersive technologies such as VR, AR, and MR.

Of course, it remains to be seen whether sufficient demand exists to make immersive tech the next major disruptive technology to capture the public's imagination. But artificial public

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[248] See Adam Thierer, "A Framework for Benefit-Cost Analysis in Digital Privacy Debates," *George Mason University Law Review* 20, no. 4 (2013): 1066–69.

[249] See Susan E. Dudley and Jerry Brito, *Regulation: A Primer,* 2nd ed. (Arlington, VA: Mercatus Center at George Mason University, 2012), 97–98. ("The cost of a regulation is the opportunity cost—whatever desirable things society gives up in order to get the good things the regulation produces. The opportunity cost of alternative approaches is the appropriate measure of costs. This measure should reflect the benefits foregone when a particular action is selected and should include the change in consumer and producer surplus.") See also Jerry Ellig and Patrick A. McLaughlin, "The Quality and Use of Regulatory Analysis in 2008," *Risk Analysis* 32, no. 5 (2012), 855–80.

[250] Walter Isaacson, *The Innovators* (New York: Simon & Schuster, 2015), 488.

policy barriers should not be placed in the way of this sector's development. By following the blueprint set out herein, policymakers can make permissionless innovation the cornerstone of immersive tech policy going forward and possibly help spur the development of a wide array of new life-enriching technologies in this sector.