A Survey of Virtual Reality Applications

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Abstract

This paper aims to explore whether the applications of virtual reality in sports and video entertainment are viable. Virtual reality (VR) is achieved using a headset, which "creates a completely immersive experience ostensibly tricking the brain into believing the virtual environment is real" (Potter, 2017). This technology is increasing in popularity in the context of sports and healthcare and is expected to achieve a penetration rate of 30% and 25%, respectively (Bellini et al., 2016). However, virtual reality technology is less viable in video entertainment because of a lack of standards for VR content and the absence of a uniform mode of distribution.

Keywords: virtual reality, sports, video entertainment, healthcare

Introduction

Virtual reality is a rapidly advancing technology with the potential to become the next widely-used platform (Bellini et al, 2016). It is expected to bring in over $1 billion in revenue in the U.S. in 2018 (Statista, n.d.). Virtual Reality already serves a variety of purposes across many industries. According to research done by Goldman Sachs, the "most meaningful drivers of the [virtual reality] market in the near-term [will be] video games, live events, video entertainment, healthcare, real estate, retail, education, engineering, and military" (Bellini et al, 2016).

Thus, the purpose of this research paper is to explore the applications of virtual reality in the areas of sports and video entertainment. It must be noted that in 2018, it is estimated that video games will hold 48% of the "share of global virtual reality software revenue" followed by entertainment at 15% and interactive media at 9% (LinkedIn, n.d.). This shows that virtual reality has yet to gain a solid foothold in industries outside of gaming. This paper will explore whether virtual reality is a worthwhile investment for other industries, or if it is simply the latest gaming trend.

First, the concept of virtual reality will be introduced. This will include varying definitions of the technology as well as its most common uses. Next, the different types of virtual reality technologies will be outlined including the most common examples of each type. Then, the application of virtual reality in sports will be explored; first examining the potential impact of virtual reality on athletes, particularly their ability to utilize the technology in training. Subsequently, the potential impact on the fan experience both at home and in-game will be analyzed. Finally, the effects of virtual reality on individual programs or teams as well as on the leagues as a whole will be examined. Next, the role of virtual reality in video entertainment will be discussed. Particularly as it relates to the creation and consumption of film content.

Virtual reality is important because of its potential to radically alter many fields including, but not limited to, sports and entertainment. According to Statista, the anticipated international economic impact of virtual and augmented reality assuming medium adoption of the technology will reach $15.6 billion U.S. dollars by 2020 (Analysis Group, n.d.). As the virtual reality market revenue is projected to increase exponentially, exploring whether this technology is viable in the long-term is extremely important. Furthermore, this topic is worth exploring to determine if the revenue estimations are accurate, or if virtual reality will have less of an impact than projected on the worldwide economy.

Description

What is Virtual Reality?

Virtual reality can be defined as "near-reality" ("What is Virtual Reality," n.d.). Humans gather information about their surroundings through sensory perception. Thus, virtual reality is the process of taking in artificial information through one's senses which the brain then perceives as reality. Technically speaking, "virtual reality is the term used to describe a three-dimensional, computer generated environment which can be explored and interacted with by a person" ("What is Virtual Reality," n.d.).

To be successful, virtual reality technology must achieve "[a perfect] combination of hardware, software and sensory synchronicity" which leads to a "sense of presence… in the perceived environment ("What is Virtual Reality," n.d.). A "sense of presence" is achieved when the person using the virtual reality technology experiences no discrepancies between the technology and the real-world. For example, "although you are not always consciously aware of your peripheral vision, [you would notice] if it were gone" ("What is Virtual Reality," n.d.). As

such, virtual reality technology cannot lack key aspects one would perceive in the real-world, such as peripheral vision.

The possible applications of virtual reality technology are endless. The most obvious and popular application is in gaming. However, other industries in which virtual reality has the potential to make an immediate impact are real estate, retail, and healthcare (Bellini et al, 2016).

Types of Virtual Reality

Virtual reality. This technology "immerses the user wearing a headset in a programmed reality" (M. Dupagne, class lecture, November 7, 2017). This type of technology can be further divided into the following categories: "snap-in headsets, PC/console headsets, and all-in-one, or AIO, headsets" (Potter, 2017).

Snap-in headsets. This technology "utilizes a smartphone that snaps into the device, providing its screen and brains" (Potter, 2017). It offers a less-costly option for consumers who want to experience virtual reality. The quality is substandard due to the lack of processing power as compared to PC/console headsets. The most common examples of snap-in headsets are Google Daydream and GearVR (Potter, 2017).

PC/console headsets. This technology "[requires] a separate video game console or PC to be tethered to the device" (Potter, 2017). It offers consumers a superior virtually reality experience, however the headsets and PC are expensive. Additionally, these headsets are tethered to the PC/console "through a wire or wires in order to transmit video and data as quickly as possible" (Potter, 2017). This puts PC/console headsets at a disadvantage as compared to wireless devices because the wearer is limited by the length of the wire. The most common examples of a PC/console headset are the Sony PSVR, Oculus Rift and Vive (Potter, 2017).

All-in-one headsets. As of 2017, "no AIO headsets have been released to the market," however "shipments are anticipated to begin in 2018" (Potter, 2017). This technology will be "wireless and [will not] require connecting a separate computer device" (Potter, 2017). Additionally, these headsets "will provide a much better user experience than snap-in headsets, but will not be able to match the power of PC/console headsets" (Potter, 2017). While these headsets will initially be expensive, since the user does not have to purchase a PC or console to connect to, they "should still be able to compete well with other segments of the market" (Potter, 2017).

Augmented reality. This technology "adds layers of data to the user's experience who wears a headset but remains in the real world" (M. Dupagne, class lecture, November 7, 2017). Some common examples of this type of technology are Google Glass and the Pokemon Go app.

Mixed reality. This technology is "a derivative from [augmented reality] that incorporates believable virtual objects into the real world" (M. Dupagne, class lecture, November 7, 2017). A common example of this type of technology is the Magic Leap game.

Adoption of Virtual Reality

Adoption of virtual reality technology is projected to be widespread. By 2017 however, the technology had failed to make a sizeable impact. According to Felix Richter, "virtual reality has not lived up to the hype that surrounded the technology in recent years. Despite several headsets finally hitting the market in 2016, the consumer response to VR devices has been tepid at best" (Richter, 2017). The primary "reasons against owning a VR device," according to:

> a survey of 926 U.S. internet users aged 18+ in Q1 2017 [are: they are] just not interested, [the devices] are too expensive, [the] possibility of motion sickness, [the] lack of content, [and the] poor quality of [available] content. (Richter, 2017)

Overview of Virtual Reality Applications

As mentioned in the introduction, Goldman Sachs projects the following fields to be the primary drivers of the virtual reality market: "videogames, live events, video entertainment, healthcare, real estate, retail, education, engineering, and military" (Bellini et al, 2016). Virtual reality has already become a defining feature of the videogame industry. However, Bellini et al (2016) indicate that education and healthcare may increase the awareness of VR technology. This is because virtual reality can be easily incorporated into these industries. In healthcare, virtual reality has the potential to help doctors with medical procedures, treat mental illnesses such as phobias, and increase patients' access to doctors via virtual encounters (Bellini et al, 2016). Similarly, in the field of education, virtual reality will allow students to interact with the content they are learning about – such as "the solar system or a historical event" (Bellini et al, 2016). By deploying virtual reality in education, children are more likely to see the benefits of the technology; increasing the likelihood that they will use it in other areas.

Further, "VR/AR technology has the potential to change business models and the ways in which we transact" (Bellini et al, 2016). This will have a sizeable impact on the retail and real estate industries. For example, utilizing virtual reality technology to display products could decrease the need for in-store displays of inventory. This could further undermine the "value of physical stores to the extent that the viewing experience can be deployed in the home and via mobile devices" (Bellini et al, 2016). Thus, if consumers are able to use virtual reality technology to see how clothes look on them without visiting a store or to tour homes that are for sale without an agent, the adoption of this technology may radically alter the existing norms of these industries.

Applications of Virtual Reality in Sport

Sports are a unique realm for virtual reality because they blur the line between live events and video entertainment. Considering this fact, Bellini et al (2016) anticipates a 30% penetration of virtual reality technology related to live events. This equates to 95 million virtual reality users in the year 2025 (Bellini et al, 2016). The utilization of virtual reality in sport has the potential to benefit every entity involved. First, it can benefit the athletes by aiding in the training process (Zorowitz, n.d.). Second, it can benefit the fans by providing them with a view of the event that could not otherwise be replicated. Finally, it can benefit the programs, teams, and leagues by allowing them to place a price tag on the virtual reality experience.

Virtual reality for athletes. Virtual reality technology can be used to train athletes without their physical presence on the practice field. This is done by projecting actual footage of practices - not animation or simulated images - through a headset (Zorowitz, n.d.). By using virtual reality to train athletes, it is possible to circumvent limitations of the human body as well as those put in place by leagues and umbrella organizations (Zorowitz, n.d.).

For example, virtual reality technology can be used to help players "visualize formations and see how plays unfold while avoiding the rigors of physical contact and potential injury" (Reynolds, 2015). Furthermore, using virtual reality technology to this end could circumvent the limits placed by the NCAA or other leagues/umbrella organizations on the number of times per day an athlete can practice. This technology also has the potential to help players "'feel more confident and comfortable'" during a game (Reynolds, 2015).

Similarly, one can only complete so many repetitions of a drill during the time allotted for practice. By utilizing virtual reality, athletes could bypass the limits of the human body by engaging their muscle memory to complete certain drills. This could be done during or outside of the time allotted for practice. Athletes can further circumvent the limitations of the human

body by using virtual reality technology to practice while they are injured. For example, a college basketball player who has a broken leg can use this technology to practice his plays. This serves two purposes: to ensure he is not far behind once his injury is healed and to protect the recovery process. Finally, virtual reality technology is "important for players who do not get on the field that often" (Reynolds, 2015). By allowing these athletes to practice using virtual reality, their coaches can ensure "'they… stay sharp and [are] ready if called into the game'" (Reynolds, 2015).

Though virtual reality technology gives athletes countless opportunities to improve their craft, these benefits may be outweighed by its cost. The cost of virtual reality is gradually decreasing, bringing the technology more into the mainstream ("What is Virtual Reality," n.d.). Despite this fact, the "equipment is not cheap, and [it is] most likely not built into most programs' budgets" (Zorowitz, n.d.). Thus, to fully integrate virtual reality technology in the routine of most athletes, the leagues and umbrella organizations would have to allot funds.

Virtual reality for fans. Virtual reality technology offers fans many opportunities. For example, virtual reality can give spectators a view that cannot be replicated in non-augmented reality. This is possible from both inside and outside of the physical venue in which a team plays.

Outside the physical venue, virtual reality technology presents fans with the opportunity to view an event as if they were in the venue. This experience is far more immersive than watching a game broadcast on television. Jeff Marsilio, NBA vice president for global media distribution said, "'we realize most fans will never get to an arena, much less sit courtside or behind the basket in premium seats… virtual reality can provide them with that experience"

(Reynolds, 2015). This would allow fans to feel more immersed in the action than they would if they were watching the game on television (Bellini et al, 2016).

Inside the venue, many "teams [are] looking to provide VR entertainment for fans at [the games]" (Reynolds, 2015). This entertainment can take many different forms. For example, at the 2015 U.S. Open tennis championships, "VIP [American Express] cardholders had the chance to return serve against the virtual version of top player Maria Sharapova" (Reynolds, 2015). Similarly, virtual reality technology can be used to "[give] fans access to locations they normally could not access [such as] the locker room or [on the court] during shoot-arounds" (Reynolds, 2015).

Furthermore, fans can fully personalize their sports experience with virtual reality (Klein, 2017). For example, many fans "already experience a game while reviewing fantasy scores, texting with friends, and accessing information feeds well beyond anything provided by a single TV commentator" (Klein, 2017). This is known as the second screen phenomenon (Flomenbaum, 2015). While this technology will allow fans to customize their experience, there is also a sizeable social component. Virtual reality technology can add to the second screen phenomenon by allowing fans to connect with each other as well as to the sport they are watching (Klein, 2017).

Though virtual reality presents fans with the opportunity to engage with the sport they are experiencing in a novel way, there are quite a few obstacles to pass before "the 'virtual reality' fan experience becomes simply the 'regular reality' fan experience" (Klein, 2017). Specifically, "connection speeds, standardized communications protocols, stitching technologies, natural language processing capabilities, image capture and integration [all] need further development" (Klein, 2017). There is also a chance this technology will never reach its full potential as far as

altering the fan experience. This is because "it [does not] seem as if the experts… believe that the virtual reality world will ever really eclipse the experience of sitting at the 50-yard line at Gillette Stadium or center ice at Madison Square Garden" (Zorowitz, n.d.).

      Virtual reality for programs, teams, and leagues. Virtual reality technology can be extremely profitable for the programs, teams, and leagues/umbrella organizations employing it in conjunction with sporting events. For example, virtual reality season tickets can be made available to fans who want a more immersive experience than watching the broadcast on television. NextVR, one of the companies that has been working with various sports leagues, presented one programming possibility for an NBA game. They placed one camera courtside, "one in the mezzanine [and] another on a basket stanchion" (Reynolds, 2015). The experience produced by these cameras was far more immersive and extensive than the experience a fan has by watching a game on television. According to Matt Hong, executive vice president and general manager of Turner Sports, "'you could look up and see the Jumbotron. You could look down and see the court… you could hear the sounds in the arena, all of the fans sitting next to you cheering'" (Reynolds, 2015).

      Furthermore, especially in college sports, utilizing virtual reality technology can be appealing to potential recruits. Because this technology is still in the early stages of adoption, few programs utilize it. Thus, virtual reality technology could be an impressive quality to people looking to join the program or team (Zorowitz, n.d.).

      Virtual reality technology also presents the challenge of cannibalizing attendance. If the virtual experience of a sporting event is better and cheaper than the in-person experience, how will teams at any level keep fans coming to the games? While this has the potential to decrease revenue, programs, teams, and leagues seem unconcerned. Since many of these entities across a

wide range of sports are in talks with VR companies, "it is safe to assume that those

organizations [do not] fear what this technology may do to attendance or ticket sales, but instead

welcome its ability to supplement the real life experience" (Zorowitz, n.d.).

Applications of Virtual Reality in Film

Virtual reality technology has the potential to radically alter the way people consume film

content. Key to understanding these impacts are the:

> two ways to consume video in VR: one, as a unique platform that drops the viewer inside
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> a new three-dimensional, 360-degree world developed as native VR content, and two, as
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> a virtual theater where video content can be consumed in a simulated setting that could
>
> rival todays' most advanced theater systems. (Williams, 2015b).

This technology remains in the early stages of adoption, especially with regards to entertainment.

This is partially because of Hollywood's hesitancy to pioneer technologies whose impacts are

uncertain (Williams, 2015b). As such, "no one is quite sure what a VR 'movie' is supposed to

look like or even how successful native narrative content might be" (Williams, 2015b).

However, it is clear that virtual reality offers content-producers manifold ways to tell a story. As

such, Bellini et al (2016) anticipate a 25% penetration rate of virtual reality technology among

video entertainment. This equates to 79 million users in the year 2025 (Bellini et al, 2016).

Virtual reality and film. Virtual reality is in the early stages of adoption among many

content-producing companies. This includes Sony, which announced it would be teaming up

"with… Reality One to develop a range of virtual reality content" in 2016 (Jimenez, 2016).

Furthermore, Warner Brothers has also ventured into the world of virtual reality, as announced

by its chief digital officer and executive vice president Thomas Gewecke in 2015 (Williams,

2015a).

The concept of virtual reality film remains largely foreign. This is because it can take many different forms. Furthermore, each company that ventures into virtual reality film "will [likely] have their own slightly different model of VR" (Dowd, 2017). However, one feature that will be present in all iterations is an immersive, interactive quality (Dowd, 2017). One example, produced by Scatter – a New York-based "immersive media studio" – is an "experience [in which] 'you put on a headset and [you are] in a totally convincing virtual depiction of a New York subway car. In the car, which you can move about in, are various characters and as you turn to look you hear what each [person is] thinking" (Dowd, 2017). This experience can be compared to a movie as well as to "immersive live theatre" (Dowd, 2017).

 The concept of interactivity raises the question: how will virtual reality film differ from virtual reality video games? The difference lies in the type of interactivity. In virtual reality film, "the interactivity is there to increase the viewer's emotional involvement, not to give them control – this [is not] like winning points in a video game" (Dowd, 2017). Furthermore, virtual reality need not "just be for one person at a time" (Dowd, 2017). Instead, virtual reality film can involve experiences in which many people are encountering the same scene at the same time (Dowd, 2017).

Just as virtual reality film presents many unique creative opportunities to producers, it also presents a variety of challenges. By December 2017, film content had not yet caught up with the rapid innovation of virtual reality technology (James, 2017). The companies that have experimented with this technology have yet to produce unprecedented content. For example, Discovery Communications Inc., has used virtual reality technology to "[give] viewers an immersive back-stage pass to many of its outdoor series" rather than produce novel content exclusively for the medium (Williams, 2015b). This lack of content to pioneer the technology as

a revolutionary way to consume film that cannot be consumed elsewhere has given pause to some.

Furthermore, distribution and monetization concerns have not yet been solved. The question of how virtual reality content will be distributed to mass audiences largely depends upon the mode of delivery. Because the technology is rapidly evolving, "'no one can say if a version of today's headsets will be the medium of mass distribution at all: maybe it will all be embedded in eyeglasses or contact lenses or maybe it will be a hologram experience" (Dowd, 2017). This question of mass distribution must be solved before companies can develop a plan for monetizing the content.

In relation to its application to film, companies blazing the trail of virtual reality must develop content that is not just a novelty, but rather must-have entertainment. This, coupled with technological advances will create the right conditions for mass adoption. According to the "overall programmer for VR at the Tribeca [Film Festival:] 'the richer the content is, and the more compelling, the more it warrants being paid for. [That is] when we have an industry and a legitimate visual medium" (Dowd, 2017).

Discussion

Summary

Virtual reality technology has numerous practical applications in both sports and entertainment. In sports, this technology can be used to train athletes without their physical presence on the practice field (Zorowitz, n.d.). This serves four purposes. First, it allows athletes to practice plays and see how they unfold without risking injury (Reynolds, 2015). Second, it can circumvent the limitations placed by leagues and umbrella organizations on the number of times an athlete can practice. Third, it can allow athletes who are injured to continue

utilizing muscle memory without disrupting the rehab process. Finally, it can be used to keep

back-up athletes sharp without giving them significant reps during a physical practice. This will

not only make them more comfortable with the plays, but it will also ensure they are ready if

called upon in a game-time situation (Reynolds, 2015).

Virtual reality can also be utilized by sports fans. This technology allows fans to become

more immersed in the action than they would be watching the television broadcast. While virtual

reality will never surpass the experience of physically being in the venue for a sporting event, it

can be used to transport fans to areas they would not normally have access to (Reynolds, 2015).

Furthermore, virtual reality can offer fans the opportunity to personalize the content they are

experiencing as well as the social component of connecting with other fans (Klein, 2017).

Finally, virtual reality can be utilized by programs, teams, and leagues because it can be

monetized. By offering virtual reality experiences to fans, these entities could tap into a unique

market (Reynolds, 2015). In addition, since virtual reality is in the early stages of adoption

within sports, use of the technology could serve as an added incentive for individuals to join a

program, team, or league. This is especially relevant in the recruiting process of college sports.

Though virtual reality offers many opportunities to athletes, fans, teams, and leagues, its

cost can be a barrier to mainstream use. Thus, teams and leagues would have to allot the funds

for virtual reality technology to reap its many benefits. Furthermore, various technical aspects of

the technology must be improved before it can be utilized in the mainstream by athletes, fans,

teams, and leagues (Klein, 2017).

Virtual reality technology also has practical applications in entertainment, particularly in

film. This technology has the potential to radically alter the way people consume content by

making film fully immersive and interactive (Dowd, 2017). While this technology presents

many opportunities to content producers, it also presents many challenges. For example, there is a lack of revolutionary content to pioneer the technology in relation to film. As such, the concept of a virtual reality film remains largely foreign. Furthermore, issues of distribution and monetization of virtual reality film content have not yet been solved. Until standards have been created to govern what a virtual reality film looks like and a mode of mass distribution created, virtual reality film will likely remain a novelty rather than must-have entertainment.

Significance

This survey of virtual reality applications outside the realm of gaming is significant because it may affect the projected economic impact of the technology. According to Statista, the "projected economic impact of virtual and augmented reality technologies worldwide" assuming medium adoption will reach $15.6 billion U.S. dollars by 2020 (Analysis Group, n.d.). That virtual reality technology can and should be utilized in sports to the benefit of athletes and fans supports the projected economic impact. However, its slow adoption in film and entertainment – apart from gaming – may detract from the projected economic impact. Thus, virtual reality may not experience as high of an adoption rate or have as great of an impact on the worldwide economy as projected.

Predictions

Based on the evidence regarding virtual reality applications, it appears that this technology is more likely to be utilized in sport than in entertainment. This is because virtual reality would provide many benefits to athletes, fans, programs, teams, and leagues. Furthermore, the disadvantages of using virtual reality in sport – cost, technical concerns, and cannibalizing attendance – are far outweighed by the benefits. As the technology evolves, it is likely the price will decrease and concerns about connection speeds and integration will be

eliminated (Klein, 2017). Once a larger segment of the population can afford this technology, it will become mainstream in the world of sports. Furthermore, sports fans are an extremely reliable demographic. Many are passionate about their team and thus, are more likely to invest in virtual reality technology in hopes of getting an experience that cannot be replicated in non-virtual reality. The reliability of this demographic also minimizes concerns over virtual reality cannibalizing attendance. Most experts agree that "the virtual reality world will [never] really eclipse the experience of sitting at the 50-yard line" (Zorowitz, n.d.). As such, it is more likely that virtual reality will serve as a supplement to the fan experience, rather than a replacement.

Conversely, virtual reality technology is less likely to be utilized in entertainment because the disadvantages far outweigh the benefits. Furthermore, it seems these concerns will be magnified as the technology develops. For example, as virtual reality moves from headsets to eyeglasses and contact lenses, it will create more potential modes of distribution for virtual reality film content (Dowd, 2017). This decreases the chances of standardization or creating a uniform mode of distribution across the film industry. Furthermore, the interactive quality of virtual reality film is too similar to that of video games to tap into a separate share of the market.
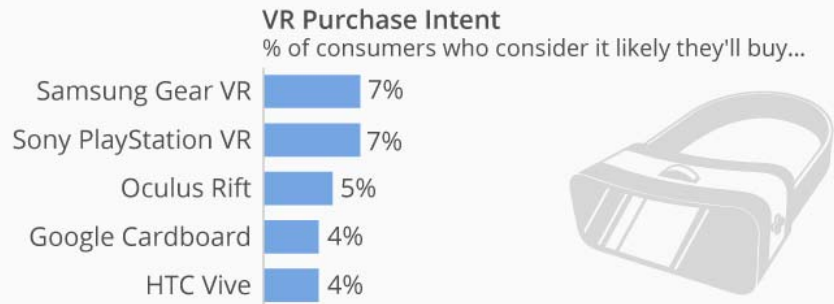
Conclusion

Overall, the evidence regarding virtual reality applications suggests that the technology is more likely to succeed in sport rather than entertainment. This is because the potential benefits of virtual reality far outweigh the disadvantages in sport. As such, virtual reality technology should be deployed by programs, teams, and leagues to benefit athletes and fans. However, virtual reality technology should not be utilized to create novel film content because there is no uniform means to distribute and monetize this content. Instead, virtual reality film content will continue to exist on the shoulders of non-virtual reality film content.
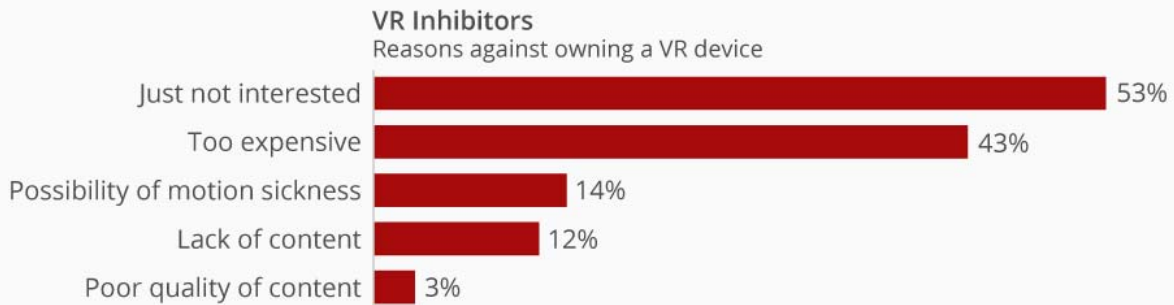
Chart 1

Virtual Reality Has Yet to Make a Big Impression

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VR Purchase Intent
% of consumers who consider it likely they'll buy...

Samsung Gear VR	7%
Sony PlayStation VR	7%
Oculus Rift	5%
Google Cardboard	4%
HTC Vive	4%

Based on a survey of 2,000+ U.S. consumers aged 13+ in Q1 2017

VR Inhibitors
Reasons against owning a VR device

Just not interested	53%
Too expensive	43%
Possibility of motion sickness	14%
Lack of content	12%
Poor quality of content	3%

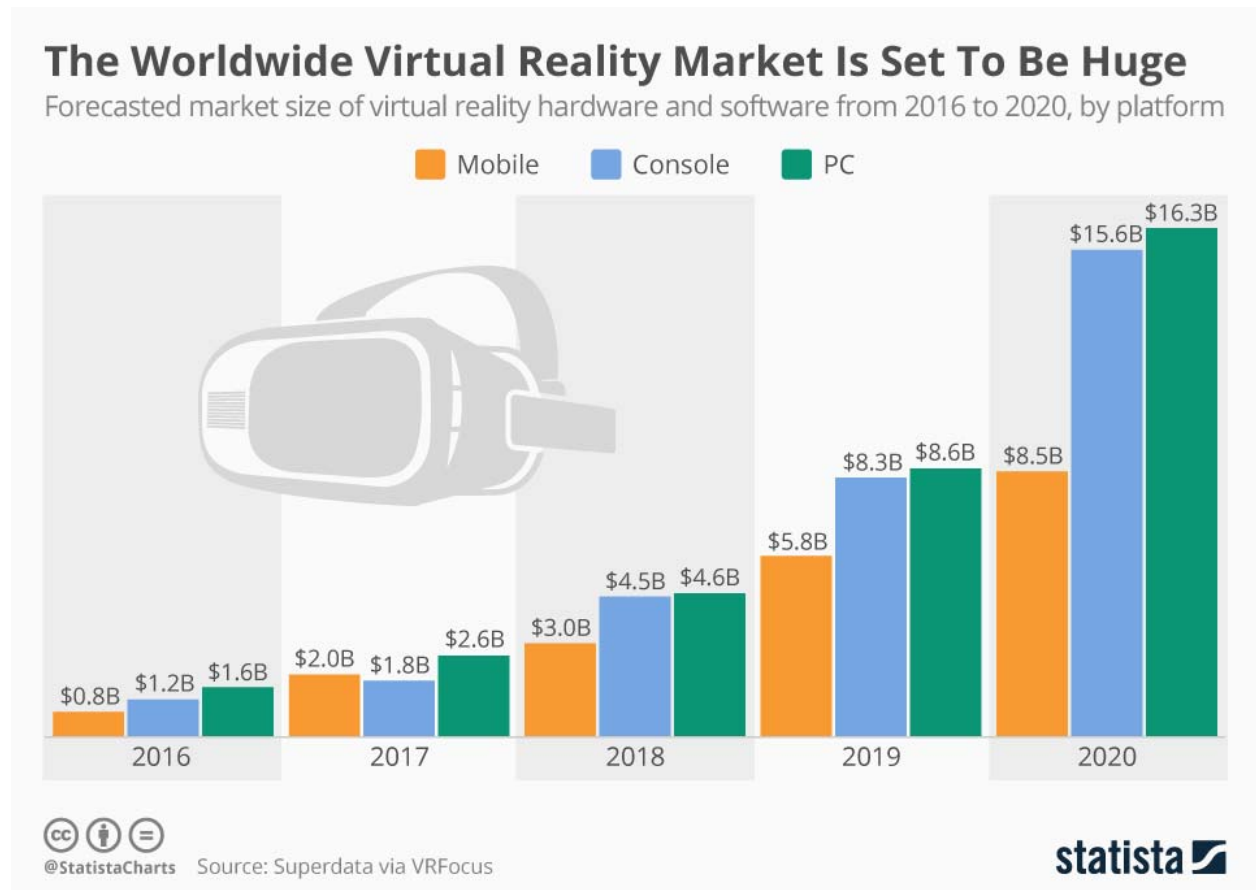Based on a survey of 926 U.S. internet users aged 18+ in Q1 2017

@StatistaCharts   Sources: Nielsen, Thrive Analytics

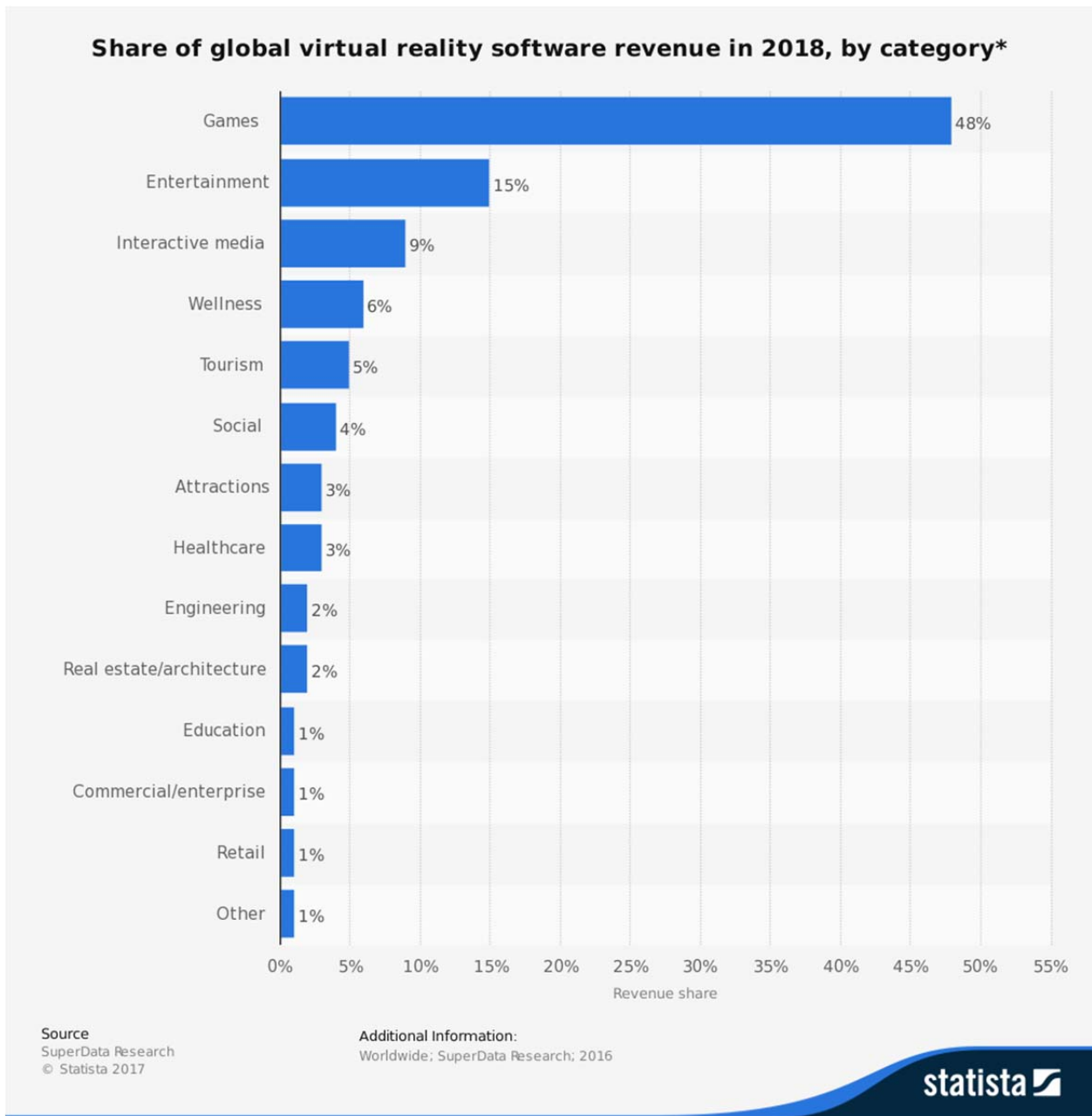statista

Source: Richter (2017)

Chart 2

The Worldwide Virtual Reality Market Is Set To Be Huge

Source: Armstrong (2016)

Chart 3

Share of global virtual reality software revenue in 2018, by category

Source: LinkedIn (n.d.)

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