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A Holistic Analysis towards Understanding Consumer Perceptions of Virtual Reality Devices in the Post adoption Phase

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Despite gaining consumer momentum and interest of Virtual Reality (VR) in the consumer marketplace, the literature has lagged in exploring the continuance usage behavior and factors associated with the post-adoption. To build on this, the current research seeks to identify factors that support the continuance usage of current VR users. To examine this, we employ a mixed-method approach. In Study 1, we initially gathered a total of 3,205 actual purchasers (Amazon verified purchase) from the top 10 VR brands listed in Amazon.com, Through a nethnographic content analysis, the key determinants of post-adoption of VR devices emerged (i.e., perceived functional benefit, perceived discomfort, perceived focused immersion, temporal dissociation, perceived health risk, and task quality). In Study 2, hypotheses were tested using structural equation modeling from 119 current VR users. The results demonstrate temporal dissociation and task quality were found to be the most significant antecedents affecting continuance usage. Theoretical and managerial implications are debated, as well as suggestions for future research.

Keywords- Virtual Reality; VR; Netnography; Continuance Intention; Immersion; Post-adoption; Use behavior.

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1. Introduction

The proliferation of Virtual Reality (VR) devices in the consumer marketplace have paved the ways for novel applications to extract novel and exciting consumer experiences (Loureiro, Guerreiro, Eloy, Langaro & Panchapakesan, 2019; Tussyadiah, Wang, Jung & Dieck 2018). VR provides “immersive, interactive, multi-sensory, viewer-centred, three-dimensional computer-generated environments and the combination of technologies required to build these environments” (Gong, 2018). That is, VR delivers a simulated environment that mimics real-life experiences (Diemer et al., 2015) and allows users to interact with places, objects, and characters in real-time, causing an illusion of reality (Sherman & Craig, 2018). In practice, VR devices have been adopted and incorporated into various industries such as tourism, marketing, luxury branding fashion, planning and management, entertainment, healthcare, education, and retail (e.g., Han, An, Han & Lee, 2020; Herz & Rauschnabel, 2019; Jung, Yu, Seo & Keo, 2019; Rawassizadeh et al., 2015).

VR devices have steadily gained popularity in the consumer marketplace. For instance, the US had the world’s strongest VR market with a revenue of US\$1.5bn in 2017, a growth of over 250% year-over-year; the projected revenue is estimated at US\$7.2bn by 2022 (PWC, 2019). However, one of the most critical concerns going forward is the chasm between current and prospective consumers (Moore, 1999). Indeed, understanding the components that influence continued usage of VR devices is essential for the growth in this emerging tech field. Hence, Laurell et al. (2019) have highlighted that understanding barriers to continuing the use of VR technology is also hence a crucial issue from both the consumer perspective and company perspective. They also call for further research to reveal VR's present state of diffusion and its

associated barriers, which remains understudied in evaluating how VR technology's improvement unrolls.

Without a comprehensive understanding of the post-adoption factors, changes that could enhance the drivers and reduce the barriers may never be identified. This could result in a slower rate of adoption. To date, there is little understanding of why post-adoption remains low and the factors associated with limited usage. Thus, our objective is to investigate the following research questions:

- *What are the barriers contributing to the low levels of continuance usage of VR devices?*
- *What are some potential drivers of building continuance usage for VR devices?*

As one of the few post-adoption VR studies in this domain, this study conducts one of the largest scale studies using 3,205 users who have purchased VR devices from one of the top ten VR brands on Amazon. Further, a complementary study provides the post-adoption reactions of VR customers with the ultimate goal of recommending practical implications for VR designers and practitioners.

2. Related literature

2.1. Overview of VR Devices

VR immerses users into a digital environment while providing users with real-time experiences (Guttentag, 2010; Wirth et al., 2007). Herz & Rauschnabel (2019) define VR as a form of immersive digital media that generates a 3D virtual and interactive media environment that allows users to perceive as they are in the real world. For example, people can enter simulated environments such as flying over cities or visiting tourist attractions, giving them a sense of telepresence (Gibson & O'Rwe, 2018). In another example, Marriot uses VR to feature resorts and

destinations so that people can “try before they fly” (Jung, Tom Dieck, Lee, & Chung, 2016). Additionally, e-commerce benefits from VR devices to generate higher positive consumer responses. As a real-life example, it was found that the benefits of virtual stores are creating more positive consumer responses such as brand recall and purchase intention rather than traditional physical stores (Martínez-Navarro, Bigné, Guixeres, Alcañiz & Torrecilla, 2019). Table 1 details the evolution of VR definition over time.

Table 1
Definitions of VR overtime

Authors and Year	Definition of Virtual Reality	Key Findings
Steuer (1992)	“as a simulated environment in which the perceiver experiences telepresence, which is the extent to which a person feels present in a virtual environment”	- Vividness and interactivity are interconnected in a virtual environment. - If the virtual environment is highly vivid and interactive, which results in a higher sense of presence.
Pennington (2001)	“a sign system external to consumers that consumers interpret to be a representation of a possible reality”	- Virtual reality is a different experience than the interactivity or online experience. - To compose a virtual reality, an only sign will not be adequate in an isolation environment. Hence, brand or marketing managers can create a virtual reality that involves signal brands or icons during consumption as a cue.
Suh and Lee (2005)	“computer-generated, interactive, 3D environment in which people become immersed”	- The interfaces of virtual reality devices boost consumers learning in overall relation to products. - The performance of the learning might vary from product type, including both virtually high and low experiential products. The findings illustrate that VHE products are most effective rather than VLE products.
Guttentag (2010)	“as the use of a computer-generated 3D environment – called a ‘virtual environment’ (VE) – that one can navigate and possibly interact with, resulting in real-time simulation of one or more of the user's five senses”	- Virtual reality provides a vast of encouraging applications in fields changing from planning and management to entertainment. - Virtual reality provides the possibility to complete alternate experiences that might be remarkably valuable for heritage protection in particular situations. - Virtual reality will open new and unique opportunities in the tourism field.
Borsci, Lawson, Jha, Burges, and Salanitri D (2016)	“as human–computer environments in which users are immersed in, and able to perceive, act, and interact with a 3D world”	- Virtual reality-based systems have many advantages in training automotive duties. - The experiential activities implemented in a virtual reality environment are more productive than observational training in the training of car maintenance. - The various hardware and controllers by which users undergo the virtual based training application do not impact the ability recovery and performance of the process. - During the virtual reality training, there is a relationship between trust in the use and perceived usability.

Tussyadiah, Wang, Jung, and Dieck (2018)	“as a computer-simulated environment with and within which people interact”	-The sense of being in the virtual environment enhances the virtual reality experiences' enjoyment. -The emphasised feeling of being there occurs a more powerful liking and preference in the destination. -Positive attitude difference results in a higher level of visitation intention. -This study verifies the effect of virtual reality on creating consumers' attitude and their behavioral intentions.
Herz and Rauschnabel (2019)	“as a form of immersive digital media that generates a three-dimensional, virtual imaginary and interactive media environment that the user processes or perceives much as he/she perceives the real world”	-In the adoption of using virtual reality devices, health and privacy risks have a role in the diminishing usage rate, but psychological or physical risks do not have any such role. -Fashionable designs and wearable comfort play a crucial role in virtual reality adoption. -Sense of virtual embodiment and virtual presence has a positive impact on VR adoption, whereas the presence does have a negative impact on it.

According to the definitions in Table 1, we defined VR as *a form of immersive environment in which the user experiences a real sense of presence in the virtual world, ensuing in a real-time simulation of one or more of the user's five senses*. Advances in modern age computing have led to a surge of interactive VR systems for the consumer marketplace. Each system includes a unique Head Mounted Display (HMD) where users place over their eyes (akin to a ski-goggle) for a 360°, three-dimensional experience. Currently, there are several VR systems available at various price points (Gutiérrez -Maldonado et al., 2016). VR systems sometimes require the support of external hardware, such as a dedicated PC-computer with an advanced graphics card to support the operations of the VR app, software, and content. These PC-based or console-based HMD's (e.g., Oculus Rift, HTC Vive, Playstation VR,) provide the most immersive experience for the user. Compared to the lower-cost alternatives (e.g., Google Cardboard, Samsung Gear, Google Daydream), a console-based HMD provides user-tracking, stereoscopic 3D vision, faster refresh rate and head tracking, better image quality, and a greater extended field of view (Cummings & Bailenson, 2016). Some of these systems also have an integrated touch input method where users can use hand gestures and receive haptic feedback in real-time (e.g., Oculus Touch, Vive Tracker)

(Han & Kim, 2017). These systems may also be more suitable for simulations (Vaughan, Gabrys, & Dubey, 2016) than mobile-based platforms. However, despite the increased functionalities, PC-dedicated VR headsets are expensive and less portable. For VR systems that are mobile-based, the lighter weight and the ease of portability offers are more liberating and a self-contained experienced (Wiederhold, Riva & Wiederhold, 2016). Although, due to its limited computing power and capacity, features are restricted (no touch input); it limits consumers from fully optimizing their VR experience. Also, Jung et al., (2019) explored that consumer experiences can be categorized in three themes: VR as embodied escapism, VR as democratization, and VR as actualized anxiety. Given that there are strengths and weaknesses of VR devices, we believe this is an apt time to explore consumers' post-adoption reactions (thoughts, feelings, and experiences) associated with their usage behavior pattern.

3. Research Methodology

The main goal of this research is to develop a theoretical framework of virtual reality adoption, expanding on the critical factors affecting post-adoption behavior. The development of the framework includes both the identification and validation of the adoption factors. To achieve this goal, a mixed-method approach is deployed across two studies. First, Study 1 is an exploratory nethnographic study that uncovers the post-adoption factors data generated from the retail giant – Amazon. This approach was taken mainly due to the lack of empirically validated research toward the post-adoption of VR devices. Second, Study 2 takes a quantitative angle to empirically validate the qualitative findings by evaluating the robustness and generalizability of the proposed theoretical framework. This paper uses the general guidelines for conducting mixed-method research proposed by Vankatesh, Brown, and Bala (2013) and DeVellis (2003). Figure 1 provides a high-level depiction of the mixed methodology used for this research.

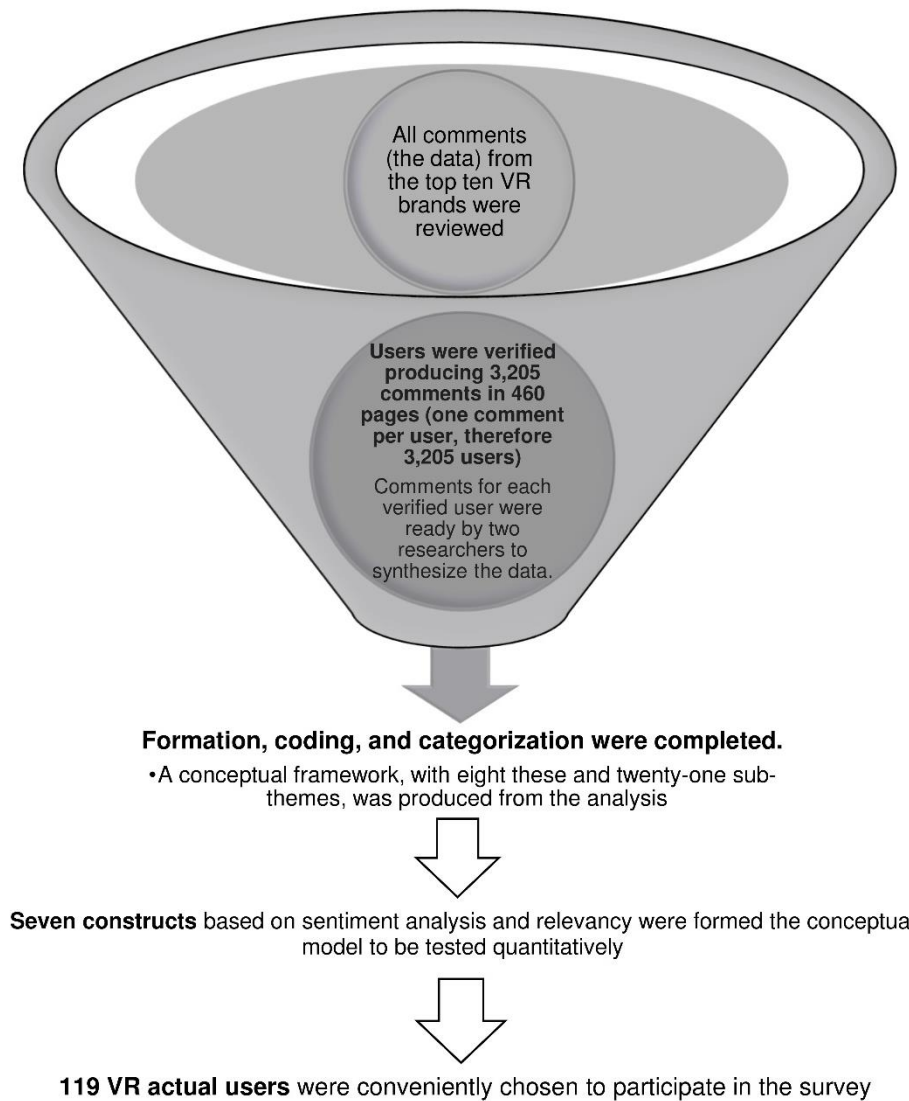


Fig 1. Mixed Methodology Process

3.1. Study 1 – Exploratory Nethnography

The following section outlines the qualitative method used for Study 1. It outlines the study's design, participant involved for data collection, data analysis, and results.

3.1.1. Research Design

Nethnography adapts “ethnographic research techniques to study the cultures and communities that are emerging through computer-mediated communications” (Kozinets, 2002, p.62). It is closely associated with other qualitative research methods for inter-related fieldwork such as digital and virtual ethnography (Hjorth, Horst, Galloway, & Bell 2017; Tunçalp & Lê, 2014). Nethnography enables researchers to reach audiences that were previously difficult to reach (e.g., couch-surfing) (Wu & Pearce, 2014). In the past, nethnography has been used to identify music event opportunities via distribution channels (Beaven & Laws, 2007), specifying features of flourishing destination websites (Osti, 2010), exploring the motivational factors of smartwatches (Dehghani, 2018), understanding service experiences (Wu & Pearce, 2014), and among others. Here, a content analysis method is used to identify consumer perceptions towards VR devices in the post-adoption process.

3.1.2. Participants

Here, we chose the ‘Amazon.com’ community as the context of our investigation. To meet the criteria set by Kozinets (2002; 2010), we chose a platform that contained high traffic of reviews and postings with vast amounts of descriptive data; it also encompasses numerous interactions among members of a group with common interests. We chose Amazon since it has more than 310 million active customer accounts worldwide and a forum to share opinions, testimonials, and photos of their experiences with products (Statistica, 2016). Amazon provides a platform for consumers to express their thoughts and concerns, allowing researchers to analyze key emergent themes from verified user accounts. First, this research gathers descriptive data of the shared content (e.g., # of comments, Q&A). Then, the data is further analyzed to unearth consumer perceptions of VR devices from posts, comments and questions on the Amazon database. The dataset was then developed by employing an advanced search of the ten most popular and

purchased brands of VR devices as of 2019 This included: *Oculus Rift*, *Google Daydream View*, *Google Cardboard*, *HTC Vive*, *Samsung Gear*, *HTC View Pro*, *Lenovo Mirage Solo*, *VR Headset Homido V2*, *Merge VR*, *PlayStation VR (Bonderlands 2)*. Table 2 illustrates a descriptive summary of our investigation.

Table 2
Summary of VR-Related Comments

	Number of Comments	Number of Positive Comments	Number of Critical Comments	Q&A by Customers
HTC Vive	1142	862	280	691
Oculus Rift	1135	880	255	514
Google Cardboard	344	200	144	64
Google Daydream View	218	134	84	175
Samsung Gear	92	67	25	47
PlayStation VR (Bonderlands 2)	77	67	10	30
HTC View Pro	72	44	28	164
Lenovo Mirage Solo	52	36	16	121
VR Headset Homido V2	54	29	25	39
Merge VR	19	16	3	4
TOTAL COMMENTS	3205	2335	870	1849

3.1.3. Reliability and Validity

NVivo 12 provides researchers with intera-rater reliability, Cohen's Kappa coefficient (k), and the percent agreement for intera-rater data (Cohen, 1960). The intera-rater reliability which is the degree of agreement among repeated administrations of a diagnostic test performed by a single rater was confirmed.

As a single coder performed the analysis, actions were considered to run an internal validity check on the coding process. Following the 25% had been coded, a new identifier was created in

the Nvivo file two weeks after the first coding process. This lets the coder recode the transcript without visibility of the codes from the first coding iteration (Girvan & Savage, 2019).

The minimal disagreement when coding the responses is an important criterion for this type of data. The aim of using this method was to manage the data in a way that makes it easier to efficiently obtain responses. This differs from other methods, such as the grounded theory approach which focuses on forming new themes and hypotheses during the content review (Glaser & Strauss, 1967). The possibility of having data that agree purely by chance is taken into consideration by the Kappa coefficient. However, there is no standard way of evaluating the strength of the data agreement. For example, by NVivo's standards, a coefficient of 0.75 and higher suggest that the agreement is very high or "excellent". In any case, the Kappa value acquired in this study is considered to be high by all standards. Also, the statistical analysis applied a review of the researcher's use of codes during the coding process, which included reassessing references and detecting overlap between codes casing in a reduction of codes.

3.1.4. Data Analysis and Results

The data gathered was reported in a text format from a total of 3,205 verified users who have purchased one of the top 10 VR products listed on Amazon. A total of 460 pages of transcripts were compiled and content analyses via NVivo 12 software were performed. Similar to recent studies (Dehghani, 2018; Habibi, Laroche, & Richard, 2014), an open-coded process was used to analyze the data. This process consisted of analyzing, testing, conceptualizing, comparing and categorizing the data. First, all of the text was read, placing an emphasis on identifying keywords and phrases, while uncovering positive and negative emotions. To pay attention to the analytic depth of the issue, this research did not exclude any type of comments or questions (Brown,

Kozinets, & Sherry, 2003). We then took an iterative process reading and re-reading the transcriptions to take notes and develop ideas for this stage.

We then developed nodes, discarding any irrelevant content. Once the textual data was analyzed, a list of post-adoption factors was gathered based on their degree of similarity and then synthesized into well-defined categories and subcategories. After several iterations, themes were found within the collected data, and the final framework was subsequently produced. The content analysis and emergent themes are provided in table 3. Further, themes and representative quotes are also provided in Table 3.

Table 3

Results of content analysis towards VR usage history (As calculated by NVivo)

Themes	Frequency codes	Total Percentage ¹	Definition	Selected Quote
Perceived Functional Benefit/ Task Quality	34	% 8.22	The consumer's perception of how much easier and quicker a technological device allows certain tasks to be done and the degree of accuracy of the principal task. (Gupta et al., 2013; Herz & Rauschnabel, 2019).	"It has an "action button" (a large silver button on the upper-right-hand side). ... that means this "action button" works with ALL touch screens (compared to other VR headsets that work only with android devices), which is all you need to play VR games/apps that require interaction"
Interoperability	12	% 2.92	A device's ability to function with other external devices and operating systems.	<i>"Always launches daydream app and all videos must be watched through daydream. No port available for phone camera, so there is no way to have an AR experience or take pictures while the headset is on."</i>
Effort Expectancy	7	% 1.70	The degree of ease linked to technology use, is a cross over between perceived ease of use and complexity (Venkatesh et al., 2012).	<i>"Another unexpected aspect to the VR experience was locating my buttons. I haven't used the motion controllers until this point, so trying to remember where the buttons are is not instinctual yet."</i>
Perceived Interactivity	3	% 0.07	Interactivity represents the level of vividness as factors influencing consumer evaluations, which can be mediated by immersion	<i>"Using voice recognition to specify what site you want to visit makes things really user-friendly. If you don't like voice recognition, I suggest you bookmark all your favourite sites via the app first and then plug it into the headset, so they are easily accessible"</i>
Health Motivation	11	% 2.68	The degree to which health is incorporated into a person's daily life and increases users' health motivation (e.g., exercise regularly and eat healthy food) (Claussen et al., 2015)	<i>"My favorite game is VR Boxing and I burn about 500 calories a day in a guitar-hero-style gym smashing orbs that move towards you. Finally, exercise I look forward to!."</i>
Effort Reduction	12	%2.92	Perceptions of a reduced level of energy exerted, and pain felt when completing tasks while in a VR environment.	<i>"Some people have predicted that all Gyms will use VR in the future, because normal exercise equipment is so boring that you can only think about exercise. But in VR, you don't feel like you are exercising or feeling tired, even when exerting yourself."</i>
Hedonic Motivation	7	% 1.70	It occurs when a person partakes in entertainment activities in order to attain personal satisfaction (Davis et al., 1992)	<i>"This is a lot more fun than I expected and is a great escape to watch a movie on a "big screen with surround sound" with the outside world shut out for a while. I'm also enjoying some of the fantastic VR apps."</i>
Perceived Discomfort	39	% 9.51	Due to keeping the device at eye level, head-based displays have a negative	<i>"The first couple of days using the Vive gave was uncomfortable"</i>

			impact, leading to physical discomfort (Suh & Prophet, 2018)	
Perceived Aesthetic Appeal	2	% 0.04	The level of perception regarding design or vogue (Nam et al., 2007)	<i>"The controllers are brutal in their design, side push bumpers are hard to depress and starting to wear after an intense month or two."</i>
Perceived Focused Immersion	39	% 9.51	The experience of total engagement where other attentional demands are, in essence, ignored (Agarwal & Karahanna, 2000, p. 673)	<i>"I feel much more immersed in games, shooting and picking up objects with my real hands provides gameplay experiences I've never experienced before, and I don't even notice the low resolution anymore because I'm so immersed and most gameplay with these controllers involves interacting with objects close to you".</i>
Temporal dissociation	34	% 8.2	The inability to perceiving the spent of time during the interaction with a particular task (Agarwal & Karahhana, 2000)	<i>"More times than I could count I would forget that I am in the game and try to actually touch items in the environment".</i>
Perceived Visual Appeal	30	% 7.31	The level of perception regarding design or vogue (Nam et al., 2007)	<i>"The controllers are brutal in their design, side push bumpers are hard to depress and starting to wear after an intense month or two."</i>
Perceived Complementary Goods	21	% 5.12	As extra goods and services that improve the value of another product (Schilling, 2010).	<i>"Limited contents and most of the available contents require purchase. My use is to mainly watch videos, so for me it is okay as I can upload my own video and play it through Oculus Theater or Samsung VR"</i>
Perceived Spatial Quality	11	% 2.68	Perceptions of the size, emptiness and tranquillity of the setting to which the VR experience is occurring.	<i>"That's how important space is to the experience. VR sitting is a novelty. VR in room scale is mind blowing. The more you can move around in the space, the more immersive your experience will be. Forget everything else, room scale and size of space is king when it comes to VR."</i>
Perceived External Compatibilities	21	% 5.12	The degree to which the innovation is perceived as being consistent with existing values, past experiences, and existing technology of potential adopters' (Rogers, 1995, p.236).	<i>"Keep in mind when buying this your computer needs to be a new computer with high storage and the newest technology. Otherwise you will end up sending it back saying not compatible with technology"</i>
Perceived Health Risk	30	% 7.31	The potential loss of consumers' health as a result of their use of technology	<i>I've realized humans can go with very little sleep. How did I realize that? I've spent the last nights sleeping only 3 hours because I'm completely addicted to VIVE"</i>

Perceived Privacy Risk	2	% 0.04	The potential privacy loss incurred when chasing a desired outcome (Featherman & Pavlou, 2003)	<i>"My only concern is that Facebook owns Oculus now and I don't trust Facebook for my information privacy."</i>
Perceived Autonomy	7	% 1.70	As their sense of independence in making decisions (Dwyer et al., 2007).	<i>"I love the freedom of movement you have even with the tether. Some movement is restricted by my VR software, but it can be overlooked. They really do become "hands" in the VR space, and they are quite intuitive to use and become second-nature after only a few minutes of use. The sense of presence in the VR world is significant with the sensors and controllers giving you freedom of movement and to use your hands but caution should be considered."</i>
Price value	24	% 6.2	As the trade-off between the financial benefits and cost of any product or service (Dodds et al., 1991).	<i>"I paid this for \$350 and I was worry if this is the right investment. I read a lot of reviews and articles before purchasing this item and it was a mixed review. let me know tell you right now; if you are a visual person and enjoy watching videos... any videos (i.e. travelling videos, music videos, video games, and yes adult materials) get this NOW!"</i>
Enhancement of services and products-Customer support	20	% 4.87	The perceived amount of help consumers get from a company or brand when trying to find answers to their questions or solutions to their problems	<i>"Over the next month we managed to diagnose the problem ourselves and was due to rather poor product design that makes it extremely susceptible to water damage. Such damage was covered by their warranty, but their representative in customer service was unhelpful at best and seemed to ignore our replies."</i>
Perceived Future Functions	19	% 4.63	The expected utilitarian functionality of high-technology products in the near future.	<i>This is a first-generation headset you can expect that, as with both Oculus and Vive, there will be future improvements in later models to make this lighter, powerful and even more comfortable."</i>
User reactions	25	% 6.09	The use behavior of actual users through the number of times that a periodic function repeats itself at a specified time (Dehghani et al., 2018)	<i>"So this was an interesting snapshot of where the technology is and while I do not regret the purchase I also think that anyone accustomed to high-resolution content and intuitive experiences on their phone or tablet or laptop or television is at risk of being disappointed with this unit."</i>

¹Total overall perceptions towards the content analysis of themes throughout the transcript page

3.2. Study 2 – Quantitative Survey

The following section provides a detailed description of the survey methodology used for Study 2. We begin with hypotheses development followed by data collection and data analyses. Regarding the constructs identified in Study 1, five constructs had robust scales (content analysis) and had high relevancy for the post-adoption of VR devices according to the results of table 3. These constructs were perceived discomfort, focused immersion, temporal dissociation, perceived health risk, and task quality.

3.2.1. Theoretical Background

3.2.1.1. Information System (IS) Continuance Theory

The Information System (IS) Continuance Model was introduced by Bhattacharjee (2001) to reveal post-adoption behaviors of information technologies. A fundamental theory describing IS continuance model is based on expectation-confirmation theory (ECT), or expectation-disconfirmation theory (EDT) (Bhattacharjee, 2001). This model explores the continuous intention of IS users and demonstrates the primary constructs that lead to continued use of IS (Bhattacharjee, 2001). Although the first acceptance of IS is a crucial part, Bhattacharjee (2001) asserts that the continued usage represents the long term achievement in the post-adoption behaviors for IS. The field of post-adoption research hunts IS users' beliefs, attitudes, and behaviors to explore whether they have continuance intention or not (Fleischmann et al., 2016). In the based model, Bhattacharjee (2001) investigated the effect of perceived usefulness and satisfaction on continuance intention. However, it has been asserted that based on the users' experience with IS, their beliefs, attitudes, and behaviors might switch during continuous use (Bhattacharjee and Premkumar, 2004). Hence, with high-speed technology developments, continuance intention might be determined by different constructs depending on the different research settings.

It is also highlighted that companies also require to preserve existing consumers and promote their continued purchase (Gao et al., 2015). Hence, continuance intention during the explanation of post-adoption behaviors, in the current literature, has achieved importance in several studies. The topic has been examined in distinct context; e-learning under the education area (e.g., Hayashi et al., 2020), health (e.g., Mellikeche et al., 2020), online banking (e.g., Bhattacharjee, 2001), Enterprise 2.0 (e.g. Jia et al., 2017), software updates (e.g., Fleischmann et al., 2016), mobile apps (e.g., Tam et al., 2020), online social networking sites (e.g. Li & Wang, 2017), augmented reality (AR) applications (e.g., Li et al., 2020; Kim et al., 2016), mobile internet (e.g., Thong et al., 2006), wearable technology (e.g., Nascimento et al., 2018). However, there is a lack of research on IS continuance model in the context of VR such as VR device usage or VR based applications in the current literature. Based on this discussion, to fill this gap in the literature, we aim to understand consumer perceptions of VR devices in the post-adoption behavior by applying IS continuance theory.

3.2.2. Hypothesis Development

The following section proposes a set of hypotheses for Study 2. This study introduces a new model (Fig. 1) to investigate the principal factors influencing the continuous intention and usage towards virtual reality devices. The data is collected from current users of virtual reality devices, Below, we elaborate on the constructs and theoretical justification for the proposed model.

3.2.2.1. Perceived Discomfort

Following the definition of perceived comfort which is defined by Herz and Rauschnabel (2019), we define perceived discomfort as the psychological state of physical discomfort that is representative of dissatisfaction regarding the design and the usage of any technological device. Within the VR context, perceived discomfort occurs when users have adverse experiences, such

as insensitivity of the body, injury, and tiredness (Kuijt-Evers, Twisk, Groenesteijn, De Looze, & Vink, 2005; Suh & Probhet, 2018). Physical discomfort is consistent with previous studies that demonstrate that discomfort has considered as one of the negative factors affecting the usage of technology (e.g. Fisk, Patricio, Lin, & Chang, 2011; Parasuraman, 2000; Walczuch, Lemmink, & Streukens, 2007). Overall, perceived discomfort is one of the adverse antecedents of extended reality consisting of virtual, augmented, and mixed reality (Chuah, forthcoming).

While the continuous intention represents a user's intention to continuously use the instant product or service currently being used, the usage behavior of actual users measures the number of times that a periodic function repeats itself at a specified time (Hong, Lee, & Suh, 2013; Dehghani, Kim, & Dangelico, 2018). Hence, based on the aforementioned discussion, we posit the following:

H1. Perceived discomfort is negatively associated with the continuance intention of virtual reality devices.

H2. Perceived discomfort is negatively associated with the actual usage behavior of virtual reality devices.

3.2.2.2. Perceived Focused Immersion

The sensation of immersion, such as that faced in virtual worlds, has been previously proved as an antecedent condition to both telepresence and social presence (Baker et al., 2019). Perceived focused immersion is described as the psychological process of engagement with a task or activity while neglecting attentional demands (Agarwal & Karahanna, 2000; Georgiou & Kyza, 2017; Hess, Fuller, & Mathew, 2005). In this context, a user is deeply involved in an immersive environment (Sherman & Craig, 2003) and this immersive environment enables the user to have

the absorb, interact, and engage with the environment, while disconnecting themselves from the real world (Biocca & Delaney, 1995; Palmer, 1995; Teng, 2010). Zhou (2013) states that when people are immersed in mobile sites, they are less involved with their surroundings, and subsequently may lose their sense of time. (Zhou, 2013). Even though the perceived focused immersion has been examined in various contexts, it is often referred to in virtual environments (Christou, 2014). Focused immersion can be considered as the experience of total engagement where other attentional demands are, in actual fact, passed over (Agarwal & Karahanna, 2000).

In such virtual environments, creating an immersive reality is one of the most important goals (Shin & Biocca, 2018). This is because focused immersion has a positive impact on users' intentions in the virtual environment (Goel, Johnson, Junglas, & Ives, 2013). Lee et al., (2012) found that immersion (e.g., escapism and esthetic experiences) impacts overall museum experience, and eventually intention to visit the actual museum. Moreover, elevated perceived immersion leads to positive behavioral intentions such as positive brand attitude or high purchase intention (Biocca, Burgoon, Harms, & Stoner, 2001). In recent literature, it is suggested that immersion is one of the most essential antecedents that should be examined, and it is one of the most influential factors enhancing users' attitudes and future intentions to use a VR device (Chuah, forthcoming; Shin & Biocca, 2018). We, therefore, propose the following hypotheses:

H3. Perceived focused immersion is positively associated with the continuance intention of virtual reality devices.

H4. Perceived focused immersion is positively associated with the actual usage of virtual reality devices.

3.2.2.3. Temporal Dissociation

Temporal dissociation is the inability to allocate the passage of time while engaged in a particular task and activity (Agarwal & Karahanna, 2000). It is associated with the notion of flow such as "the transformation of time" and "of time distortion". (Csikszentmihalyi, 1990; Novak, Hoffman, & Young, 2000; Rutkowski, Saunders, Vogel, & Van Genuchten, 2007). Furthermore, temporal dissociation refers to the term "psychological clock" to demonstrate time distortion (Levine, 1997). This occurs when people have intense and deep engagement in virtual reality environments, such as being immersed within a video game (Chen, 2006). Wei, Qi, & Zhang (2019) found that perceived time flies rapidly during the usage of the virtual community since visitors visiting the museum are profoundly involved without being unaware of the passing time. As a result, users that experience temporal dissociation are found to have the perception of less time feeling (Skadberg & Kimmel, 2004; Lee, Li, & Edwards, 2012).

Temporal dissociation is one of the sub-constructs of cognitive absorption. Therefore, it is not sufficiently examined yet separately. Whereas, it is thought that examining each construct of cognitive absorption lead to give more significant ideas about virtual reality environments (Rutkowski et al., 2007). In the existing literature, Tan, Lee, & Hsu (2015) found that high temporal dissociation is a moderator that decreases the impact of satisfaction on continuance intention. While there is fragmented research in the domain of temporal dissociation and its impact on technological devices, we infer that higher temporal dissociation may lead to a higher level of continuous intention and usage of VR devices. Therefore, to bridge the gap in the context of temporal dissociation for VR devices, we hypothesize the following:

H5. Temporal dissociation is positively associated with the continuance intention of virtual reality devices.

H6. Temporal dissociation is positively associated with the actual usage of virtual reality devices.

3.2.2.4. Perceived Health Risks

Perceived health risk is defined as the potential loss of consumers' health as a result of using the technology. In other words, it is considered that the perceived health risk is a result of the adverse outcomes of any user's health on using technological devices. Numerous studies also approved that perceived health risk might apply an adverse effect on technology usage (e.g., Egea & Gonzáles 2010; Ernst; 2015; Herz & Rauschnabel, 2019; Tan, 1999). For instance, x-rays or radioactivity stemmed from technological devices may lead to headaches, fatigue, insomnia, and eye irritation (Chuah, 2019). Consequently, these health issues may prevent further usage of technological devices. In particular, in the case of VR devices, health risks have negatively impacted usage experience with the product (Chuah, 2019). This has led to reducing users' trust and adoption propensity (Luo, Zhang, & Shim, 2010; Verkijika, 2018). Furthermore, Stock, Dos Santos Ferreira, & Ernst (2016) highlight that perceived health risk has a negative and indirect effect on behavioral intentions. Together, we propose that the following hypotheses:

H7. Perceived health risks are negatively associated with the continuance intention of virtual reality devices.

H8. Perceived health risks are negatively associated with the actual usage of virtual reality devices.

3.2.2.5. Task Quality

Task quality refers to the degree to the users' relevance, importance, familiarity, and usage towards task or activity. It is also associated with functionality, which relates to how easier and quicker a technological device allows certain tasks to be completed (Herz & Rauschnabel, 2019). Hence, task quality is achieved when a user considers that the task to be of value, further leveraged

by the use of the technological device. Also, Sagnier et al. (2020) found that perceived ease of use is influenced by pragmatic quality.

In the existing literature, task quality also refers to individuals' evaluations of task-relevant consequences such as product (Sasser & Sørensen, 2016). Task quality can also be explained by the information structure in the task. That is, to achieve quality, the information in the task should not be too complex; this is to ensure that the task performance can be positively affected (Lankton, Speier, & Wilson, 2012). Even though task quality has been partially investigated in the context of education (e.g. Amosa, Ladwig, Griffiths, & Gore, 2007), job satisfaction (e.g. Sasser & Sørensen, 2016), and Internet-based system (Gupta, Li, & Sharda, 2013; Lankton et al., 2012), in the case of technological devices, task quality has not been adequately examined. When the aim of task quality is taken into consideration, task quality can be one of the effective antecedents of usage behavior of VR devices. We therefore propose the following:

H9. Task quality is positively associated with the continuance intention of virtual reality devices.

H10. Task quality is positively associated with the actual usage of virtual reality devices.

3.2.2.6. Continuance intention

Continuance intention is described as “a user’s intention to continuously use the instant product or service currently being used” (Hong et al., 2013). In other words, a user's intention is based on a decision process where s/he might choose and utilize the products or services (Dehghani & Tumer, 2015). Continuance intention is a critical predictor that helps to understand a person's conscious plans to achieve a specific behavior (Agudo-Peregrina, Hernández-García, & Pascual-Miguel, 2014; Venkatesh, Thong, & Xu, 2012). In the technology context, Venkatesh, Morris, Davis, & Davis (2003) have stated that the effect of user behavior is measured by using the technology of

behavioral intention. Moreover, the Technology Acceptance Model (TAM) suggests that behavioral beliefs also affect attitudes toward technology usage (Davis, 1989). Even though continuance intention is often examined in the context of technology (e.g. Dehghani et al., 2018; Hong, Lin, & Hsieh, 2017; Nascimento, Oliveira, & Tam, 2018; Oghuma, Libaque-Saenz, Wong, & Chang, 2016), use behavior of actual users remain unexplored; explaining the number of times that a periodic function repeats itself at a specified time (Venkatesh et al., 2012). Therefore, we propose the following hypothesis:

H11. Continuance intention is positively associated with the actual usage of virtual reality devices.

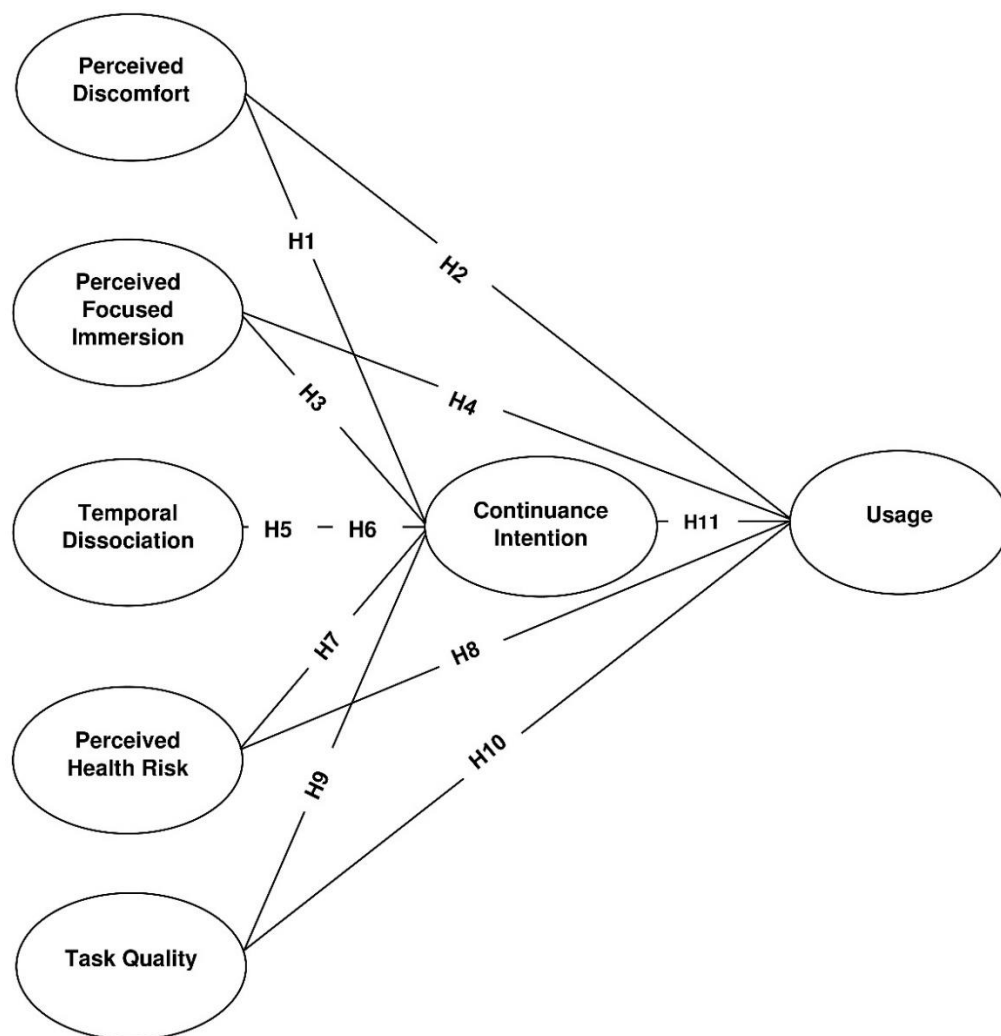


Fig. 3. The conceptual research model

3.2.3. Data Collection

Data were collected through a survey of VR users. The questionnaire was distributed through the top ten most active Virtual reality groups on Facebook to reach as many respondents as possible. Data collection lasted two months (November 2019 – January 2020). A total of 136 responses were received. 8 participants indicated that they received the device as a gift, and thus were eliminated from the final sample to increase the reliability of data. Further, to determine whether the participants in this study are actual users, we ask all respondents to clearly determine their date of purchase for the VR device to confirm their usage history. Finally, after reviewing the sample and pruning duplicate and incomplete responses, 119 valid responses were remained for the final analysis (27% female and 73% male). To determine whether non-response bias was present, we followed guidelines set forth by Armstrong and Overton's (1977). We compared the demographic and main variable responses (adoption factors) of early and late participants. The findings indicated no significant differences between the early and late respondents. Hence, we have confidence that non-response bias is not present. Further, there were no differences between the average purchase time and users' responses to the survey.

4. Data Analysis

This research utilized PLS-SEM analysis technique via SmartPLS version 3.2.8. The rationale for this selection is that PLS-SEM is designed to maximize the total variance explained (R^2) by the latent variables making its core goal to predict target constructs (Hair, Ringle, & Sarstedt, 2011). Also, Smart PLS is well suited to analyze the data with limited sample sizes and is advantageous for highly complex predictive models which is more appropriate than other statistical applications for this study (Hair et al., 2019; Ringle, Da Silva and Bido, 2015). Further,

this method allows the presentation of formative and reflective measures and shows fewer demands on the normal distribution of data. Finally, PLS-SEM is suitable because it can produce latent variable scores for lower-order constructs and precisely estimate constructs without modifying its specifications (Hair, Sarstedt, Ringle, & Gudergan, 2018). In terms of reporting and conducting PLS-SEM, the research at hand mirrored the standard evaluation guidelines indicated by Hair, Hult, Ringle, and Sarstedt and Thiele (2017) and Hair, Sarstedt, Ringle, and Gudergan, (2018). As recommended, we performed the analysis in two stages: (a) measurement model and (b) the structural model.

Additionally, when using self-reported data, the possibility of common method bias may emerge. To test for common method bias, Harman's one-factor test was used (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). The results indicate multiple factors and that these factors, combined, explain <50% of the total variance. This verifies that common methods bias is not present for in this dataset (Suh, Kim, & Suh, 2011).

4.1. Measurement Model

The initial model included gender and age as control variables. When both indicated variables are removed, the effect on the variance described in the outcome variables (t-values ranged in 0.7 and 1.1) was marginal, if any. The measurement model was tested to confirm whether the constructs had adequate validity. Reliability was measured by means of internal consistency scores determined by composite reliability scores. Internal consistency scores are acceptable if they surpass the 0.70 thresholds (Hair et al., 2018). Regarding usage (i.e., formatively measured construct), the multicollinearity between indicators was first calculated by assessing the variance inflation factor (VIF). The VIF inner and outer values for five formative indicators ranged from 1.

051–1.125, which were lower than the suggested value of 5; indicating formative indicators were not highly correlated (Diamantopoulos & Siguaw 2006; Hair et al. 2017).

Table 4
Measurement Model

Instrument Items	Loadings	α	CR	AVE
<i>Perceived Health Risk (BHR)– Adopted from Featherman and Pavlou, (2003)</i>				
BHR1: VR device is harmful to wear.	(0.83)	0.87	0.92	0.80
BHR2: Wearing VR device would expose me to health risks.	(0.93)			
BHR3: Wearing VR device would have adverse effects on my health.	(0.92)			
<i>Perceived Focused Immersion (PFI)– Adapted from Agarwal & Karahanna (2000)</i>				
PFI1: While using VR, I am able to block out most other distractions.	(0.67)	0.81	0.87	0.64
PFI2: While using VR, I am absorbed in what I am doing.	(0.90)			
PFI3: While in VR, I am immersed in the task I am performing.	(0.93)			
PFI4: When in VR, I get distracted by external influences very easily (removed).	(0.65)			
PFI5: While in VR, my attention does not get diverted very easily.				
<i>Perceived Temporal Dissociation (PTD)–Adapted from Agarwal & Karahanna (2000)</i>				
PTD1: Time appears to pass by very quickly when I am using VR.	(0.87)	0.90	0.93	0.78
PTD2: I lose track of time when I am using VR.	(0.89)			
PTD3: Most times when I use VR, I end up spending more time than I had planned.	(0.92)			
PTD4: Overall, I often spend more time on VR than I had intended.	(0.83)			
<i>Perceived Discomfort – Inspired from Kuijt-Evers et al., (2005)</i>				
PD1: While using VR, I feel pressure on my head.	(0.93)	0.88	0.92	0.81
PD2: While using VR, I feel cramped muscles.	(0.91)			
PD3: While using VR, I feel inflamed skin on the face.	(0.85)			
<i>Task Quality – Adapted from Lankton et al., (2012) & Gupta et al., (2013)</i>				
While using VR, I can perform related tasks:	(0.77)	0.89	0.91	0.65
TQ1: Flawless	(0.76)			
TQ2: Reliable	(0.83)			
TQ3: Precise	(0.87)			
TQ4: Accurate	(0.84)			
TQ5: error-free	(0.75)			
TQ6: Correct				
<i>Continuance Intention (CI)- Adapted from Lin et al., (2005)</i>				
CI1: I intend to continue using VR rather than discontinue its use.	(0.90)	0.83	0.90	0.75
CI2: My intentions are to continue using VR rather than use any alternative means.	(0.80)			
CI3: I expect my use of VR to continue in the future.	(0.89)			
<i>Usage frequency (Usage)-Adapted from Venkatesh et al., (2012)</i>				
Usage (how often do you use your VR device for each of the following activities):	(0.05)	n/a	n/a	n/a
Watching video/Movie	(0.78)			
Gaming	(0.66)			
Web Browsing	(0.15)			
Virtual chat	(0.00)			
Others				

Note: AVE=Average Variance Extracted; α = Cronbach's alpha; CR = Composite Reliability. All measures used seven-point scales where higher values indicate greater agreement or higher evaluation.

Table 4 shows that all constructs demonstrate good internal consistency. The Heterotrait-Monotrait Ratio (HTMT) (Henseler, Ringle, & Sarstedt, 2015; Hair, Sarstedt, & Ringle, 2019) was used to affirm the discriminant validity. As outlined in Table 5, all HTMT values fell below the threshold of 0.90. The AVE for all constructs surpassed the correlations between any given construct and all other constructs. When contrasting inter-construct correlations with the AVE, all constructs share a higher variance with their own indicators than to the indicators of other constructs.

Table 5
Heterotrait - Monotrait Ratio

	CI	PC	PFI	PHR	PTD	TQ
CI						
PC	0.305					
PFI	0.377	0.288				
PHR	0.347	0.081	0.23			
PTD	0.4	0.157	0.167	0.107		
TQ	0.151	0.093	0.2	0.053	0.122	

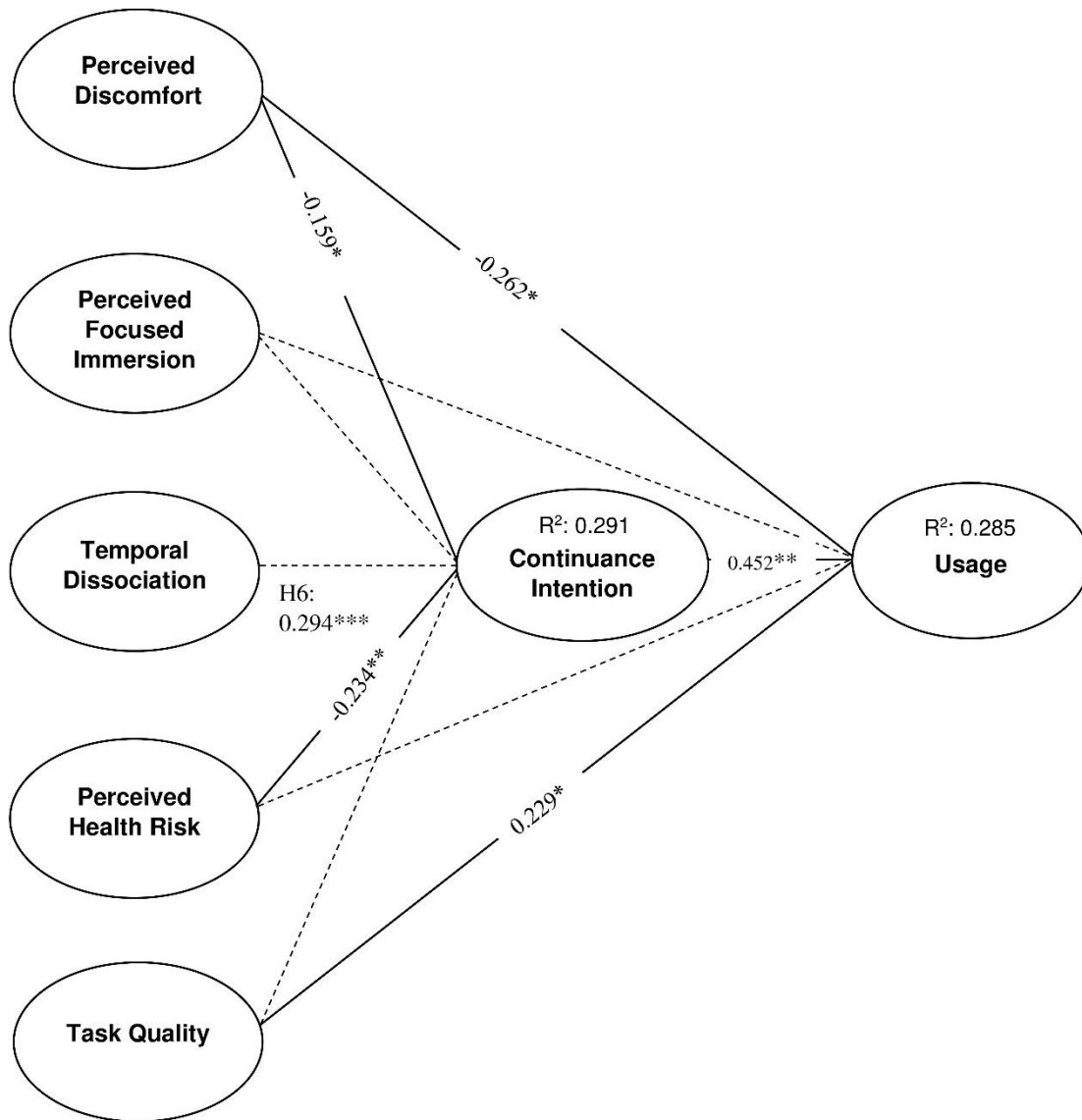
Further, the standardized root mean square residual (SRMR) did not indicate any concerns regarding the model fit (SRMR = 0.071). In addition, when latent variables with high levels of internal consistency are in the model, more attention should be given to the model's predictive relevance to be aligned with the casual-predictive goal of SEM-PLS. Therefore, the relevance of prognoses (Q2) should be considered. To do so, the Stone-Geisser criteria with a blindfolding procedure with an omission distance of 7 was used (Tenenhaus & Hanafi, 2010). The results verify that the Q2 value (0.172) is greater than zero indicating the model has high predictive validity (Hair, et al., 2017; Henseler et al., 2015).

4.2. Structural Model

Once the measurement model has been assessed, the structural model is analyzed to test the hypotheses. The PLS bootstrap resampling procedure, using an iteration of 1000 sub-samples selected with replacement from the original sample, was used to ensure the stability of the model and generate the percentile bootstrap P values. The R2 measure and the level of path coefficient significance were used to evaluate the structural model. The results of the analysis (PLS structural model) are shown in Figure 4 and the results of the hypothesis testing are summarized in Table 6.

Hypotheses	β	P-value	t-values	Results
H1: Perceived Discomfort→ Continuous Intention	-0.159	0.034	1.826	Supported
H2: Perceived Discomfort → Usage	-0.262	0.014	2.542	Supported
H3: Focused Immersion → Continuous Intention	0.194	0.06	1.552	Not Supported
H4: Focused Immersion → Usage	-0.035	0.401	0.251	Not Supported
H5: Temporal Dissociation → Continuous Intention	0.105	0.232	0.731	Not Supported
H6: Temporal Dissociation → Usage	0.294	0.000	3.673	Supported
H7: Perceived Health Risk→ Continuous Intention	-0.234	0.002	2.822	Supported
H8: Perceived Health Risk→ Usage	0.039	0.313	0.377	Not Supported
H9: Task Quality→ Continuous Intention	0.091	0.733	0.232	Not Supported
H10: Task Quality→ Usage	0.229	1.937	0.031	Supported
H11: Continuous Intention → Usage	0.452	0.002	2.94	Supported

Table 6 Hypothesis Results



Note: $*p < .05$, $**p < .01$, $***p < .001$

H^6 : The relationship examines the impact of continuance intention to usage.

Fig. 4. PLS Structural Model with Path Coefficients

4.3. Results

The results show that perceived discomfort and perceived health risk both had a significant negative relationship to continuous intention of VR devices ($\beta = -0.159$, $t = 1.826$, $p < 0.034$; $\beta = -0.234$, $t = 2.822$, $p < 0.002$). Moreover, the results indicate that perceived discomfort had a

significant negative effect on the actual usage of VR devices ($\beta = -0.262$, $t = 2.542$, $p < 0.014$). Further, the temporal dissociation and task quality relationship were found to have a positive relationship on actual usage ($\beta = 0.294$, $t = 3.673$, $p < 0.000$; $\beta = 0.229$, $t = 1.937$, $p < 0.031$). Focused immersion was found to be non-significant factors for both continuous usage and actual usage ($\beta = -0.194$, $t = 1.552$, $p > 0.06$; $\beta = -0.035$, $t = 0.251$, $p > 0.401$). Finally, the continuous intention towards usage was significant ($\beta = 0.452$, $t = 2.94$, $p < 0.002$).

5. Discussion

Despite the revolutionizing potential of VR in various industries, there exists some barriers to consumer adoption. In reviewing the post-adoption stage of VR consumers, this research provides may provide key insights to the success and demise of the VR market. Here, we employed a mixed-method approach, developing eight classifications of the post-adoption stage of VR consumers (qualitative investigation), and subsequently, five factors were chosen to test its impact on continuous usage and intention of VR devices (quantitative investigation). The classifications borne from a netnographic inquiry revealed nine classifications which included: technology-specific aspects, fashion aspects, media aspects, environment, and external factors, perceived risk, healthtology, manufacturer related aspects, perceived future functions, and user reactions. Considering the existing constructs in the domain of adoption, the objective of our work was to pay closer attention to the post-adoption factors. Therefore, not only do we provide a holistic framework towards the continuance usage of VR devices, but we also uncover emergent themes unique to HMD-based VR experiences (i.e., perceived spatial quality)

As noted via our content analyses, VR is immersive and provides users with a real sense of presence in the virtual world. On the other hand, VR consumers have identified that they are concerned with both the perceived health risk and visual appeal of VR devices. Notably, their top

concern was the lack of comfort in using a VR device. These three factors are highlighted as the main barriers towards the continuance usage of VR devices. Moreover, consumers have expressed that the head-mounted device of VR can be heavy and bulky, with some users claiming that they feel “trapped” when wearing the headset. This demonstrates that developers must be cognizant of the ergonomic design of VR devices, and redesign and customize based on user demographic factors.

With regards to the quantitative results, task quality and temporal dissociation were found to be a positive indicator of actual usage, while perceived health risk and perceived discomfort were two significant barriers towards continuance usage and actual usage of VR devices, respectively. Regarding the non-significant findings, it can be further inferred that focused immersion is not predetermined for both continuous usage and actual usage, but it is only reconstructed through users’ activities and actions. Since VR devices distinct from other consumer electronics on the creation of virtual environment which should be vivid and fun, it is expected that Focused Immerse features the use of the target VR device. Therefore, the insignificant effects of focused immerse is very surprising and deserves a much extended comprehensive discussion in future studies. However, a reasonable justification for this outcome is because of the context selected in this study. Users often perform many tasks while using VR devices simultaneously which involves multitasking and coordination.

Chuah (2019) have stated that immersion should be investigated as an antecedent of users' attitudes and behavioral intention. Moreover, Dehghani et al. (2020) have also stated that immersion in the existing literature does not offer a comprehensive measurement to verify the relationship with behavioral intention. Based on these, immersion is a relatively new construct to examine the effect of itself on the behavioral patterns. The impact of immersion can change in

each context. VR devices are a relatively new technology for users. Hence, we did not find any direct empirical evidence between focused immersion and behavioral usage, and continuance intention. That's why this part of our study to figure out how to enhance the feeling of focused immersion feeling is crucial for the brand managers of the VR devices.

The contribution of this study is to clarify how users perceive task quality and temporal dissociation and enact them using VR devices, how recognized task quality plays a role in the development of usability in a VR, and how technological features lead to improving actual usage. Also, the findings demonstrate that the perception of temporal dissociation in continuance usage and actual usage are different, which should be distinguished in the post-adoption phase. The perception of VR's task quality whether is capable of meeting specified requirement by users is one key factor for achieving a market breakthrough for a system (Kurilovas, 2016); although, it is worth noting that perceived discomfort may interfere with users' continued interest in the VR technology.

5.1. Theoretical Contributions

Research in understanding the post-adoption phase of VR users has been limited, and thus, gaining insight into the different factors that contribute to post-adoption behaviors by applying IS continuance theory is of value. Here, a holistic framework has been developed to examine the continuance usage of VR devices, of which some new emergent themes such as perceived spatial quality and perceived effort reduction were presented. As a result of that, we answer Laurell et al's (2019) call and reveal novel antecedents and examine their effect on continuous intention and usage. Further, going beyond previous studies, this study considers focused immersion and temporal dissociation separately and examine the differential effect (if any) of the two cognitive absorption elements on continuance intention and actual usage. In other words, this study further

enhances the research on cognitive absorption by determining that the different factors of cognitive absorption can act differently for continuous intention and actual usage.

5.2. Industry Implications

The ability to identify consumer reactions to the adoption of VR devices and platforms may help companies to minimize the risks as it relates to tech initiatives. By focusing on what the consumers are concerned about, manufacturers can better meet expectations and in turn, increase VR adoption. One of the issues consumers expressed was the prevalence of nausea and motion sickness while wearing the headset for extended periods. Therefore, manufacturers are advised to consider novel design methods (motion control technologies, i.e., BodyNav) to provide a more realistic full-body experience.

Manufacturers should also be cognizant of user comfort. By allowing the headset to be more adjustable and customizable, consumers may feel more encouraged to integrate it into their daily life. In addition, some users have stated that VR encourages a stationary lifestyle and consumers may inadvertently spend too much time with the device. To counter this, manufacturers can integrate warning notifications when a certain usage time has been reached. Moreover, with the growing concern for visual appeal, VR devices should consider factors to improve user satisfaction, such as resolution quality. Lastly, perceived spatial quality increases the feeling of immersion and could be utilized to integrate other artificial features that will enhance the quality of the experience. Further, content creators can develop more immersive feelings with a live narrative to satisfy VR users, in particular, in gaming or adult entertainment industries.

According to the result of this study, a higher temporal dissociation increases the actual usage. This result implies that application software developers should make a rigorous effort to include more features in their applications that lead actual users to be unaware of the passage of

time while using VR devices' applications. Finally, the VR industry can work to strike a balance between task quality and device quality; understanding the process by which task quality can be converted into users' quality of experience, in particular, for VR game experiences. The industry should affect how to augment users' quality of experience in VR devices rather than solely boosting technical quality.

5.3. Limitations and Future studies

This study is not without its limitations. This research study identified factors influencing the post-adoption of VR, and customer experiences for VR devices as a whole (not brand specific).

This study found that focused immersion is not a predictor of post-adoption because users utilize VR to perform multiple tasks simultaneously. Future studies can consider focused immersion as a moderator to uncover relationships with other variables. One final avenue of future research could be to conduct a longitudinal study to consider how the adoption landscape evolves over time. VR is rapidly developing, meaning the technology, and environmental factors may change. A longitudinal study could capture these changes.

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