Abstract

This dissertation examines the factors that affect consumers' adoption of virtual reality (VR) technologies. Based on Uses & Gratification theory, this study tested factors proposed by previous theoretical models: the Theory of Planned Behavior (TPB), the Technology Acceptance Model (TAM), and the Unified Theory of Acceptance and Use of Technology (UTAUT). It also explores the roles of additional factors, such as perceived risk, negative emotions, motion sickness, and discomfort, in shaping consumers' intentions to purchase and use VR devices.

The study employs an online survey to collect data from a convenience sample of adults aged 18 or older. The results show that different models have varying explanatory power for VR adoption behavior and that perceived risk and comfort have significant impacts on consumers' purchase and usage intentions. This study also proposed a new model aiming at providing a better understanding of how consumers adopt VR technologies. The study contributes to a better understanding of the challenges and opportunities for promoting VR adoption across various domains and applications.
Keywords: Virtual Reality, U&G, TPB, TAM, UTAUT, Intention

Why are VR headsets collecting dust? The exploration of potential factors affecting media consumer's adoption of VR technologies

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I.INTRODUCTION

On October 28, 2021, Mark Zuckerberg, the founder of Facebook, made a momentous announcement, revealing a significant shift in the company's direction by changing its name to Meta. This change symbolizes the company's unwavering commitment to developing the "metaverse" (Facebook, 2021). The metaverse, as described by Meta, is "an immersive virtual environment where we can work, play, and connect with others" (Facebook, 2021). This new focus entails a substantial investment in hardware, software, and content, all aimed at constructing a vast, intricate virtual space that offers users an alternative reality within the digital realm.

The idea of the metaverse is not entirely new. The term first appeared in 1992, when author Neal Stephenson introduced it in his science fiction novel "Snow Crash" (CNBC, 2021). The narrative revolves around individuals employing digital avatars to explore an online world (CNBC, 2021). Elements of this concept have existed in various forms since the advent of computer games and the internet. However, the metaverse distinguishes itself as a unique evolution of the virtual world in which we currently engage.

When examining the metaverse as a distinct form of media, it becomes evident why it transcends traditional internet experiences. Throughout the history of communication research, media has consistently reflected and emulated the physical and social environment. Early newspapers and radio provided one-dimensional information delivery, which limited users' perception of the world around them. In contrast, television revolutionized media consumption by presenting vivid, lifelike content. Similarly, virtual reality (VR) headsets used as a gateway to access the metaverse offer an information-rich experience, thanks to advancements in extended reality (XR) technologies that enable a sense of escape or presence (Biocca & Delaney, 1995).

Meta is not the only company investing heavily in the development and improvement of immersive technologies. Major computing and graphics chip corporations such as Nvidia, Intel, and AMD are all dedicated to refining these innovative technologies. Nvidia has even introduced the concept of "digital twinning," where real-world objects are replicated digitally within virtual environments (Nvidia, 2022). Furthermore, Sony has launched its second-generation PlayStation VR headset, and numerous hardware companies, including HTC, HP, and PICO, are actively exploring the potential of these groundbreaking technologies.

Given the marketing efforts surrounding these products, one would expect widespread adoption of VR headsets if they were as revolutionary as they are portrayed. However, the global consumer VR market is projected to reach only $5.1 billion by the end of 2023 (Stasia, 2023), a relatively modest figure compared to other technology sectors. In fact, Apple generated $40.67 billion in revenue from iPhone sales in just the third quarter of its 2022 fiscal year (Apple, 2022). Additionally, among VR headset owners, many devices remain underutilized, with only 28% of owners reporting daily use (Greenlight Ventures, 2022).

Market research suggests that the primary barrier to widespread VR adoption is the user experience. Approximately 20% of potential customers and businesses are hesitant to embrace VR technology due to its shortcomings (Statista, 2022). Issues such as bulky headsets, motion sickness, tangled wires, and subpar VR content are common complaints. Even Meta's initial social VR platform, Horizon, faced criticism for its poorly designed content.

This dissertation aims to delve deeper into the reluctance of individuals to utilize VR devices to access virtual environments by examining the issue more systematically and theoretically. This study drew upon the Theory of Planned Behavior, the Technology Acceptance Model, the Unified Theory of Acceptance and Use of Technology model, and the Uses and

Gratifications Theory and identified potential factors that provide explanations for why people do not actively use virtual reality devices. To validate each model, a nationwide online survey was distributed. The data provided valuable insights into this issue and contributed to a better understanding of people's attitudes toward VR technology.

Virtual reality as a unique medium

Virtual reality stands out as a unique medium because it allows users to experience content in a more immersive and interactive way than other media. As a communication medium, virtual reality facilitates the transmission of messages through a digital environment, enabling users to interact with one another and the virtual world itself (Baym, 2010).

VR provides a sense of "presence" that is unparalleled in other media forms (e.g., newspaper and Television; Biocca & Delaney, 1995; Biocca & Levy, 2013). In VR, users are fully immersed in the digital world, experiencing it through visual, auditory, and sometimes haptic and olfactory stimuli. They feel as though they are inside an interactive digital environment rather than passively viewing a screen. In contrast to traditional media like television or movies, which provide a one-way communication channel from the content creator to the viewer, VR enables users to interact with the digital environment in real time, offering a more engaging and personalized experience. This interactivity can foster a stronger emotional connection with the content, leading to a more memorable and impactful experience for users (Gorini et al., 2011).

Similar to other media forms such as video games and online games, VR enables social interactions, allowing users to express themselves, share information, and collaborate with others (Castronova, 2005). In virtual reality environments, users communicate through avatars, serving as digital representations of themselves. These avatars can display a range of emotions, gestures, and body language, adding depth to the communication process (Davis et al., 2009). Furthermore, virtual reality platforms often support real-time voice communication, enhancing the social experience by facilitating more natural conversations and interactions (Schroeder, 2011).

VR outshines other media forms in its ability to provide a heightened sense of presence, contributing to its effectiveness as a communication medium (Biocca & Levy, 2013). Presence refers to the sensation of being physically located within the virtual environment rather than merely observing it from an external perspective (Slater & Wilbur, 1997). This sense of presence can lead to more meaningful and engaging interactions between users, as they perceive the virtual environment as a shared space that closely mirrors real-life interactions (Yee & Bailenson, 2007).

Additionally, virtual reality's capacity for creating immersive environments with high levels of interactivity promotes a stronger sense of social presence (De Kort et al., 2015). Social presence is the perception of other users as real and distinct within the virtual environment (Biocca et al., 2003). This increased social presence can result in a more authentic sense of connection between users, fostering deeper relationships and more effective communication compared to other media forms (Cummings & Bailenson, 2016).

Lastly, VR is unique because it offers unprecedented control and customization for users. They can tailor their experience by selecting different environments, interacting with objects and characters, and even creating content themselves. This level of control is not possible with traditional media (i.e., newspaper, radio and TV) and limited with some newer media forms (i.e., video games), which restricts the viewer's ability to engage with the content.

Uses and Gratification

While virtual reality's unique characteristics - its immersive and interactive nature, its capacity for fostering social presence, and its provision of control and customization - are well established, understanding the motivations behind why individuals choose to engage with this distinct medium remains pivotal. Considering VR as a unique medium, it is interesting to investigate how its properties fulfill individuals' needs and gratifications and how these subsequently shape users' engagement with this media form. This deeper understanding of individual motivation can be provided by examining the subject through the lens of the Uses and Gratifications Theory (UGT).

In the quest to comprehend people's engagement with various forms of media, the Uses and Gratifications Theory (UGT) has emerged as a principal approach employed by researchers to determine why individuals actively seek out specific media outlets and how they utilize them. Katz, Blumler, and Gurevitch (1973) initially developed the UGT, with early studies concentrating on understanding audience involvement with different media types. UGT attempts to explain how people use communication to satisfy their needs and achieve their goals. From a psychological communication perspective, it focuses on receivers to assess how people use the media (Bryant & Oliver, 2009).

Evolved from the "Uses and Gratifications Model" (Lundberg & Hulten, 1968), UGT assumes that: the audience is actively consuming media content, being variably active communicators rather than passive recipients of messages; the audience member is responsible for the need gratification and media choice; the media compete with other sources of need satisfaction; the audience is able to recognize their need for gratification; and value judgments about the cultural significance of mass communication should not be put into consideration while the audience should be explored on their own terms.

Central to the UGT is the notion that audiences are active agents capable of evaluating media content to fulfill their needs and desires. Studies have shown that audience gratifications can be derived from different sources: media content, exposure to the media, and the social context that typifies the situation of exposure to different media (Katz et al., 1974). By consuming these sources, the audience fulfills the following needs (Katz et al., 1974): cognitive needs, affective needs, personal identity/interactive needs, social interaction, and integration needs, and tension release needs (escapism).

This perspective enables researchers to delve deeper into the motivations and behaviors of media consumers, shedding light on their preferences and choices. Although the UGT often does not serve as a theoretical foundation itself, it is widely employed as a methodology for gathering data to explain various phenomena. This approach has proven particularly valuable in the field of new media technology, where it has been adopted as a fundamental means of understanding human interaction with emerging media forms (Ruggiero, 2000). By utilizing the UGT as a framework for examining the adoption and use of new media, researchers can identify the underlying gratifications that drive individuals to engage with different media platforms. This, in turn, helps to paint a more comprehensive picture of how and why people interact with the ever-evolving media landscape.

II. LITERATURE REVIEW

Definition of immersive virtual reality

The concept of virtual reality (VR) has been a topic of discussion and debate for decades, primarily due to the continuous evolution of VR technology. Although there is no universally agreed-upon definition of virtual reality, some common threads exist in understanding what constitutes immersive VR.

Jaron Lanier coined the term "virtual reality" in 1989 (Krueger, 1991), initially referring to the hardware used to generate a "computer-created environment." Contemporary VR encompasses various hardware components, such as computers, headsets, headphones, and motion trackers. In terms of hardware, modern VR devices are advanced computer systems featuring high-quality, wide field-of-view headsets with six-degrees-of-freedom head tracking. This definition arose in tandem with the consumer market's VR headsets, such as the Oculus Quest, which remains the most prevalent type of VR device.

Lanier's hardware-centric definition was fitting for a VR manufacturer but ultimately generated confusion. Steuer (1992) contended that this hardware focus failed to adequately analyze VR as a medium or an experience. Since VR adoption could be influenced by hardware or content concerns, interpreting survey results on VR adoption proves challenging.

An alternative and more straightforward definition of VR is a "computer-generated world" (Pan & Hamilton, 2018), which encompasses both hardware and content. While this definition is suitable for discussing VR in gaming, where a program creates an environment with defined user roles experienced through devices, it lacks the intricacies necessary for capturing immersive VR's stereoscopic view and multi-sensory experience. According to this definition, desktop VR would also qualify as VR (Slater, 2018).

To address these ambiguities, Bailenson (2019) describe immersive VR as a computer-generated environment that surrounds the user, enhancing their sense of presence within it. This feeling of presence is achieved by fully engaging the user's sensory experience through visual, auditory, and occasionally haptic and olfactory stimuli, creating the illusion of being transported to another location. Instead of merely viewing a screen, users feel as though they are within an interactive digital world.

The definition of VR is multifaceted and continues to evolve. While it initially focused on hardware, contemporary interpretations emphasize the overall experience. The "computer-generated world" definition is simplistic but insufficient for immersive VR. No universal definition for VR exists, but some commonalities can be found in understanding virtual reality, particularly immersive VR.

For the current study examining consumers' perspectives on virtual reality (VR) devices, encompassing both hardware and software experiences, the VR experience is defined as:

"An experience generated by computers that envelop users and enhance their sense of presence within the virtual environment using a combination of virtual reality system hardware, including a high-quality, wide field-of-view stereo head-mounted display and six degrees of freedom head tracking."

This working definition considers the full spectrum of VR system components needed to immerse users and augment their belief in being present within the virtual world. Sophisticated VR setups, featuring high-fidelity graphics, spatialized audio, and intuitive interaction modalities, hold the potential to foster a profound sense of immersion and presence for users. For this study, the definition of the VR experience encompasses both the technical capabilities of the hardware and software systems and the psychological experience of presence and immersion within the virtual environment they facilitate.

Theory of Planned Behavior

For decades, scholars have explored various models to elucidate the intricate relationship between consumer attitudes, intentions, and behaviors. The Theory of Planned Behavior (TPB), developed by Icek Ajzen in 1991, is a renowned psychological model that expounds on the connections between attitudes, subjective norms, and behavioral intentions. It has been extensively applied to explain people's technology adoption behaviors and decisions.

The Theory of Planned Behavior (TPB) emerged as an extension of the earlier Theory of Reasoned Action (TRA). The Theory of Reasoned Action (TRA) (Fishbein, 1967; Montaño & Kasprzyk, 2015) posited that individuals make rational and voluntary decisions based on available information (Ajzen, 1985). According to Sheppard et al. (1988), a person's attitude toward behavior and the subjective norms of the groups they belong to directly influence their intention to perform that behavior, subsequently determining their actual behavior. However, as the Theory of Reasoned Action (TRA) assumed that behavior was primarily voluntary and rational, it did not entirely account for impulsive behaviors or those not entirely under a person's control (Hale et al., 2002).

Ajzen (1991) developed the Theory of Planned Behavior (TPB) to address some limitations of the original Theory of Reasoned Action model. One significant drawback of the Theory of Reasoned Action was that it did not consider a person's perceived capability or self-efficacy to perform a given behavior. If an individual had a highly positive attitude toward a behavior and strong intentions to perform it but did not believe they were capable of doing so, the Theory of Reasoned Action model would not predict a high likelihood of behavioral change

(Ajzen, 1991). By introducing the additional construct of perceived behavioral control into the original Theory of Reasoned Action framework, the Theory of Planned Behavior provided a more comprehensive model that could better predict and explain human behavior across a broader range of contexts (Ajzen, 1991; Montaño & Kasprzyk, 2015). Perceived behavioral control refers to a person's perception of the level of control they have over the factors that enable them to perform a given behavior successfully. This element is expected to have a direct influence on behavior, particularly when a person's perception of control accurately reflects the actual control they have over the behavior in question (Montaño & Kasprzyk, 2015).

Besides perceived behavioral control, the Theory of Planned Behavior also takes into account a person's attitude toward the behavior and subjective norms. A person's attitude toward a behavior depends on their beliefs about the likely consequences of the behavior and the value or importance they place on those consequences. For instance, if someone believes that exercising on a regular basis will lead to improved health and they highly value their health and well-being, they will likely have a positive attitude toward exercising regularly. Subjective norms pertain to a person's perception of the expectations and opinions of significant others, such as family, friends, or colleagues, regarding the behavior in question. If someone believes that their friends and family expect them to exercise regularly, they may feel increased social pressure to do so, even if they do not personally value the behavior or find it important.

The Theory of Planned Behavior has broadened the scope and applicability of models centered on technology acceptance and adoption by offering a framework to explain both rational and less-than-fully voluntary human behavior. It presents a comprehensive model that considers the complex interactions between a person's attitudes, perceived social pressure, and perceived capability to successfully perform a behavior when predicting their intentions and actual behavior. This comprehensive approach allows for a deeper understanding of the factors influencing individuals' adoption and use of new technologies, which is crucial for promoting and designing more effective interventions.

Technology acceptance model (TAM)

While the Theory of Planned Behavior provides a robust framework for understanding the relationship between attitudes, perceived social norms, perceived behavioral control, and the adoption of certain behaviors, it may not fully capture the complexities of technology adoption. One all-encompassing theoretical perspective for understanding user technology adoption is the Technology Acceptance Model (TAM). Developed in the 1980s, the TAM posits that the adoption of new technology hinges on two critical factors: perceived usefulness and perceived ease of use (Davis, 1986). This model offers a more specialized lens through which to examine the factors influencing the acceptance and use of technology, including virtual reality.

The TAM was introduced as an extension of the earlier Theory of Reasoned Action (TRA) and Theory of Planned Behavior (TPB) models. Consequently, the TAM's key parameters of perceived usefulness and perceived ease of use were formulated based on a combination of human experience, logical reasoning, and psychological processes (Davis, 1986). Perceived usefulness refers to the belief that using a new technology will yield tangible benefits and value to the user (Davis, 1989). These benefits are thought to apply not only to individuals but also to the organizations and groups they belong to (Au & Enderwick, 2000). Perceived usefulness can encompass a wide array of potential benefits, including increased job effectiveness and productivity, enhanced efficiency, and external motivators such as career advancements, salary increases, bonuses, and other rewards.

On the other hand, perceived ease of use pertains to the extent to which a user deems a technology to necessitate minimal effort to comprehend, learn, and operate (Davis, 1989). Minimal effort implies that the system is user-friendly and uncomplicated and does not impose undue cognitive demands or burdens on the user (Agarwal & Karahanna, 2000). Perceived ease of use is akin to the perceived behavioral control factor addressed in the Theory of Planned Behavior model but covers a user's confident or unconfident self-efficacy beliefs regarding their ability to effectively utilize the technology. According to the original TAM model, perceived usefulness directly influences a user's intention to adopt and use new technology, while perceived ease of use indirectly impacts technology usage intention through its effect on perceived usefulness. In other words, the easier a technology is to use, the more useful and valuable it is likely to appear to potential users. Studies employing the TAM model have demonstrated the strong reliability and validity of these two factors in explaining user behavioral intentions and actual technology usage behavior (Davis et al., 1989; Venkatesh & Davis, 2000).

Over time, researchers have refined and expanded the original TAM model by incorporating additional factors to enhance its explanatory power and address common criticisms, such as neglecting end-goal attainment (Bagozzi, 2007), social influences (Venkatesh & Morris, 2000), and emotional influences (Bagozzi, 2007) on technology acceptance and usage. For instance, TAM2 integrated social influence processes and cognitive instrumental processes by adding the constructs of subjective norm (which was deliberately excluded from the original TAM model), voluntariness (the degree to which technology use is perceived as voluntary versus mandatory), and image (the degree to which the use of technology is perceived to enhance one's image or status) to the model (Venkatesh & Davis, 2000). TAM3 further extended TAM2 by incorporating factors from the Motivational Model, such as experience, anxiety, and facilitating conditions (the availability of technical and support resources) (Venkatesh & Bala, 2008). These extensions and modifications to the original TAM model have considerably increased the variance explained in technology usage intention and actual usage behavior, offering a more comprehensive theoretical view of technology acceptance.

UTAUT model

While the Technology Acceptance Model offers insights into the perceived usefulness and ease of use of a technology, it may overlook other critical factors that can affect the acceptance and usage of technology. The Unified Theory of Acceptance and Use of Technology (UTAUT) model, developed by Venkatesh et al. (2003), aimed to consolidate elements from eight existing technology acceptance models into a comprehensive theoretical framework, offering a more comprehensive understanding of technology adoption. These models included the technical adaptation model, the innovation diffusion theory, the theory of reasoned action, the theory of planned behavior, the motivational model, a model combining TAM and TPB, the model of PC utilization, and the social cognitive theory. The UTAUT model posits four key constructs that determine technology acceptance and usage: performance expectancy, effort expectancy, social influence, and facilitating conditions (Venkatesh et al., 2003). Additionally, the model identifies several moderating variables that impact these key constructs, such as gender, age, voluntariness, and experience (Venkatesh et al., 2003).

Performance expectancy refers to the extent to which an individual believes that employing a specific technology will enhance their work outcomes (Venkatesh et al., 2003). In other words, it represents the perception that technology will offer benefits and advantages in how one fulfills their job responsibilities and tasks, ultimately improving productivity and efficiency.

Effort expectancy concerns the perceived ease of use of the technology and the amount of effort an individual believes will be required to employ the technology effectively. Similar to the concept proposed by Davis (1989), effort expectancy denotes the perceived level of effort necessary for the operation and actual use of the technology. A higher effort expectancy positively impacts performance expectancy, as individuals are more likely to adopt and use technology that they perceive as easy to learn and operate (Venkatesh et al., 2003).

Social influence pertains to the degree to which an individual perceives that important people in their life—such as colleagues, managers, friends, and family members—believe they should adopt and use the technology (Venkatesh et al., 2003). An individual may perceive that influential individuals in their life think they should utilize the technology, which increases the likelihood of technology acceptance and use due to this social pressure and validation.

Facilitating conditions refer to the extent to which an individual believes that the necessary technical and organizational infrastructure exists to support the technology (Venkatesh et al., 2003). These factors encompass the availability of technical resources, knowledge, and support required to use the technology effectively. When facilitating conditions are present, individuals perceive that the means and mechanisms for using the technology are in place. This positively impacts technology acceptance and use by reducing barriers and providing an environment conducive to successful technology adoption.

The use of TPB, TAM, and UTAUT model in the VR adoption research

The TPB, TAM, and UTAUT models have been instrumental in elucidating people's intentions to adopt new technologies, offering valuable insights into the underlying factors that influence their decisions. Considering the rapid advancements in virtual reality (VR) and its increasing adoption across various domains, it becomes imperative to examine how these models are specifically applied within the VR context to better understand individuals' intentions to use such technologies.

By investigating the application of these models in VR research, we can identify common patterns and unique factors that drive VR adoption in different settings, such as gaming, education, healthcare, and training. A deeper understanding of the nuances in these contexts will enable researchers and practitioners to develop targeted interventions and design strategies to promote the adoption of VR technologies more effectively.

The Theory of Planned Behavior (TPB) emphasizes the roles of attitude, subjective norms, and perceived behavioral control in predicting individuals' intentions to engage in certain behaviors, including the adoption of new technologies. Researchers have applied TPB to examine people's intentions to use VR technologies. For instance, Kim and Forsythe (2008) investigated consumers' intentions to use virtual try-on technology for online apparel shopping, finding that attitude, subjective norms, and perceived behavioral control significantly predicted the intention to adopt the technology. Similarly, Lai (2017) conducted a literature review that featured TPB as a framework for understanding the adoption of innovative technologies like VR, highlighting the importance of the abovementioned factors in shaping users' intentions to adopt new technologies.

The Technology Acceptance Model (TAM) asserts that perceived usefulness and perceived ease of use influence users' intentions to adopt a technology. Researchers have employed TAM to study the intention to use VR technologies across various contexts. Studies have shown that intention to use VR is predicted by perceived usefulness (Chow et al., 2012; Fetscherin & Lattemann, 2008; Tokel & İsler, 2013) and perceived ease of use (Bertrand & Bouchard, 2008; Chow et al., 2012; Fetscherin & Lattemann, 2008; Tokel & İsler, 2013), with perceived ease of use significantly impacting perceived usefulness (Chow et al., 2012; Fetscherin & Lattemann, 2008; Kim & Forsythe, 2008; Tokel & İsler, 2013). Furthermore, Yang et al. (2016) and Sagnier et al. (2020) examined the intersection of VR, aviation training, and TAM. Sagnier et al. (2020) evaluated user acceptance of VR for an aeronautical assembly task using an extended TAM, incorporating factors relevant to VR in training tasks, such as cybersickness, presence, and hedonic quality stimulation.

The Unified Theory of Acceptance and Use of Technology (UTAUT) and its extension, UTAUT2, combine elements from multiple technology acceptance models, including TPB and TAM. In recent years, researchers have utilized UTAUT and UTAUT2 to explore people's intentions to use VR technologies. For example, Huang (2023) applied UTAUT to investigate the acceptance of VR tourism, emphasizing the importance of performance expectancy, effort expectancy, social influence, and hedonic motivation in shaping user intentions. Additionally, Ustun et al. (2022) used UTAUT to develop an educational VR acceptance scale, emphasizing good explanation power to technological acceptance of VR technologies.

Motion sickness and discomfort

While theoretical models such as TPB, TAM, and UTAUT provide valuable frameworks for understanding the factors that influence the adoption of virtual reality (VR), they do not fully address all aspects that might deter potential users. One of the practical aspects, which isn't fully represented in these models, relates to the physiological and psychological experiences of VR users. Specifically, concerns regarding motion sickness and discomfort, which are common issues faced by VR users, could significantly impact the rate of VR adoption.

Experiencing motion sickness or discomfort while using VR technology could lead to negative attitudes towards this technology, which could potentially override factors such as perceived usefulness, social influence, or facilitating conditions. These issues represent significant challenges to VR adoption and warrant closer examination in the context of technology acceptance research.

Motion sickness and discomfort are among the most prominent factors preventing people from adopting virtual reality (VR). Since the inception of VR technology, these issues have persisted as significant concerns and continue to pose challenges to its widespread acceptance and adoption (LaViola Jr, 2000). The negative experiences associated with motion sickness and discomfort can deter potential users, even though VR technology has made considerable advancements in recent years (Moss & Muth, 2011).

Motion sickness, also known as cybersickness or simulator sickness, encompasses symptoms such as nausea, dizziness, and disorientation experienced by some users while using VR systems (Rebenitsch & Owen, 2016). The sensory conflict theory posits that motion sickness arises from discrepancies between the visual, vestibular, and proprioceptive systems (Reason & Brand, 1975). In VR contexts, these discrepancies may occur when the visual input from the virtual environment is inconsistent with the user's physical movements or the vestibular system's expectations (Stanney & Kennedy, 1998).

One primary cause of motion sickness in VR is latency, defined as the time it takes for the system to respond to users' movements and update the visual display (Munafo et al., 2017). High latency can result in a noticeable lag between users' actions and the corresponding changes in the virtual environment, leading to sensory mismatches and increasing the likelihood of motion sickness (LaViola Jr, 2000). Although advances in VR technology have substantially reduced latency, it remains a challenge in some systems, particularly those with lower processing power or complex virtual environments (Kemeny & Panerai, 2003).

Another contributing factor to motion sickness in VR is the field of view (FOV) of the display. A limited FOV can restrict users' peripheral vision, causing a tunnel vision effect that can exacerbate sensory mismatches and heighten the risk of motion sickness (Moss & Muth, 2011). Expanding the FOV can alleviate this issue to some extent; however, there is a trade-off between increasing the FOV and maintaining the system's visual quality and performance (Bowman & McMahan, 2007).

In addition to motion sickness, discomfort is another significant factor deterring people from adopting VR. Physical discomfort can arise from the weight and design of VR headsets, causing strain on users' heads and necks, especially during extended use (Davis et al., 2015). Furthermore, some users may experience eye strain or visual fatigue due to the display's close proximity to the eyes and the need to continually focus on virtual objects at varying distances.

Social discomfort is another consideration impacting the adoption of VR. Some users may feel self-conscious or isolated while using VR headsets, particularly in public or group settings (Schroeder, 2011). This sense of isolation can be exacerbated by the fact that VR headsets typically block out users' surroundings, making it challenging to maintain social connections and real-world awareness while immersed in the virtual environment (Yee & Bailenson, 2007).

In conclusion, motion sickness, physical discomfort, and social discomfort are substantial factors hindering the widespread adoption of virtual reality technology. These issues are measured in this dissertation as factors that might affect people's willingness to adopt virtual reality. Although advances in VR hardware and software have mitigated some of these concerns, further research and development are necessary to address the remaining challenges and create a more comfortable and accessible user experience. By resolving these concerns, VR technology can become more appealing and accessible to a broader range of users, ultimately facilitating its growth and adoption across various applications and industries.

Perceived Risk

While motion sickness and discomfort are two explicit manifestations of negative experiences related to VR adoption, they can also contribute to a more general perception of risk associated with using VR technology. The perception of risks plays a critical role in shaping consumers' attitudes toward VR adoption, adding another layer of complexity to the behavioral intentions explored by theoretical models such as TPB, TAM, and UTAUT. According to Bauer (1960), uncertainty surrounding products and potential negative consequences can decrease consumers' purchase intentions. Numerous studies demonstrate that perceived risk, which is defined as consumers' uncertainty and expectations of undesirable outcomes (Littler & Melanthiou, 2006), significantly influences technology product adoption rates (Arndt, 1967; Cunningham, 1967; Folkes, 1988; Locander & Hermann, 1979).

The potential positive and negative consequences of adopting new technology may heighten consumers' resistance. As an undesirable consequence, perceived risk adversely affects consumer adoption. In e-commerce research, the decision to purchase and use a product has also been found to depend on consumers' perceived risk (Antony et al., 2006). Consumers may be hesitant to buy due to a sense of risk concerning the product or the purchase experience itself.

Consumers' perceived risks before purchasing and using products can relate to various factors, including product performance, social and psychological aspects, health, and safety. When evaluating a product, consumers form a specific perception of it that shapes their risk views. This perception is often a function of the "likelihood and outcome" (Slovic, Fischhoff, &

Lichtenstein, 1977). Consequently, the level of risk for a particular product primarily depends on the probability and severity of undesirable consequences.

Past personal experiences with technology and existing tech attitudes (Gilbert et al., 2003) can significantly impact subsequent decision-making (Fisher et al., 2003). Negative personal risk experiences may substantially reduce purchase intentions by increasing negative emotions. For instance, if a consumer has previously experienced motion sickness or other adverse side effects from using VR or other immersive digital technologies, they may perceive a higher health risk associated with purchasing and using new VR devices. Their past experience has primed them to anticipate similar undesirable consequences with future use, thereby decreasing their willingness to adopt the technology despite interest or perceived benefits. Conversely, a consumer with extensive experience using VR technology without issue may perceive minimal health risks and feel more at ease adopting new VR devices, all other factors being equal.

The relationship between perceived risk and technology adoption is multifaceted. Even if a consumer perceives higher risks associated with a new technology, the potential rewards of adopting it, such as enhanced productivity, entertainment, social connections, or other benefits, may outweigh their concerns. It is crucial to understand how consumers balance these perceived risks and rewards when considering the adoption of emerging technologies like VR, as this balance plays a significant role in shaping the market's trajectory and technological advancements.

Negative Emotions

Negative emotions toward a technology, such as worry, anxiety, or regret, can significantly decrease adoption intention and actual usage. If a consumer associates feelings of worry or anxiety with using a new VR device due to perceived health or safety risks, they will likely be reluctant to purchase the technology despite any interest or perceived benefits. The anticipated negative emotional experience outweighs the potential rewards, leading the consumer to avoid adopting the technology. Conversely, if a consumer expects to feel enjoyment, excitement, or other positive emotions from using a VR device, they will likely be more willing to adopt the technology, all else being equal. The potential positive emotional experience adds value and motivates their decision to purchase and use the new technology.

Numerous studies demonstrate that negative emotions play a more significant role in risk perception than positive emotions. Risk perception and negative emotions are strongly correlated (Sjöberg, 2007). In other words, negative emotions can heighten perceived risk, and perceived risks also evoke negative emotions (Slovic & Peters, 2006). When people have personal experiences, they tend to rely on negative emotions based on those past experiences (Dunlop, Wakefield & Kashima, 2008; Terpstra, 2011) when judging an object and forming risk perceptions. In other words, risk perception and judgments about risk originate from harmful experiences people have previously encountered.

Previous research on consumer behavior found that positive or negative emotions substantially impact decision-making (Bagozzi et al., 2016). Anticipated emotional outcomes in purchase intentions powerfully guide the decision-making process (Mellers & McGraw, 2001). Notably, negative emotions (e.g., regret or worry) primarily motivate behavioral intentions (Bagozzi & Dholakia, 2006; Perugini & Bagozzi, 2001). This is because consumers try to avoid negative emotional consequences and seek positive emotional consequences when purchasing (Zeelenberg et al., 2000).

Moreover, people have different emotional reactions to uncertainty, which can influence their decision-making process when considering adopting new technology like VR devices. For instance, some individuals may be more sensitive to the possible negative outcomes of using VR technology and might perceive a higher risk associated with it (Kahneman & Tversky, 1982). These heightened negative emotions could lead them to be more hesitant in purchasing and using VR devices. On the other hand, individuals who are more optimistic and have a higher tolerance for uncertainty may be more likely to embrace the new technology and enjoy its potential benefits (Weber et al., 2002).

Furthermore, individual differences in personality traits can also play a role in shaping emotional responses to new technology. For example, people with high levels of trait anxiety or neuroticism may be more prone to experiencing negative emotions when faced with novel or uncertain situations, such as adopting a new technology like VR devices (Eysenck & Calvo, 1992). Conversely, individuals who score high in openness to experience might be more inclined to feel positive emotions when encountering new technology, which can facilitate their adoption of VR devices (McCrae & Costa, 1997).

Emotions play a crucial role in shaping consumer behavior and decision-making, particularly when considering the adoption of new technologies like VR devices. Negative emotions, such as worry, anxiety, or regret, can significantly hinder the adoption and usage of technology, while positive emotions, such as excitement and enjoyment, can enhance the likelihood of adoption. Individual differences in risk perception, tolerance for uncertainty, and personality traits further influence the emotional responses to new technology, ultimately shaping the decision-making process.

Limitations of the existing models, Research Questions and Hypotheses

This research tried to understand the factors that affect people's adoption behavior toward virtual reality devices and content. By utilizing different models as theoretical frameworks, this study adapted the Theory of Planned Behavior (figure 1), the Technology Acceptance Model (figure 2), and the UTAUT model (figure 3) to demonstrate how each different model explains the low adoption rate of virtual reality devices and how well these factors affect the intention to adopt virtual reality devices. However, there are limitations with simply using these models to understand the technology adoption of VR devices which is the reason why this study also added several other factors that are also considered to be affecting people's intention to adopt virtual reality devices, such as perceived risk, negative emotions, motion sickness, physical comfort, and social comfort.

While each factor proposed in the current study would be suitable in its own model context, this study also attempted to determine whether a more comprehensive model could be created utilizing these factors. The proposed comprehensive model is designed to address the existing gaps in understanding VR adoption. This model integrated factors inherent to VR, such as perceived risk, negative emotions, motion sickness, physical comfort, and social comfort, combining them with the variables from the current models. In doing so, it aimed to offer a holistic view that captures the full spectrum of factors influencing VR adoption, from cognitive to emotional to physiological considerations. Furthermore, by including these VR-specific variables, the model aspired to enhance its predictive accuracy regarding VR adoption behaviors. This comprehensive approach is not only academically significant but also provides actionable insights for VR developers, marketers, and educators, shedding light on nuanced barriers to VR adoption. While existing models provide solid frameworks for general technology adoption, the unique characteristics of VR necessitate a more specialized approach.

Figure 1:Theory of Planned Behavior

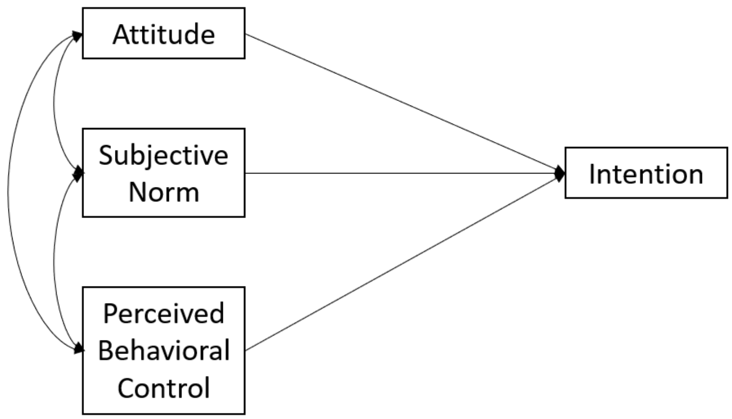


Figure 2:Technology Acceptance Model

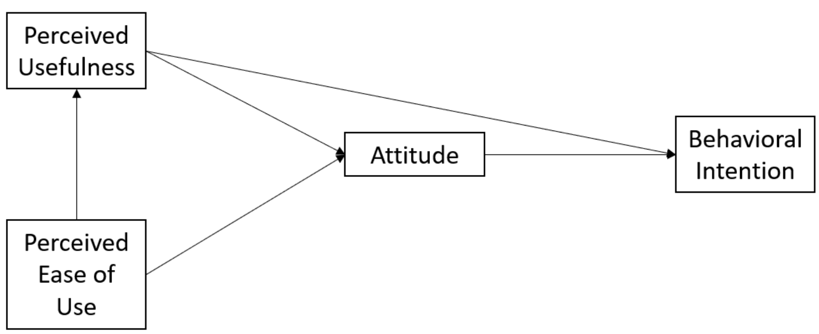
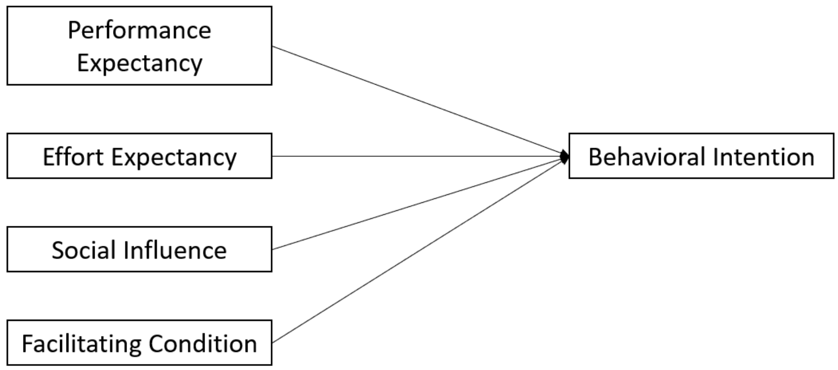


Figure 3:UTAUT Model


Performance Expectancy
Effort Expectancy
Social Influence
Facilitating Condition
Behavioral Intention

III. METHODOLOGY

Description of the study design

In this study, three models (TPB, TAM, and UTAUT) were tested to examine the consumer adoption behavior of virtual reality devices and content. The influence of additional contributing factors on the purchase and usage intentions towards current VR headsets was also evaluated.

An internet survey was distributed to adults aged 18 or older through the Prolific online panel for data collection. Prolific (https://prolific.ac), an online survey site, makes use of nonprobability sampling, drawing responses from voluntary participants for a convenience sample.

A self-reported survey was used as the method of data collection. Participants were asked to share their views on and experiences with VR devices and content. Standard incentives offered by the Prolific website were provided to encourage participation.

Data Collection

Rules of thumb for testing statistical models in social science research are prevalent; however, power analysis is frequently employed to ascertain a precise sample size for structural equation models (Cohen, 1988). The required sample size for this study was determined through the execution of an a-priori power analysis. Given that three models were slated for individual testing, separate power analyses were conducted, each incorporating varying numbers of observed and latent variables. Full models, both with and without additional variables, were tested.

The a-priori power analysis was undertaken with the assistance of the Computing Power and Minimum Sample Size for RMSEA calculator (Preacher & Coffman, 2006). For each model, parameters including a preferred Type I error (Alpha) value of 0.05, desired power values of 0.06, 0.065, 0.07,0.075, and 0.08, and a Root Mean Square Error of Approximation (RMSEA) value of 0.08 were set and analyzed (see Figure 4).

Table 1:**A-priori results**

	Model 1	Model 2	Model 3	Model 4	Model 5
	Full/no additional variable	Full/additional variable	TPB	TAM	UTAUT
h0=0.05, h1=0.06	141	78	1519	802	1519
h0=0.05, h1=0.065	83	48	735	405	735
h0=0.05, h1=0.07	57	34	449	257	449
h0=0.05, h1=0.075	43	26	310	183	310
h0=0.05, h1=0.08	34	21	231	138	231
	df: 969	df: 2548	df:45	df:93	df:45

Taking into account additional factors such as perceived risks, negative emotions, and discomfort, a total of 1000 surveys were distributed via the Prolific platform for this study. Despite indications from previous research conducted on Prolific suggesting a relatively high level of awareness about VR headsets (Yao et al., 2019 in press), the possibility that participants might not have used or owned a VR headset—given its status as relatively new technology—was acknowledged.

Consequently, the 1000 surveys were divided and disseminated in two distinct batches of 500. For the first batch, a filter was applied on Prolific, necessitating that participants should have had experience with VR headsets. For the second batch, the previously applied filter was removed, with the only restriction being that participants from the first batch were not allowed to partake in the second round of the study.

Measurements

Attitude towards Purchasing Virtual Reality headsets was measured by four items based on Francis et al. (2004)'s manual. Using a 7-point Bipolar scale questionnaire ranging from 1 (Harmful) to 7 (Beneficial), 1 (Good) to 7 (Bad), 1 (Pleasant (for me)) to 7 (Unpleasant (for me)), and 1 (Worthless) to 7 (Useful), participants was asked to rate their Attitude towards purchasing VR devices (M = 4.79, SD = 1.18, Cronbach's α = 0.86).

Attitude towards using Virtual Reality headsets on a regular basis was measured by four items based on Francis et al. (2004)'s manual. Using a 7-point Bipolar scale questionnaire ranging from 1 (Harmful) to 7 (Beneficial), 1 (Good) to 7 (Bad), 1 (Pleasant (for me)) to 7 (Unpleasant (for me)), and 1 (Worthless) to 7 (Useful), participants were asked to rate their Attitude towards using a VR headset on a regular basis(M = 4.54, SD = 1.18, Cronbach's α = 0.91).

Subjective norm towards purchasing VR headsets was measured by four modified items based on Francis et al. (2004)'s manual. Using a 7-point Likert scale questionnaire ranging from 1 (*Strongly Disagree*) to 7 (*Strongly Agree*), participants were asked to rate their subjective norms towards purchasing VR devices. This measure consists of item such as "Most people who are important to me think that I should purchase VR headsets." (M = 2.45, SD = 1.42, Cronbach's α = 0.90)

Subjective norm towards using Virtual Reality headsets on a regular basis was measured by four modified items based on Francis et al. (2004)'s manual. Using a 7-point Likert scale questionnaire ranging from 1 (*Strongly Disagree*) to 7 (*Strongly Agree*), participants were asked to rate their subjective norms towards purchasing VR devices. This measure consists of item such as "Most people who are important to me would say I should use VR devices on a regular basis." (M = 2.16, SD = 1.37, Cronbach's α = 0.93)

Perceived behavioral control towards purchasing Virtual Reality headsets was measured by four modified items based on Francis et al. (2004)'s manual. Using a 7-point Likert scale questionnaire ranging from 1 (*Strongly Disagree*) to 7 (*Strongly Agree*), participants were asked to rate their subjective norms towards purchasing VR. This measure consists of item such as "I am confident that I could purchase VR headsets when it is necessary." (M = 5.53, SD = 1.31)

Perceived behavioral control towards using Virtual Reality headsets on a regular basis was measured by four modified items based on Francis et al. (2004)'s manual. Using a 7-point Likert scale questionnaire ranging from 1 (*Strongly Disagree*) to 7 (*Strongly Agree*), participants were asked to rate their subjective norms towards purchasing VR. This measure consists of item such as "I am confident that I could use VR headsets when it is necessary." (M = 5.48, SD = 1.27)

Perceived usefulness of Virtual Reality headsets was measured by six modified items adopted from Davis (1989). Using a 7-point Likert scale questionnaire ranging from 1(*Unlikely*) to 7(*Likely*), participants were asked to rate their perceived usefulness of Virtual Reality headsets. This measure consists of item such as "Using VR headsets in my job would enable me to accomplish tasks more quickly." (M = 2.49, SD = 1.74, Cronbach's α = 0.99)

Perceived ease of use of Virtual Reality headsets was measured by six modified items adopted from Davis (1989). Using a 7-point Likert scale questionnaire ranging from 1(*Unlikely*) to 7 (*Likely*), participants were asked to rate their perceived ease of use of Virtual Reality headsets. This measure consists of item such as “Learning to operate VR headsets would be easy for me.” (*M* = 5.49, *SD* = 1.23, Cronbach’s α = 0.96)

Performance Expectancy of using a VR headset was measured by three modified items adopted from Venkatesh et al. (2012). Using a 7-point Likert scale questionnaire ranging from 1(*Strongly Disagree*) to 7 (*Strongly Agree*), participants were asked to rate the degree to which using a VR headset will provide benefits to their adoption of a VR headset. This measure consists of item such as “I would find VR headsets useful in my daily life.” (*M* = 3.29, *SD* = 1.75, Cronbach’s α = 0.95)

Effort Expectancy of using a VR headset was measured by four modified items adopted from Venkatesh et al. (2012). Using a 7-point Likert scale questionnaire ranging from 1(*Strongly Disagree*) to 7 (*Strongly Agree*), participants were asked to rate the degree of ease associated with using a VR headset. This measure consists of item such as “Learning how to use VR headsets would be easy for me.” (*M* = 5.63, *SD* = 1.22, Cronbach’s α = 0.96)

Social Influence of using VR headsets was measured by three modified items adopted from Venkatesh et al. (2012). Using a 7-point Likert scale questionnaire ranging from 1(*Strongly Disagree*) to 7 (*Strongly Agree*), participants were asked to rate the extent their important others believe that they should adopt using a VR headset. This measure consists of item such as “People who are important to me think that I should use VR headsets.” (*M* = 2.52, *SD* = 1.64, Cronbach’s α = 0.96)

Facilitating conditions of using VR headsets was measured by four modified items adopted from Venkatesh et al. (2012). Using a 7-point Likert scale questionnaire ranging from 1(*Strongly Disagree*) to 7 (*Strongly Agree*), participants were asked to rate the resources and support available to adopt using VR headsets. This measure consists of item such as "I have the resources necessary to use VR headsets." (*M* = 5.26, *SD* = 1.28, Cronbach's α = 0.83)

Hedonic Motivation (Enjoyment toward using a VR headset) was measured by three modified items adopted from Venkatesh et al. (2012). Using a 7-point Likert scale questionnaire ranging from 1(*Strongly Disagree*) to 7 (*Strongly Agree*), participants were asked to rate their perceived fun or pleasure derived from using VR headsets. This measure consists of item such as "Using VR headsets can be fun." (*M* = 5.58, *SD* = 1.36, Cronbach's α = 0.97)

General emotions towards VR devices was measured using an adapted version of the PANAS scale (Watson et al., 1988). Participants were asked to rate their general emotions towards VR headsets on a 7-point scale questionnaire from 1 (*Not at all*) to 7 (*Extremely*) which all questions were divided into positive emotions (e.g., Interested) and negative emotions (e.g., Nervous). (Positive affect: *M* = 4.55, *SD* = 1.43, Cronbach's α = 0.93; Negative affect: *M* = 1.53, *SD* = .88, Cronbach's α = 0.91)

Motion sickness when using a VR headset was measured on a five-item scale on 5 commonly occurred symptoms with motion sickness (nausea, fatigue, dizziness, eyestrain, and headache) (Keshavarz et al., 2019). Participants were asked to rate their susceptibility to these symptoms when using VR headsets on a 7-point scale questionnaire from 1 (*Not at all*) to 7 (*Extremely*). This measure consists of item such as "I would feel nausea when using VR headsets." (*M* = 2.69, *SD* = 1.52, Cronbach's α = 0.93)

Perceived other people's Motion sickness when using a VR headset was measured on a five-item scale on 5 commonly occurred symptoms with motion sickness (nausea, fatigue, dizziness, eyestrain, and headache) (Keshavarz et al., 2019). Participants were asked to rate if they have heard about other's susceptibility to these symptoms when using VR headsets on a 7-

point scale questionnaire from 1 (*Not at all*) to 7 (*Extremely*). This measure consists of item such as “I heard others say they feel nausea when using VR headsets.” (M = 3.67, SD = 1.81, Cronbach’s α = 0.94)

Physical comfort when using VR headsets was measured by single item. Using a 7-point Likert scale question ranging from 1 (*Strongly Disagree*) to 7(*Strongly Agree*), participants were asked to rate their overall physical comfort level using VR headsets. This measure consists of item “It is comfortable to wear a VR headset.” (M = 4.34, SD = 1.46)

Social comfort when using VR headsets was measured by a 7-point Likert scale questionnaire. Using three 7-point Likert scale questions ranging from 1 (*Strongly Disagree*) to 7(*Strongly Agree*), participants were asked to rate their overall social comfort level using VR headsets in public. This measure consists of item “I feel comfortable wearing VR headsets in public.” (M = 2.52, SD = 1.81)

General Comfort was measured by single item. Using a 7-point Likert scale question ranging from 1 (*Strongly Disagree*) to 7(*Strongly Agree*), participants were asked to rate their overall comfort level using VR headsets. This measure consists of item “I think using VR headsets is overall comfortable.” (M = 4.09, SD = 1.59)

Perceived Risk toward using VR headsets was measured by four modified bipolar scale items adopted from Yang et al. (2015). Using a 7-point Bipolar scale questionnaire ranging from 1 (*Not Severe*) to 7 (*Severe*), 1 (*Of no consequence*) to 7 (*Of great consequence*), 1 (*Negligible*) to 7 (*Grave*), and 1 (*Insignificant*) to 7 (*Significant*), participants were asked to rate their perceived health risk towards using VR headsets. (M = 2.43, SD = 1.14, Cronbach’s α = 0.94)

Perceived other people’s perception of Risk toward using VR headsets was measured by four modified bipolar scale items adopted from Yang et al. (2015). Using a 7-point Bipolar scale questionnaire ranging from 1 (*Not Severe*) to 7 (*Severe*), 1 (*Of no consequence*) to 7 (*Of great consequence*), 1 (*Negligible*) to 7 (*Grave*), and 1 (*Insignificant*) to 7 (*Significant*), participants were asked to rate their perceived health risk towards using VR headsets. (M = 2.56, SD = 1.14, Cronbach's α = 0.97)

Use intention of VR headsets on a regular basis was measured using a five items, 7-point Likert scale adapted from Spears and Singh (2004). Participants were asked to rate their use intentions from 1 (*Not at all*) to 7 (*Extremely*). Purchase intention questions include "I intend to use VR headsets on a regular basis." (M = 3.96, SD = 1.62, Cronbach's α = 0.91)

Purchase Intention of VR headsets was measured using a five items, 7-point Likert scale adapted from Spears and Singh (2004). Participants were asked to rate their purchase intentions from 1 (*Not at all*) to 7 (*Extremely*). Purchase intention questions include "I intend to buy VR headsets." (M = 4.45, SD = 1.81, Cronbach's α = 0.95)

Data analysis plan

Factors within each model and additional factors proposed were first assessed separately using regression coefficient tests to see whether they had a statistically significant relationship with purchase/use intentions. Each model was then assessed controlling for whether the participant had previously used a VR headset, whether the participant owned a VR headset, as well as their age, gender, education level, and annual household income using a hierarchical regression analysis, aiming at determining whether factors within the model adds to the explanation power of the control variables towards purchase/use intentions.

Each model (TPB, TAM and UTAUT) was then assessed separately as a path model. Lastly, a structural equation model (SEM) was performed to propose a new model to explain the phenomenon.

IV. RESULTS

Descriptive analysis

Subjects

Upon distributing the online survey, a number of 987 responses were gathered. This represented a very high response rate of 98.7%. 124 responses had to be removed due to the presence of missing data after initial step of data cleaning and analysis.

Thus, the final sample size reduced to 863 ($N = 863$). When looking at the gender distribution among these respondents, males made up 57.7% of the total, females accounted for 40%, and the remaining 0.3% identified as other genders. For the convenience of the analysis, male was coded as 1 while female was coded as 2. With respect to the age distribution, the median age was observed to be 35 years. The majority of the participants identified as white (71%), Black or African American (13%) and Hispanic (11.5%).

In terms of the respondents' educational qualifications, a large proportion had a bachelor's degree (37.8%) or had some college experience but no degree (22.4%). Additionally, when considering the economic backgrounds of the respondents, the median annual household income was found to be between $50,000 and $59,999.

Table 2:Demographic Characteristics of Respondents

Demographic Characteristics	
Used VR headset before	
Yes	716(83.0%)
No	147(17.0%)
Own a VR headset	
Yes	338(39.2%)
No	525(60.8%)
Gender	
Male	498(57.7%)
Female	343(40%)

Other	22(0.3%)
Age	
18-29	266(30.8%)
30-49	440(51.0%)
50-64	123(14.3%)
65+	34(3.9%)
Education	
Less than high school	3(0.3%)
High school graduate (high school diploma or equivalent including GED)	131(15.2%)
Some college but no degree	193(22.4%)
Associate degree in college (2-year)	87(10.1%)
Bachelor's degree in college(4-year)	326(37.8%)
Master's degree	94(10.9%)
Doctoral degree	16(1.9%)
Professional degree (JD,MD)	11(1.3%)
Prefer not to say	2(0.2%)
Race	
White/Caucasian	613(71%)
Black or African American	112(13%)
Hispanic	99(11.5%)
Asian	91(10.5%)
American Indian or Alaska Native	17(2%)
Native Hawaiian or Pacific Islander	5(0.5%)
Others	11(1.2%)
Annual Household Income	
Less than $10,000	47(5.4%)
$10,000 to $19,999	56(6.5%)
$20,000 to $29,999	86(10.0%)
$30,000 to $39,999	83(9.6%)
$40,000 to $49,999	67(7.8%)
$50,000 to $59,999	89(10.3%)
$60,000 to $69,999	52(6.0%)
$70,000 to $79,999	74(8.6%)
$80,000 to $89,999	44(5.1%)
$90,000 to $99,999	49(5.7%)
$100,000 to $149,999	138(16.0%)
$150,000 or more	75(8.7%)

Prefer not to say	3(0.3%)

Index Construction

The collinearity statistics (i.e., tolerance and VIF) were conducted and found all scores within accepted limits. Residual and scatter plots indicated that the assumptions of normality, linearity, and homoscedasticity were all satisfied.

The reliability of each scale used to measure variables is listed in Figure 6.

Table 3:Reliability

Measure	Cronbach's Alpha
Attitude towards Purchasing Virtual Reality headsets	0.86
Attitude towards using Virtual Reality headsets on a regular basis	0.91
Subjective norm towards purchasing VR headsets	0.90
Subjective norm towards using Virtual Reality headsets on a regular basis	0.93
Perceived behavioral control towards purchasing Virtual Reality headsets	0.56
Perceived behavioral control towards using Virtual Reality headsets on a regular basis	0.46
Perceived usefulness of Virtual Reality headsets	0.99
Perceived ease of use of Virtual Reality headsets	0.96
Performance Expectancy of using a VR headset	0.95
Effort Expectancy of using a VR headset	0.96
Social influence of using VR headsets	0.96
Facilitating conditions of using VR headsets	0.83
Hedonic Motivation (Enjoyment toward using a VR headset)	0.97
Positive emotions	0.93
Negative emotions	0.91
Motion Sickness when using a VR headset	0.93
Perceived other people’s motion sickness when using a VR headset	0.94
Perceived Risk toward using VR headsets	0.94
Perceived other people’s perception of Risk toward using VR headsets	0.97
Use Intention of VR headsets on a regular basis	0.91
Purchase Intention of VR headsets	0.95

Most scales achieved good reliability/internal consistency using the Cronbach's Alpha test. However, perceived behavioral control towards purchasing headsets/using virtual reality headsets on a regular basis does not achieve acceptable reliability score. Upon further inspection, the item "Whether I purchase/use VR headsets on a regular basis or not is entirely up to me." was not consistent with the other items in the scale. After removing the item, the Perceived behavioral control towards purchasing virtual reality headsets achieved a Cronbach's Alpha score of 0.73 while the Perceived behavioral control towards using VR headsets on a regular basis achieved a Cronbach's Alpha score of 0.70. The potential cause for this issue will be further analyzed in the discussion session.

Other related factors

The survey results indicated that most respondents had prior experience with Virtual Reality (VR) headsets, as shown by the 83.0% who reported usage. However, ownership of these devices was less common, with the majority, or 60.8% of respondents, reporting that they do not currently possess a VR headset.

When looking at the non-filtered batch, similar patterns emerged. High previous usage of VR headsets was reported by 71.6% of respondents, and a considerable majority (68.9%) indicated they do not own a VR headset. This aligns consistently with the findings of previous studies (Yao et al., 2021).

When it comes to participants' willingness to spend on VR technology, a majority of participants expressed a willingness to pay in the range of $300 (140 out of the 863), $400 (81 out of the 863), and $500 (118 out of the 863) for a single VR headset. These results hint at a tendency among the participants not to overpay for the current VR headsets available in the market.

Participants were also asked to rate their willingness to pay more for a VR headset. They demonstrated relatively low rates for willingness to pay more ($M = 3.57$, $SD = 1.86$), willingness to pay a higher price for VR headsets than for other technology ($M = 3.59$, $SD = 1.90$), and acceptance of price increases ($M = 3.13$, $SD = 1.74$). These findings further affirm the observed cautious spending tendencies when it comes to VR technology.

Table 4:Correlation Matrix between variables

	Attitude towards Purchasing Virtual Reality headsets	Attitude towards using Virtual Reality headsets on a regular basis	Subjective norm towards purchasing VR headsets	Subjective norm towards using Virtual Reality headsets on a regular basis	Perceived behavioral control towards purchasing Virtual Reality headsets	Perceived behavioral control towards using Virtual Reality headsets on a regular basis	Perceived usefulness of Virtual Reality headsets	Perceived ease of use of Virtual Reality headsets	Performance Expectancy of using a VR headset	Effort Expectancy of using a VR headset	Social influence of using VR headsets	Facilitating conditions of using VR headsets	Hedonic Motivation (Enjoyment toward using a VR headset)	Motion Sickness when using a VR headset	Perceived other people's motion sickness when using a VR headset	Positive Emotion	Negative Emotion	Perceived Risk toward using VR headsets	Perceived other people's perception of Risk toward using VR headsets	Use Intention of VR headsets on a regular basis	Purchase Intention of VR headsets
1	1																				
2	0.944**	1																			
3	0.466**	0.428**	1																		
4	0.414**	0.395**	0.877**	1																	
5	0.209**	0.176**	0.044	-0.002	1																
6	0.313**	0.274**	0.032	-0.013	0.674**	1															
7	0.383**	0.364**	0.579**	0.588**	-0.061	0.001	1														
8	0.431**	0.374**	0.152**	0.109**	0.397**	0.510**	0.113**	1													
9	0.553**	0.527**	0.586**	0.561**	0.049	0.112**	0.743**	0.272**	1												
10	0.408**	0.348**	0.139**	0.104**	0.353**	0.477**	0.111**	0.896**	0.254**	1											
11	0.481**	0.448**	0.827**	0.821**	0.052	0.052	0.578**	0.176**	0.607**	0.177**	1										
12	0.417**	0.367**	0.258**	0.213**	0.518**	0.512**	0.162**	0.678**	0.315**	0.667**	0.290**	1									
13	0.615**	0.539**	0.300**	0.224**	0.271**	0.375**	0.242**	0.553**	0.414**	0.541**	0.309**	0.532**	1								
14	-0.373**	-0.371**	-0.060	-0.045	-0.200**	-0.270**	-0.103**	-0.248**	-0.175**	-0.231**	-0.089**	-0.194**	-0.253**	1							
15	-0.124**	-0.151**	-0.043	-0.052	-0.034	-0.044	-0.099**	0.068*	-0.078*	0.103**	-0.033	0.108**	0.063	0.537**	1						
16	0.550**	0.494**	0.475**	0.412**	0.229**	0.238**	0.455**	0.353**	0.546**	0.315**	0.467**	0.409**	0.551**	-0.178**	-0.030	1					
17	-0.270**	-0.269**	0.070*	0.122**	-0.294**	-0.333**	0.075*	-0.331**	-0.045	-0.305**	0.043	-0.287**	-0.278**	0.437**	0.144**	-0.073*	1				
18	-0.376**	-0.389**	-0.048	-0.022	-0.192**	-0.312**	0.002	-0.323**	-0.105**	-0.315**	-0.075*	-0.289**	-0.288**	0.399**	0.138**	-0.108**	0.347**	1			
19	-0.329**	-0.350**	-0.036	-0.023	-0.202**	-0.273**	0.017	-0.247**	-0.094**	-0.236**	-0.060	-0.250**	-0.208**	0.320**	0.168**	-0.108**	0.300**	0.735**	1		
20	0.700**	0.655**	0.545**	0.499**	0.234**	0.337**	0.462**	0.424**	0.625**	0.410**	0.558**	0.493**	0.647**	-0.224**	0.046	0.570**	-0.180**	-0.308**	-0.238**	1	
21	0.675**	0.610**	0.507**	0.412**	0.271**	0.357**	0.371**	0.461**	0.548**	0.441**	0.495**	0.507**	0.664**	-0.211**	0.070*	0.560**	-0.210**	-0.307**	-0.225**	0.898**	1

Note: **. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

The variance-covariance matrix outlined earlier served as a foundational representation of the interrelationships among variables. It's vital to understand that the subsequent analyses conducted in this study, while potentially drawing insights from the matrix, operate under their unique sets of assumptions and criteria. Given the nature of these analytical methods, certain patterns from the matrix might resurface, not out of redundancy, but due to the inherent interconnectedness of our data. Such overlaps underscore the importance of certain relationships rather than represent repetitive analysis. To put it succinctly, while the matrix provides an essential framework, each subsequent analytical stage, be it path analysis or SEM, adds depth, nuances, and specificity, honing the understanding of the data's dynamics.

Regression and T-test analysis results

To assess the impact of each proposed factor—regardless of whether they were posited within the context of the Theory of Planned Behavior (TPB), the Technology Acceptance Model (TAM), the Unified Theory of Acceptance and Use of Technology (UTAUT), or other models—on people's intention to purchase or continue using VR headsets daily, multiple linear regression analyses were conducted. The subsequent sections are divided into four parts, examining the results related to TPB, TAM, UTAUT, and other factors, respectively.

TPB-Related Factors:

In line with the Theory of Planned Behavior, three central factors were hypothesized to influence people's intentions: attitude, subjective norm, and perceived behavioral control. Six linear regression analyses were conducted to examine the direct impact of these factors on the intention to purchase and use VR headsets.

There was a significant positive association between attitudes towards purchasing VR headsets and the intention to purchase them ($\beta = 0.68$, $t\ (861) = 26.88$, $p < 0.001$). This pattern was also observed for subjective norms towards purchasing VR headsets ($\beta = 0.51$, t (861) = 17.28, $p < 0.001$) and perceived behavioral control over purchasing VR headsets ($\beta = 0.27$, t (861) = 8.28, $p < 0.001$).

Similarly, there was a significant positive association between attitudes towards using VR headsets regularly and the intention to do so ($\beta = 0.66$, t (861) = 25.47, $p < 0.001$). This pattern was consistent with subjective norms towards regular VR headset usage ($\beta = 0.50$, t (861) = 16.92, $p < 0.001$) and perceived behavioral control over regular VR headset usage ($\beta = 0.34$, t (861) = 10.49, $p < 0.001$).

Two hierarchical multiple regressions were conducted to test the overall model while accounting for control variables. These control variables, entered at stage one of the regression, included whether the participant had previously used a VR headset, whether the participant owned a VR headset, as well as their age, gender, education level, and annual household income. Attitudes, subjective norms, and perceived behavioral control were added to the model at stage two.

Regarding the intention to purchase VR headsets, the results from the hierarchical multiple regression indicated that at stage one, the variables of education level and annual household income did not contribute significantly to the regression model. Conversely, variables such as previous usage of a VR headset, VR headset ownership, age, and gender were significant contributors to the model (F (6, 851) = 51.86, $p < 0.001$). These variables collectively explained 27% of the variance in the intention to purchase VR headsets.

When attitudes towards purchasing VR headsets, subjective norms, and perceived behavioral control were added at stage two, they explained an additional 30% of the variance in the intention to purchase VR headsets. This change in R^2 was significant (F (3, 848) = 218.50, p

< 0.001), indicating the substantial impact of these factors on the purchasing intentions towards VR headsets.

Table 5:Hierarchical Multiple Regression Analysis of TPB for purchase intention

Variable	*Step 1*			*Step 2*		
	B	*SE B*	*β*	*B*	*SE B*	*β*
Have used or not	-0.59	0.15	-0.12^{***}	-0.32	0.12	-0.07^{**}
Own or not	-1.53	0.12	-0.41^{***}	-0.58	0.10	-0.16^{***}
Age	0.02	0.00	0.15^{***}	0.00	0.00	0.01
Education	-0.08	0.04	-0.07^{*}	-0.03	0.03	-0.02
Gender	-0.45	0.10	-0.14^{***}	-0.32	0.08	-0.10^{***}
Annual household income	0.00	0.02	0.01	-0.01	0.01	-0.02
Attitude	-	-	-	0.73	0.04	0.48^{***}
Subjective Norm	-	-	-	0.25	0.03	0.20^{***}
Perceived Behavioral control	-	-	-	0.17	0.03	0.12^{***}
Adjusted R^2		0.27^{***}			0.57^{***}	
R^2 change					0.30	
F for change in R^2		51.86^{***}			193.43^{***}	

Note: $^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$.

In terms of the intention to use VR headsets regularly, the hierarchical multiple regression results indicated that at stage one, both the education level and annual household income did not contribute significantly to the regression model. On the other hand, variables such as previous VR headset usage, VR headset ownership, age, and gender were significant contributors to the model (F (6, 851) = 58.74, p < 0.001). These factors accounted for 29% of the variance in the regular usage intention of VR headsets.

When the attitudes towards regular VR headset usage, subjective norms related to regular VR headset usage, and perceived behavioral control over regular VR headset usage were introduced at stage two, these factors explained an additional 31% of the variance in the intention to use VR headsets regularly. The change in R^2 was statistically significant (F (3, 848) = 218.50,

$p < 0.001$), highlighting the considerable influence of these elements on the intention to regularly use VR headsets.

Table 6:Hierarchical Multiple Regression Analysis of TPB for use intention

Variable	*Step 1*			*Step 2*		
	B	*SE B*	*β*	*B*	*SE B*	*β*
Have used or not	-0.47	0.14	-0.11^{***}	-0.29	0.10	-0.07^{**}
Own or not	-1.49	0.11	-0.45^{***}	-0.69	0.09	-0.21^{***}
Age	0.02	0.00	0.14^{***}	0.00	0.00	-0.01
Education	-0.06	0.04	-0.05	0.01	0.03	-0.01
Gender	-0.41	0.09	-0.14^{***}	-0.28	0.07	-0.09^{***}
Annual household income	0.00	0.02	0.01	-0.01	0.01	-0.01
Attitude	-	-	-	0.53	0.03	0.42^{***}
Subjective Norm	-	-	-	0.29	0.03	0.24^{***}
Perceived Behavioral control	-	-	-	0.23	0.03	0.18^{***}
Adjusted R^2		0.29^{***}			0.60^{***}	
R^2 change					0.31	
F for change in R^2		58.74^{***}			218.50^{***}	

Note: $^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$.

TAM related factors

In line with the Technology Acceptance Model (TAM), it's posited that perceived ease of use directly impacts both the perceived usefulness of virtual reality and the attitudes toward purchasing/using VR headsets. Perceived usefulness is hypothesized to directly influence both attitudes and the intention to purchase/use VR headsets. Furthermore, attitudes toward using/purchasing VR headsets are believed to have a direct effect on the intention toward purchasing/using VR headsets. Based on these assumptions, several linear regression analyses were performed to examine these effects.

Regarding the participants' intention to purchase a VR headset, there was a significant positive association between perceived ease of use and perceived usefulness ($\beta = 0.11$, $t(861) = 3.33$, $p < .001$). Perceived ease of use also showed a significant positive relationship with attitudes towards purchasing a VR headset ($\beta = 0.43$, t (861) = 14.01, $p < 0.001$). Perceived usefulness was positively associated with attitudes towards purchasing a VR headset ($\beta = 0.38$, t (861) = 12.15, $p < 0.001$) and the intention to purchase a VR headset ($\beta = .37$, t (861) = 11.71, $p < 0.001$). Attitudes towards purchasing a VR headset were positively related to the intention to purchase a VR headset ($\beta = 0.68$, t (861) = 26.88, $p < 0.001$).

When assessing the participants' intention to use VR headsets regularly, perceived ease of use showed a significant positive relationship with perceived usefulness ($\beta = 0.11$, t (861) = 3.33, $p < 0.001$), as well as attitudes towards regular use of VR headsets ($\beta = 0.37$, t (861) = 11.83, $p < 0.001$). Perceived usefulness was positively associated with attitudes towards regular use of VR headsets ($\beta = 0.36$, t (861) = 11.46, $p < 0.001$) and the intention to use VR headsets regularly ($\beta = 0.46$, t (861) = 15.29, $p < 0.001$). Attitudes towards regular use of VR headsets showed a significant positive relationship with the intention to use VR headsets regularly ($\beta = 0.66$, t (861) = 25.47, $p < 0.001$).

A two-stage hierarchical multiple regression analysis was conducted to evaluate the overall model with the inclusion of control variables. Variables such as previous VR headset usage, VR headset ownership, age, gender, education level, and annual household income were incorporated at stage one of the regression to account for their influence. Stage two of the regression included perceived usefulness, perceived ease of use, and attitudes towards VR headset usage.

In the context of intention to purchase VR headsets, the hierarchical multiple regression analysis revealed that at stage one, education level and annual household income did not significantly contribute to the regression model. Conversely, variables such as previous VR headset usage, VR headset ownership, age, and gender made significant contributions to the regression model (F (6, 851) = 51.86, $p < 0.001$). These variables accounted for 27% of the variance in the intention to purchase VR headsets.

At stage two, the inclusion of perceived usefulness, perceived ease of use, and attitudes towards purchasing VR headsets accounted for an additional 29% of the variance in the intention to purchase VR headsets. This increase in R^2 was statistically significant (F (3, 848) = 182.15, $p < 0.001$), indicating the considerable influence of these factors on the purchasing intentions related to VR headsets.

Table 7:Hierarchical Multiple Regression Analysis of TAM for purchase intention

Variable	*Step 1*			*Step 2*		
	B	*SE B*	*β*	*B*	*SE B*	*β*
Have used or not	-0.59	0.15	-0.12^{***}	-0.28	0.12	-0.06^{*}
Own or not	-1.53	0.12	-0.41^{***}	-0.70	0.10	-0.19^{***}
Age	0.02	0.00	0.15^{***}	0.01	0.00	0.04
Education	-0.08	0.04	-0.07^{*}	-0.02	0.03	-0.01
Gender	-0.45	0.10	-0.14^{***}	-0.28	0.08	-0.08^{***}
Annual household income	0.00	0.02	0.01	0.00	0.01	0.00
Attitude	-	-	-	0.72	0.04	0.47^{***}
Perceived Usefulness	-	-	-	0.10	0.03	0.10^{***}
Perceived Ease of Use	-	-	-	0.25	0.04	0.17^{***}
Adjusted R^2		0.27^{***}			0.56^{***}	
R^2 change					0.29	
F for change in R^2		51.86^{***}			182.15^{***}	

Note: $^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$.

For intention to use VR headsets on a regular basis, a two-stage hierarchical multiple regression analysis was employed to test the overall model with control variables. The initial stage of the regression included participant's past VR headset usage, VR headset ownership, age, gender, education level, and annual household income. At stage two, the model introduced perceived usefulness, perceived ease of use, and attitudes towards VR headset usage.

Regarding the regular usage intention of VR headsets, the analysis demonstrated that at stage one, education level and annual household income did not significantly contribute to the regression model. Conversely, whether participants have used a VR headset before, whether they owned a VR headset, their age, and their gender, significantly contributed to the model (F (6, 851) = 58.74, $p < 0.001$), accounting for 29% of the variance in regular usage intention.

Upon introducing perceived usefulness, perceived ease of use, and attitudes towards regular usage of VR headsets at stage two, an additional 30% of the variance in regular usage intention was explained. This change in R^2 was statistically significant (F (3, 848) = 202.70, $p < 0.001$), suggesting the substantial impact of these factors on the intention to use VR headsets regularly.

Table 8:Hierarchical Multiple Regression Analysis of TAM for use intention

Variable	*Step 1*			*Step 2*		
	B	*SE B*	*β*	*B*	*SE B*	*β*
Have used or not	-0.47	0.14	-0.11^{***}	-0.24	0.10	-0.05^{*}
Own or not	-1.49	0.11	-0.45^{***}	-0.77	0.09	-0.23^{***}
Age	0.02	0.00	0.14^{***}	0.00	0.00	0.03
Education	-0.06	0.04	-0.05	-0.01	0.03	-0.01
Gender	-0.41	0.09	-0.14^{***}	-0.23	0.07	-0.08^{***}
Annual household income	0.00	0.02	0.01	0.00	0.01	0.00
Attitude	-	-	-	0.19	0.02	0.21^{***}
Perceived Usefulness	-	-	-	0.20	0.03	0.15^{***}
Perceived Ease of Use	-	-	-	0.53	0.03	0.43^{***}
Adjusted R^2		0.29^{***}			0.59^{***}	
R^2 change					.30	
F for change in R^2		58.74^{***}			202.70^{***}	

Note: $^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$.

UTAUT related analysis

Building upon the Unified Theory of Acceptance and Use of Technology (UTAUT) model, it's proposed that performance expectancy, effort expectancy, social influence, and facilitating conditions are four pivotal factors affecting individuals' intent to purchase and use

VR headsets daily. To examine the direct effects of these factors, eight linear regression coefficient tests were initially conducted.

The performance expectancy showcased a substantial positive association with the intent to purchase VR headsets ($\beta = 0.55$, $t\,(861) = 19.22$, $p < 0.001$). Similar positive relationships were observed with effort expectancy ($\beta = 0.44$, $t\,(861) = 14.41$, $p < 0.001$), social influence ($\beta = 0.50$, $t\,(861) = 16.72$, $p < 0.001$), and facilitating conditions ($\beta = 0.51$, $t\,(861) = 17.27$, $p < 0.001$).

Furthermore, performance expectancy also exhibited a significant positive relationship with the intention to use VR headsets regularly ($\beta = 0.63$, $t\,(861) = 23.51$, $p < 0.001$), paralleled by effort expectancy ($\beta = 0.41$, $t\,(861) = 13.21$, $p < 0.001$), social influence ($\beta = 0.56$, $t\,(861) = 19.71$, $p < 0.001$), and facilitating conditions ($\beta = 0.49$, $t\,(861) = 16.64$, $p < 0.001$).

Subsequently, two two-stage hierarchical multiple regression analyses were performed to evaluate the overall model with control variables. In stage one, factors including participants' past VR headset usage, VR headset ownership, age, gender, education level, and annual household income were entered into the regressions as control variables. Performance expectancy, effort expectancy, social influence, and facilitating conditions were introduced at stage two.

With respect to the intention to purchase VR headsets, the hierarchical multiple regression highlighted that at stage one, education level and annual household income failed to contribute significantly to the regression model. Meanwhile, prior VR headset usage, VR headset ownership, age, and gender made significant contributions to the regression model ($F\,(6, 851) = 51.86$, $p < 0.001$), explaining 27% of the variance in purchasing intention. Introducing performance expectancy, effort expectancy, social influence, and facilitating conditions at stage two explained an additional 25% of the variance in purchasing intention. This increase in R^2 was significant (F (4,847) = 109.82, $p < 0.001$).

Table 9:Hierarchical Multiple Regression Analysis of UTAUT for purchase intention

Variable	*Step 1*			*Step 2*		
	B	*SE B*	*β*	*B*	*SE B*	*β*
Have used or not	-0.59	0.15	-0.12^{***}	-0.08	0.13	-0.02
Own or not	-1.53	0.12	-0.41^{***}	-0.86	0.10	-0.23^{***}
Age	0.02	0.00	0.15^{***}	0.01	0.00	0.09^{***}
Education	-0.08	0.04	-0.07^{*}	-0.04	0.03	-0.03
Gender	-0.45	0.10	-0.14^{***}	-0.19	0.08	-0.06^{*}
Annual household income	0.00	0.02	0.01	-0.02	0.01	-0.04
Performance Expectancy	-	-	-	0.27	0.03	0.27^{***}
Effort Expectancy	-	-	-	0.19	0.05	0.13^{***}
Social influence	-	-	-	0.18	0.03	0.16^{***}
Facilitating conditions	-	-	-	0.29	0.05	0.21^{***}
Adjusted R^2		0.27^{***}			0.52^{***}	
R^2 change					0.25	
F for change in R^2		51.86^{***}			109.82^{***}	

Note: $^{***}p < .001$, $^{**}p < .01$, $^{*}p < .05$.

In regard to the intention to use VR headsets on a daily basis, the hierarchical multiple regression indicated that in the first stage, the factors of education level and annual household income did not significantly contribute to the regression model. In contrast, factors such as prior VR headset usage, VR headset ownership, age, and gender made significant contributions to the regression model (F (6, 851) = 58.74, $p < .001$). These factors accounted for 29% of the variance in the intention to use VR headsets regularly. The introduction of performance expectancy, effort expectancy, social influence, and facilitating conditions at the second stage explained an additional 32% of the variance in regular VR headset usage intention. This increase in R^2 was statistically significant (F (4,847) = 152.41, $p < 0.001$).

Table 10:Hierarchical Multiple Regression Analysis of UTAUT for use intention

Variable	*Step 1*			*Step 2*		
	B	*SE B*	*β*	*B*	*SE B*	*β*
Have used or not	-0.59	0.15	-0.12^{***}	-0.02	0.11	0.00

Own or not	-1.53	0.12	-0.41***	-0.84	0.08	-0.25***
Age	0.02	0.00	0.15***	0.01	0.00	0.08***
Education	-0.08	0.04	-0.07*	-0.02	0.03	-0.01
Gender	-0.45	0.10	-0.14***	-0.16	0.07	-0.05*
Annual household income	0.00	0.02	0.01	-0.02	0.01	-0.04
Performance Expectancy	-	-	-	0.32	0.03	0.34***
Effort Expectancy	-	-	-	0.12	0.04	0.09**
Social influence	-	-	-	0.19	0.03	0.19***
Facilitating conditions	-	-	-	0.24	0.04	0.19***
Adjusted R^2		0.27***			0.59***	
R^2 change					0.32	
F for change in R^2		51.86***			152.41***	

*Note: ***$p < 0.001$, **$p < 0.01$, *$p < 0.05$.*

Other factors

In this study, additional factors such as motion sickness, discomfort, perceived risk, and negative emotions were posited to directly affect participants' intent to purchase and use VR headsets. A series of linear regression coefficient tests were conducted to examine the relationships between these factors and purchase/use intentions.

In considering motion sickness and discomfort, it was noted that not all study participants had prior VR headset experience. Therefore, participants' exposure to others' experiences with motion sickness was used as a surrogate for how perceived motion sickness might affect their intent to purchase or use VR headsets.

Among participants with VR headset experience, motion sickness levels were generally low (M = 2.74, SD = 1.51). However, participants reported higher levels when discussing others' experiences with motion sickness (M = 3.83, SD = 1.78). A paired sample T-test was conducted to compare these two measurements, yielding a statistically significant difference (t = -18.52, p < 0.001), indicative of a possible third-person effect.

For participants with prior VR experience, self-reported motion sickness had a significant negative relationship with both the intent to purchase (β = -0.26, t (714) = -7.25, p < 0.001) and the intent to use VR headsets regularly (β = -0.28, t (714) = -7.73, p < 0.001). For participants without VR experience, others' motion sickness experiences did not significantly influence purchase (β = 0.08, t (145) = 0.91, p = 0.36) or regular use intentions (β = -0.00, t (145) = -0.05, p = 0.96).

Users reported a modest overall physical comfort level (M = 4.43, SD = 1.50) and general comfort (M = 4.18, SD = 1.61), but reported lower comfort levels in social settings (i.e., wearing VR headsets in public; M = 2.64, SD = 1.85). Physical comfort, social comfort, and general comfort all displayed significant positive relationships with the intent to purchase and regularly use VR headsets.

Participants' perceived risk was relatively low (M = 2.43, SD = 1.14), and it had significant negative relationships with both the intent to purchase (β = -0.31, t (861) = -9.45, p < 0.001) and regular use (β = -0.31, t (861) = -9.49, p < 0.001) of VR headsets.

Lastly, participants reported low levels of negative emotions toward VR headsets (M = 1.53, SD = .88). Negative emotions showed significant negative relationships with both purchase intention (β = -0.21, t (861) = -6.30, p < 0.001) and regular use intention (β = -0.18, t (861) = -5.37, p < 0.001).

Path model testing

A confirmatory factor analysis (CFA) was performed before each path model to test whether the measurement model fit the data. This study used following criteria to evaluate the model fit: a comparative fit index (CFI) ≥ .90, a Tucker-Lewis index (TLI) ≥ .90, a root-mean-square error of approximation (RMSEA) ≤ .08, standardized root-mean-square residual (SRMR) ≤ .08 (Kline, 2005).

TPB model testing

Two path analysis based on TPB were conducted using the Maximum Likelihood method on Mplus version 8.10. One with independent variables of attitudes towards purchasing VR headsets, subjective norms towards purchasing VR headsets, and perceived behavioral control towards purchasing VR headsets and dependent variable of intention to purchase VR headsets. The other with independent variables of attitudes towards using VR headsets on a regular basis, subjective norms towards using VR headsets on a regular basis, and perceived behavioral control towards using VR headsets on a regular basis and dependent variable of intention to use VR headsets on a regular basis.

The measurement model for TPB model on purchasing VR headsets was overall mediocre (Chi-square/degree of freedom= 7.37; RMSEA = 0.08; CFI = 0.95; TLI = 0.93; SRMR = .07).Controlling for whether the participant have used VR headset before, whether the participant have owned a VR headset, Age, Gender, Education level, and Annual household income, the overall model fit of the path model was good (Chi-square = 3.29; degree of freedom = 1; RMSEA = 0.05; CFI = 0.998; TLI = 0.945; SRMR = 0.01).

The path analysis of the proposed model reviewed the following results (See Table 11.)

Table 11:The Result of Path Analysis

Path	Path coefficient
Attitude → Purchase Intention	0.73^{***}
Subjective Norm → Purchase Intention	0.25^{***}
Perceived Behavioral Control → Purchase Intention	0.17^{***}

Note: $^{***}p < .001$, $^{**}p < .01$, $^{*}p < .05$.

The measurement model for TPB model on using VR headsets on a regular basis was overall poor (Chi-square/degree of freedom= 10.23; RMSEA = 0.10; CFI = 0.92; TLI = 0.91; SRMR = 0.09).

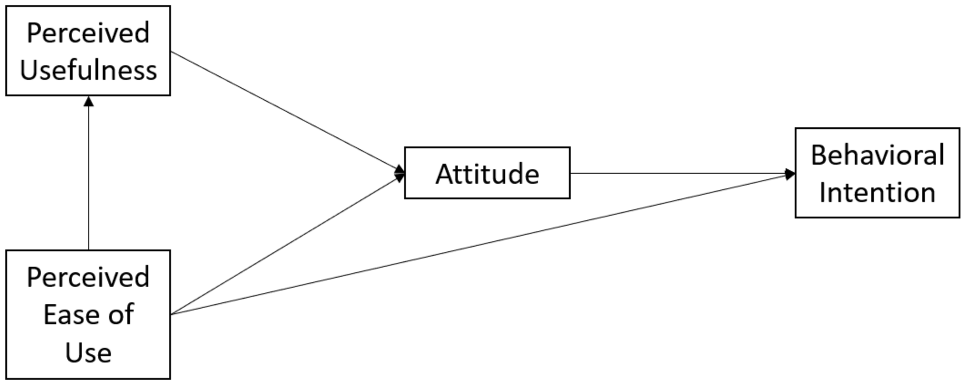
TAM model testing

Two path analysis based on TAM model were conducted using the Maximum Likelihood method on Mplus version 8.10. One with attitudes towards purchasing VR headsets and intention towards purchasing VR headsets, the other with attitudes towards using VR headsets on a regular basis and intention towards using VR headsets on a regular basis.

The measurement model for TAM model on purchasing VR headsets was overall good (Chi-square/degree of freedom = 5.24; RMSEA = 0.07; CFI = 0.96; TLI = 0.95; SRMR = 0.04). Controlling for whether the participant have used VR headset before, whether the participant have owned a VR headset, Age, Gender, Education level, and Annual household income, the overall model fit of the path model was poor (Chi-square/degree of freedom = 43.37; RMSEA = 0.23; CFI = 0.96; TLI = 0.00; SRMR = 0.03).

Upon closer investigation at the output file on factors' effect on purchase intention as well as combining the fact the current sample reported low perceived usefulness of VR headsets but high perceived ease of use of VR headsets, the current study suspected that perceived ease of use may be the major factor but not the perceived usefulness with the current sample. Thus, the following model was tested (See Figure 4):

Figure 4:Adjusted TAM Model



Controlling for whether the participant have used VR headset before, whether the participant have owned a VR headset, Age, Gender, Education level, and Annual household income, the overall model fit of the new model was mediocre (Chi-square/degree of freedom = 6.36; RMSEA = 0.08; CFI = 0.99; TLI = 0.87; SRMR = 0.01).

The measurement model for TAM model on using VR headsets on a regular basis was overall good (Chi-square/degree of freedom = 5.36; RMSEA = 0.07; CFI = 0.96; TLI = 0.95; SRMR = 0.05). Controlling for whether the participant have used VR headset before, whether the participant have owned a VR headset, Age, Gender, Education level, and Annual household income, the overall model fit of the path model was poor (Chi-square/degree of freedom = 26.16; RMSEA = 0.18; CFI = 0.98; TLI = 0.41; SRMR = 0.02).

Based on previous steps, a new model on how perceived ease of use affect intention to use VR headsets on a regular basis was tested, controlling for whether the participant have used VR headset before, whether the participant have owned a VR headset, Age, Gender, Education level, and Annual household income, the overall model fit of the path model was poor (Chi-square/degree of freedom = 59.76; RMSEA = 0.27; CFI = 0.94; TLI = 0.00; SRMR = 0.03).

UTAUT model testing

Two path analysis based on UTAUT model were conducted using the Maximum Likelihood method on Mplus version 8.10. One with intention towards purchasing VR headsets, the other with intention towards using VR headsets on a regular basis.

The measurement model for UTAUT model on purchasing VR headsets was overall good (Chi-square/degree of freedom = 4.80; RMSEA = 0.07; CFI = 0.96; TLI = 0.95; SRMR = 0.05). Controlling for whether the participant have used VR headset before, whether the participant have owned a VR headset, Age, Gender, Education level, and Annual household income, the overall model fit of the path model was poor (Chi-square/degree of freedom = 98.67; RMSEA = 0.35; CFI = 0.64; TLI = 0.00; SRMR = 0.10).

The measurement model for UTAUT model on using VR headsets on a regular basis was overall mediocre (Chi-square/degree of freedom = 5.52; RMSEA = 0.08; CFI = 0.96; TLI = 0.95; SRMR = 0.06). Controlling for whether the participant have used VR headset before, whether the participant have owned a VR headset, Age, Gender, Education level, and Annual household income, the overall model fit of the path model was poor (Chi-square/degree of freedom = 98.67; RMSEA = 0.35; CFI = 0.67; TLI = 0.00; SRMR = 0.10).

Proposing new model

An examination of three proposed models and numerous potential factors influencing individuals' willingness to acquire or regularly engage with virtual reality (VR) headsets has been completed. This process has generated several points that are notable and need to be discussed.

Beginning with the initial observations, it is clear that each separate factor identified within the three models shows a statistically significant impact on the intention to purchase or use VR headsets. This observation is based on careful examination of regression results.

Moreover, it is revealed that the incorporation of these factors into hierarchical regression models contributes a statistically significant increase to the explanation of the variance. This variance is specifically linked to the intention to purchase or regularly use VR headsets. This pattern, therefore, points to the considerable influence of these individual factors on decisions relating to VR headset usage and purchasing.

Next, control variables were examined, and some trends emerged. For instance, variables such as the participant's ownership of a VR headset and their gender demonstrated a consistent and statistically significant impact on their intention towards VR headset purchases or usage.

Prior experience with motion sickness, discomfort, perceived risk, and negative emotions towards VR headsets are also tested. Even though the overall average presence of these factors in the current sample is low, these elements still had a significant effect on the intention to purchase or use VR headsets.

When the three models were assessed as path models, with control for factors like VR headset usage and ownership, age, gender, education level, and annual household income, it became clear that all models did not achieve an optimal fit in terms of explaining regular VR headset usage by participants.

However, when the same factors were controlled, the Theory of Planned Behavior model seemed to offer a more accurate fit in the context of the current sample. This model thus appears to be a more successful framework for explaining the intention to purchase a VR headset.

Lastly, in contrast to most Technology Acceptance Models, it was found that perceived ease of use, rather than perceived usefulness, appeared to have a more direct influence on the intention to purchase VR headsets within the current sample. This observation is interesting and stands out as a point that diverges from traditional models.

Taking these findings into account, the next step of this dissertation intends to combine the various factors from preceding models, alongside additional proposed models, in order to propose a new framework that allows for a more comprehensive understanding of the matter at hand. Given the shortcoming of all existing models to provide a satisfactory fit for people's intention to use VR headsets regularly, the proposed model will primarily focus on deciphering people's intention to purchase VR headsets.

Hierarchical regression analysis result

In the light of the various hierarchical models that have been analyzed in the context of this dissertation, the initial step will be to identify those factors which continue to exert a statistically significant influence on individuals' intention to purchase VR headsets, even when incorporated into the same model. This will entail a thorough and meticulous exploration of these factors in order to develop a model that offers a more accurate and insightful understanding of VR headset purchase intentions.

A two-stage hierarchical multiple regression analysis was performed to evaluate the factors within the same model. In stage one, controlling factors including whether participants have used VR headsets before, whether they own a VR headset, age gender, education level, and annual household income were entered. Attitudes toward purchasing a VR headset, subjective norms toward purchasing a VR headset, perceived behavioral control toward purchasing a VR headset, perceived usefulness, perceived ease of use, performance expectancy, effort expectancy, social influence, facilitating conditions, experience with motion sickness, negative emotion, perceived risk, physical comfort, social comfort and general comfort were entered in stage two.

The hierarchical multiple regression highlighted that at stage one, education level and annual household income failed to contribute significantly to the regression model. Meanwhile, prior VR headset usage, VR headset ownership, age, and gender made significant contributions to the regression model (F (6, 844) = 51.41, $p < 0.001$), explaining 27% of the variance in purchasing intention.

Introducing performance expectancy, effort expectancy, social influence, and facilitating conditions at stage two explained an additional 25% of the variance in purchasing intention. This increase in R^2 was significant (F (15,829) = 50.65, $p < 0.001$).

Table 12:Hierarchical Multiple Regression Analysis of full model

Variable	*Step 1*			*Step 2*		
	B	*SE B*	*β*	*B*	*SE B*	*β*
Have used or not	-0.58	0.15	-0.12^{***}	-0.13	0.12	-0.03
Own or not	-1.53	0.12	-0.41^{***}	-0.57	0.10	-0.15^{***}
Age	0.02	0.00	0.15^{***}	0.00	0.00	0.03
Education	-0.09	0.04	-0.07^{*}	-0.01	0.03	-0.01
Gender	-0.46	0.10	-0.14^{***}	-0.24	0.07	-0.07^{***}
Annual household income	0.01	0.02	0.01	-0.02	0.01	-0.03
Attitude				0.47	0.05	0.31^{***}
Subjective norm				0.20	0.05	0.16^{***}
Perceived behavioral control				0.04	0.04	0.03
Perceived usefulness				-0.07	0.04	-0.06^{T}
Perceived ease of use				0.10	0.08	0.07
Performance expectancy				0.20	0.04	0.19^{***}
Effort expectancy				-0.03	0.07	-0.02
Social influence				0.00	0.04	0.00
Facilitating conditions				0.16	0.05	0.11^{***}
Motion sickness				0.07	0.03	0.06^{*}
Negative emotions				-0.06	0.05	-0.03
Perceived risk				-0.11	0.04	-0.07^{**}
Physical comfort				0.06	0.04	0.05
Social comfort				-0.06	0.03	-0.06^{*}
General comfort				0.10	0.04	0.09^{*}
Adjusted R^2		0.27^{***}			0.62^{***}	
R^2 change					.25	
F for change in R^2		51.41^{***}			50.65^{***}	

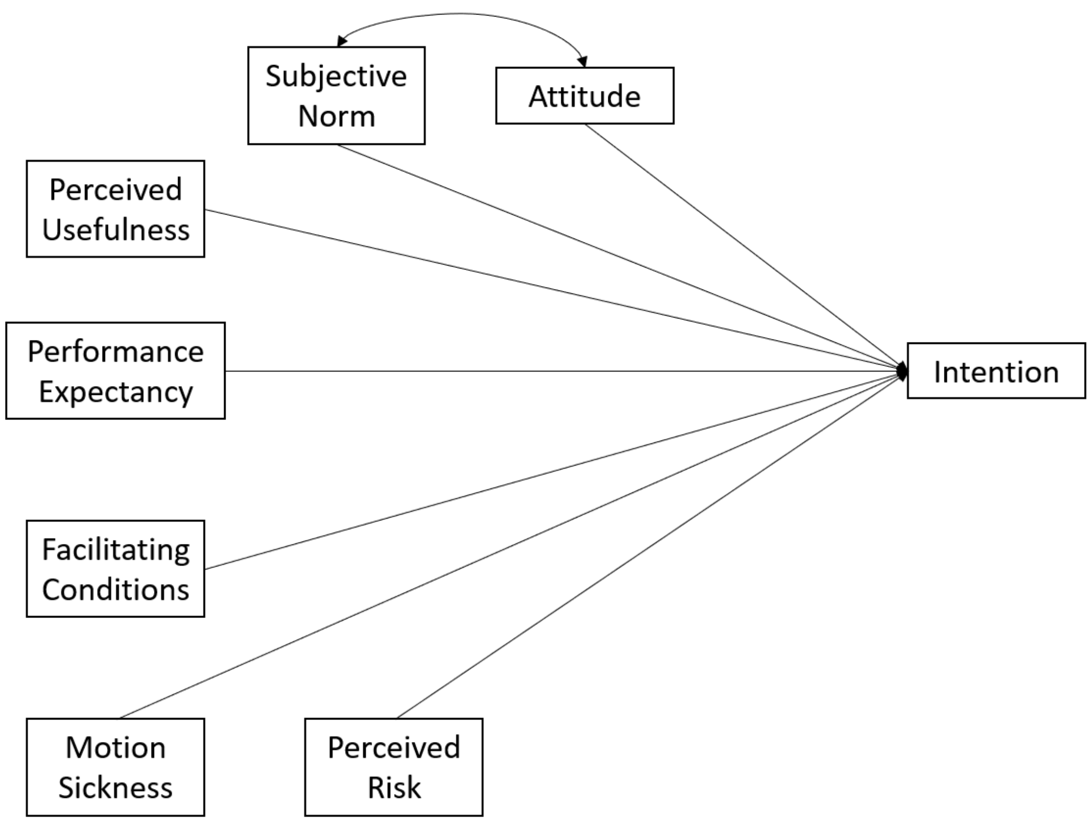
Note: $^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$, $^{T}p = 0.06$

Structural Equation Model

Based on the results of the hierarchical regression testing, whether participants own a VR headset or not, gender, Attitudes towards purchasing a VR headset, subjective norms towards purchasing a VR headset, perceived usefulness, performance expectancy, facilitating conditions, pervious experience with motion sickness, perceived risk, social comfort and general comfort are factors that would have a direct impact on participants' intention to purchase a VR headset. Because social comfort and general comfort are single item variables, they will be used along with whether participants own a VR headset or not and gender as control variables, the rest of the variables are considered to have statistically significant effect on participants' intention to purchases a VR headset.

After plugging in relationships suggested by previous models, the new proposed model looks like this: (See Figure 5)

Figure 5:New Model



To test the proposed new model, a SEM analysis with maximum likelihood estimation was employed. Controlling for whether participants own a VR headset or not and gender, the overall model fit of the path model was good (Chi-square/degree of freedom = 4.93; RMSEA = 0.07; CFI = 0.91; TLI = 0.90; SRMR = 0.11).

Additional analysis: gender

After reviewing results from model testing, gender continue to be significant predictor of purchase/use VR headsets. Thus, several independent sample T-tests were done to test whether there are significant differences with people's intention to purchase VR headsets and intention to use VR headsets on a regular basis between male/female (the other genders were not included as it was not enough sample for statistically significant result).

The mean purchase intention for a VR headset by male was 4.82 with $SD = 1.67$, while the mean purchase intention for a VR headset by female was 3.93 with $SD = 1.85$. An independent sample t-test was used to test whether these means were statistically different from each other. The result showed that the mean purchase intention for a VR headset by male were statistically different from female. The result showed that the mean purchase intention for a VR headset by male was significantly higher than the mean score by female ($t = 7.26$, $p < 0.001$).

The mean use intention for a VR headset by male was 4.30 with $SD = 1.53$, while the mean use intention for a VR headset by female was 3.45 with $SD = 1.62$. An independent sample t-test was used to test whether these means were statistically different from each other. The result showed that the mean use intention for a VR headset by male were statistically different from female. The result showed that the mean use intention for a VR headset by male was significantly higher than the mean score by female ($t = 7.78$, $p < 0.001$).

V. DISCUSSION AND CONCLUSION

Rooted in the Uses and Gratifications (U&G) theory (Katz et al., 1973), this study based its theoretical framework on the assumption that the adoption of new media technologies, such as virtual reality, is propelled by the expectation that users' specific needs will be fulfilled, leading to particular gratifications. The U&G theory focuses on the 'why' of media use, i.e., the needs and motivations driving individuals to adopt a particular technology. Thus, understanding how user motivations affect technology patterns were the key goal of the current study.

Extending from this foundational concept, the research incorporated three influential behavioral models: the Theory of Planned Behavior (TPB) (Ajzen, 1991), the Technology Acceptance Model (TAM) (Davis, 1989), and the Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh et al., 2003). Each model provided additional insights into the motivations and intentions underpinning consumer behavior.

TPB investigates the motivational factors, including attitudes and perceived behavioral control, that shape an individual's intention to perform a specific behavior. The TAM, on the other hand, specifically examines the perceived usefulness and ease of use as primary determinants of technology acceptance. Lastly, UTAUT unifies these elements, including performance expectancy, effort expectancy, social influence, and facilitating conditions to predict user acceptance of technology. The findings generally supported that all factors within the three models will have a significant impact on participants' intention to purchase and use VR headsets, suggesting that they are still beneficial frameworks for understanding consumers' intentions about new media technologies such as VR headsets.

Descriptive analysis discussion

With the high usage rate of the current sample, the actual ownership of VR headsets remains low. Most people may have used VR headsets at another place (i.e., a friend's house, commercially available VR experiences and etc.). The financial implications of VR headset ownership were further implied with participants' willingness to spend. The majority of our participants would prefer to spend between $300 and $500 for a VR headset, with a peak preference at the $300 price point. This suggests resistance among consumers to exceed this price range for the current VR headset offerings. The mean willingness-to-pay scores further substantiate this, as participants rated their willingness to pay more for VR technology and a higher price for VR headsets relative to other tech gadgets as relatively low.

The findings demonstrate that while VR technology generates significant interest, its adoption as a personal device is hindered largely by cost-related issues. This suggests that despite the technological appeal of VR, the high prices associated with current market offerings are a significant barrier to wider adoption rates. It will be vital for VR manufacturers to consider these price sensitivities when developing and pricing future products if they hope to increase ownership levels. Additionally, targeted marketing towards the demographic groups identified in this study might lead to improved sales and broader adoption of VR technology.

TPB, TAM and UTAUT models

As suggested by the literature review, the TPB, TAM, and UTAUT models have been used extensively in understanding people’s intentions to adopt new media technologies.

Consistent with previous research (e.g., Kim & Forsythe, 2008; Lai, 2017). The TPB model variables – attitude, subjective norms, and perceived behavioral control - were all significantly associated with intentions to purchase and continue use of VR headsets when testing TPB models. The model's predictive power was shown when it comes to people's intention to purchase VR headsets but it does not have a significant effect on predicting people's continued use of VR headsets. That being said, each factor in the model would still have a statistically significant impact on people's intention to use VR headsets on a regular basis, but the model itself failed to fit the data. The reason for that will be discussed in a later section. Overall, the results from the TPB model suggest that improving positive attitudes towards VR, emphasizing social acceptance, and reducing perceived barriers to use could effectively increase the purchase of VR headsets but would not necessarily keep the consumers using it in the long run.

Like previous studies, intention to use VR was significantly affected by perceived usefulness (Chow et al., 2012; Fetscherin & Lattemann, 2008; Tokel & İsler, 2013) and perceived ease of use (Bertrand & Bouchard, 2008; Chow et al., 2012; Fetscherin & Lattemann, 2008; Tokel & İsler, 2013), with perceived ease of use significantly impacting perceived usefulness (Chow et al., 2012; Fetscherin & Lattemann, 2008; Kim & Forsythe, 2008; Tokel & İsler, 2013).

When being tested by themselves, the TAM-related factors also showed a significant influence. Perceived ease of use and perceived usefulness directly affected attitudes and intentions toward VR headset use and purchase. Hence, it underlines that when VR technology is easier to use and perceived as useful, consumers are more likely to develop favorable attitudes and intentions toward it. However, as noted in the results section, the perceived usefulness of VR headsets is relatively low, which, in turn, affects the overall validity of the model. Thus, in the current sample, perceived ease of use would have a greater impact on participants' intention to purchase VR headsets than perceived usefulness. At the same time, the whole model, which I will discuss later, suggests that perceived usefulness is still one of the dominating factors when predicting people's intention to purchase VR headsets. The model fit was not great, but the measurement model did yield satisfactory results. This may indicate that the TAM model is still viable in predicting people's intention to purchase VR headsets. As such, the results imply that it may be possible that when people actually think using VR headsets is useful and the VR headsets' interfaces are simple enough to use, there would be a bump in the VR market.

Lastly, the UTAUT model, performance expectancy, effort expectancy, social influence, and facilitating conditions all have statistically significant impacts on the intention to purchase VR headsets. Yet, the overall model fit was low. The good measurement model suggests the impact of these factors individually on the intention to purchase VR headsets, but the overall model does not yield a good result. This could be caused by the strong effects of control variables, but further studies need to be done to address this issue. Nonetheless, these findings still suggest that all four constructs of this model are crucial to consider when understanding VR adoption. This highlights that to increase VR headset adoption, it is beneficial to enhance the performance of the technology, make it easier to use, increase social influence (e.g., through influencers or social media campaigns), and provide facilitating conditions (e.g., accessible customer service).

Lastly, several demographic and prior experience variables (whether a participant has owned a VR headset before and gender) were significant predictors in the regression models, suggesting that these factors could also play a significant role in VR headset adoption. Notably, education level and annual household income did not significantly contribute to the models, indicating that VR adoption might cut across different socioeconomic statuses.

Other factors

The current study underscores several contributing elements that influence the intention to purchase or use VR (Virtual Reality) headsets. These factors include motion sickness, discomfort, perceived risk, and the prevalence of negative emotions. Despite the previously unexplored nature of these elements in the context of VR headset usage, the findings indicate their significant role in shaping consumer behavior.

Motion sickness, reported relatively low in the current sample, demonstrated a statistically significant correlation with the intention to purchase VR headsets. Despite the low prevalence of prior motion sickness experiences among participants, such encounters appeared to have a substantial impact. This implies that prior experiences, particularly those related to motion sickness when using VR headsticks, serve as significant determinants when evaluating the likelihood of repeat purchases and continued use of this emerging media technology.

Furthermore, it was noted that many participants had been exposed to information about motion sickness associated with VR headset usage. This might suggest two potential scenarios. First, the public discourse about the possibility of VR headset usage leading to motion sickness has amplified. Second, people could be learning about motion sickness from a variety of other media outlets. These observations reinforce the need for further inquiry into the nature of public discourse and its influence on consumer decision-making processes.

Similarly, the study also spotlighted the impact of perceived risk and negative emotions on the usage of VR headsets. While the overall perceived risk and negative emotions towards VR headsets were generally low among participants, these factors appeared to exert a significant negative influence on the intention to purchase and use these devices. These findings underscore the importance for companies to prioritize user safety and risk reduction strategies in their VR headset design and promotion initiatives.

Social acceptance is another dimension that was investigated in the study. It appears that the use of VR headsets in social settings is still considered unfavorable by many. However, the comfort level experienced during VR headset use was identified as a significant factor shaping the intention to buy and continue using these devices. This presents an interesting avenue for future research, particularly in understanding how these social factors mold people's intention to adopt such novel technologies.

The new model – SPCA model

A significant contribution of the present study is the introduction of a novel model - SPCA (Social-Performance-Capability-Attitudinal) model - designed to enhance our understanding of the factors influencing people's intention to purchase VR headsets. This model is rooted in the intention to offer a refined lens through which the factors influencing the purchase of VR headsets can be understood. Deriving its strength from both pre-existing and newly identified variables, the SPCA model offers a unique taxonomy for categorizing these determinants. This novel categorization allows researchers and industry practitioners alike to holistically examine how different clusters of factors interact and influence consumer intentions in the VR headset market.

The study identified two control variables that exert a considerable impact on the intention to purchase VR headsets. The first control variable is the current ownership status of a VR headset. The findings suggest that a person's decision regarding future purchases is largely influenced by whether they already own a VR headset or not. This highlights the role of personal experience with VR technology in shaping future consumption patterns.

Intriguingly, the second control variable that surfaced in our study was gender. The results indicated a notable disparity between genders in their willingness to adopt VR technology, with men seemingly more open to embracing these new media technologies. This disparity is worth noting and expanding upon. Such gender differences could be rooted in a combination of societal norms, exposure to technology, or even innate preferences. This will be further discussed in a later paragraph.

A variety of elements previously proposed by different models are also tested to be influential on people's intention to adopt VR headsets. These factors are attitudes, subjective norms, perceived usefulness, performance expectancy, facilitating conditions, experiences with motion sickness, perceived risk, and degrees of social and general comfort. These can be conveniently categorized into several distinct groups of variables:

1.Socially Influential Variables:

The factors of subjective norms and social comfort fall under this category. These elements embody the social implications and potential societal influence, highlighting the importance of social dynamics in shaping the decision-making process around VR headset adoption.

2.Performance and Utility Variables

Perceived usefulness and performance expectancy play a crucial role. These factors delve into the practical utility and expected performance of VR headsets, accentuating the device's inherent benefits and its capacity to meet user expectations.

3.Capability, Risk, and Comfort Variables

This category encapsulates the facilitating conditions, perceived risk, experiences with motion sickness, and general comfort. It underscores the user's capability to utilize the VR headset, the associated risks, any previous discomfort experienced, and the overall comfort level provided by the device. These factors collectively influence the adoption of VR headsets, highlighting the need to strike a balance between user capability, safety, and comfort.

4.Attitudinal Variables

Attitudes towards purchasing VR play a pivotal role in shaping the intent to purchase. This includes individuals' positive or negative evaluations, or predispositions towards VR headsets, which can significantly influence the adoption and continuous use of this technology.

While the SPCA model integrates a comprehensive set of variables, it's crucial to acknowledge that this model in its current form does not explain more variances towards people’s intention to purchase/use VR headsets and there's still a percentage of variance in the intention to purchase VR headsets that remains unexplained. This could be because of various reasons. One potential reason is that there are still some potential influencing factors latent that is not discovered in the current study. Additionally, the current model does not fully address the interactions between the variables and the complexity of the interactions might significantly change how the model explain people’s intention. Another reason could be that there are mediation and/or moderation effects of control variables that were not considered in the current model. An avenue for future research could be the exploration of potential mediating or moderating variables within the SPCA framework. For instance, while gender surfaced as a notable control variable, its potential role as a moderator between, say, attitudinal variables and purchase intention could provide deeper insights. Similarly, prior experience with technology, in general, could mediate the relationship between performance expectancy and the intent to buy. Such mediating and moderating relationships, when tested, could further refine the model and explain the currently unaccounted variance.

The SPCA model, while comprehensive, underscores the dynamic and ever-evolving nature of consumer behavior, especially in technology-intensive markets like VR. Future research needs to consider a diverse demographic base, including varying races, ages, and other socio-cultural determinants, to ensure the model's robustness. Intersectionality, particularly the interplay between age, race, gender, and technology adoption, could be an enlightening area of exploration. Further studies are needed to test how to better categorize these variables and provide a more complete picture of this issue.

Gender and Technological adoption

A striking observation from this study is the evident gender differences in the intention to purchase and utilize VR headsets. The vast landscape of literature offers intricate views on this topic, making the findings particularly salient.

Historically, several studies have delved into gender differences in the realm of VR. Felnhofer et al. (2012) emphasized that men often report a heightened sense of immersion when compared to their female counterparts. Additionally, women are seemingly more susceptible to cyber-sickness, an often-reported drawback of VR use, as documented by studies like Stanney et al. (2020) and Munafo, Diedrick & Stoffregen (2017). These findings might shed light on the possible hesitance or reluctance of certain genders to invest in or adopt VR technologies.

Interestingly, the findings resonate with these previous observations. Even though the current study wasn't primarily angled towards gender differences, it's worth noting the potential correlation between gender and the primary intent of VR use. For instance, if gaming stands out as the predominant reason behind purchasing VR headsets, then the study's unearthed gender disparities align neatly with established gender patterns in VR gaming and broader gaming inclinations.

What this suggests is a layered, multifaceted interplay of gender with VR adoption. The current research enriches the discourse by adding another dimension to understanding gender-specific tendencies and inclinations towards VR technology. However, the gender puzzle in the VR domain is vast and still has unexplored terrains. It is crucial for future research to delve deeper, exploring the roots of these gender disparities, untangling their underlying causatives, and assessing their long-term implications on the trajectory of VR technology acceptance and normalization in society.

Limitations

While the current study provides significant insights into the factors affecting the intention to purchase and use VR headsets, it is crucial to acknowledge that it is not exempt from limitations. This section is dedicated to acknowledging these limitations, outlining the potential implications, and suggesting paths for future research.

Sample

Notwithstanding the valuable insights derived from this study, it is important to acknowledge the limitations inherent in the sampling strategy. Primarily, the study relied on online sampling pool, which inherently introduces a selection bias. The sample was predominantly white and lack racial diversity, which would potentially diminishing the generalizability of the findings.

One possible reason for the lack of significance of age as a determining factor could be the role of peer norms. Within various age cohorts, individuals tend to associate and align themselves with groups of their peers. In the current study, people may have age-peers who have shared experiences, cultural references, and societal pressures that can profoundly shape their perceived norm towards adopting VR headsets.

Furthermore, the research was constrained to U.S. participants, which could limit the cross-cultural applicability of the results, given the cultural influences on technology acceptance behaviors. Additionally, the use of a non-probability sampling method might have introduced an element of bias, as it did not provide all members of the population an equal chance of being included in the study.

Thus, while the study offers critical insights into consumer intentions to purchase and use VR headsets, these limitations should be borne in mind when interpreting the findings. Future research should endeavor to incorporate a more diverse, globally representative sample to validate and enhance the study's conclusions.

Perceived behavioral control

Despite the adaptation of the perceived behavioral control measure from previous studies, one specific item, namely "Whether I purchase VR headsets or not is entirely up to me," appeared to be inconsistent with other items in the same measure. This inconsistency raises concerns about the potential for misinterpretation or lack of understanding on the part of the participants.

It is hypothesized that the formulation of this particular item might have led participants to perceive it differently, potentially due to its subjective and somewhat absolute nature. Unlike other items that might delve into specific facets of behavioral control or evaluate certain factors that influence VR headset purchases, this item is fairly general and leaves much to the individual's interpretation.

Consequently, future studies may need to consider reformulating this item or providing additional context to ensure its accurate interpretation. More so, it might be beneficial to validate this instrument in a different sample or include other, more specific items that tap into the same dimension of perceived behavioral control. By doing so, we can provide a more robust and nuanced understanding of how perceived behavioral control influences the intention to purchase VR headsets.

The continued use of VR headsets

Another constraint of the present study lies in its inability to adequately address the evaluation of people's intention to use VR headsets regularly. It's crucial to recognize that the usage patterns for VR headsets might differ significantly from those of more conventional devices like cellphones, which are utilized on a daily basis and have become deeply embedded in our routines.

The relative novelty and specific application of VR headsets may lead participants to perceive these devices not as a staple technology but rather as a specialty or occasional use tool. This perception could influence their consideration of VR headsets as a viable option for regular use. For example, the VR technology might be seen more as a luxury, leisure, or professional tool rather than an everyday device, which could lead to a different mindset regarding its acquisition and use.

Therefore, it becomes crucial for future studies to consider these aspects while assessing the intention to use VR headsets consistently. Moreover, it would be beneficial to explore whether usage frequency influences attitudes and intentions towards VR headset ownership.

In other words, are individuals who envision regular use of these devices more inclined to purchase them? Or does the intent to purchase increase with the perception of VR headsets as an everyday device rather than a niche or luxury item? Exploring these questions can help develop a more nuanced understanding of the factors driving VR headset adoption and continued usage.

In conclusion, the findings of the present study offer a comprehensive understanding of the various factors influencing consumers' intentions to purchase and use VR headsets. The TPB, TAM, and UTAUT models were supported, and their factors, along with certain demographic and prior experience variables, play significant roles in VR adoption. The proposed SPCA model could be utilized by VR headset marketers and developers to strategize their product development and marketing initiatives.

Appendices

Questionnaire

Attitude towards Purchasing VR headsets

Please CHOOSE the most appropriate answer:

Purchasing a VR headset is:

Harmful 1 2 3 4 5 6 7 Beneficial

Good 1 2 3 4 5 6 7 Bad

Pleasant (for me) 1 2 3 4 5 6 7 Unpleasant (for me)

Worthless 1 2 3 4 5 6 7 Useful

Attitude towards using VR headsets on a regular basis

Please CHOOSE the most appropriate answer:

Using a VR headset on a regular basis is:

Harmful 1 2 3 4 5 6 7 Beneficial

Good 1 2 3 4 5 6 7 Bad

Pleasant (for me) 1 2 3 4 5 6 7 Unpleasant (for me)

Worthless 1 2 3 4 5 6 7 Useful

Subjective norm towards purchasing VR headsets

Please CHOOSE the most appropriate answer that best describes your experience with purchasing VR headsets(A 7-point Likert Scale: Strongly Disagree to Strongly Agree)

1. Most people who are important to me think that I should purchase VR headsets	1	2	3	4	5	6	7
2. It is expected of me that I purchase VR headsets.	1	2	3	4	5	6	7
3. I feel under social pressure to purchase VR headsets.	1	2	3	4	5	6	7

4. People who are important to me want me to purchase VR headsets.	1	2	3	4	5	6	7

Subjective norm towards using a Virtual Reality headset on a regular basis

Please CHOOSE the most appropriate answer that best describes your experience with using VR headsets on a regular basis(A 7-point Likert Scale: Strongly Disagree to Strongly Agree)

1. Most people who are important to me think that I should use VR headsets on a regular basis.	1	2	3	4	5	6	7
2. It is expected of me that I use VR headsets on a regular basis.	1	2	3	4	5	6	7
3. I feel under social pressure to use VR headsets on a regular basis.	1	2	3	4	5	6	7
4. People who are important to me want me to use VR headsets on a regular basis.	1	2	3	4	5	6	7

Perceived behavioral control towards purchasing Virtual Reality headsets.

Please CHOOSE the most appropriate answer that best describes your experience with purchasing VR headsets(A 7-point Likert Scale: Strongly Disagree to Strongly Agree)

1. I am confident that I could purchase VR headsets if I wanted to.	1	2	3	4	5	6	7
2. For me, purchase VR headsets is easy.	1	2	3	4	5	6	7
3. The decision to purchase VR headsets is beyond my control.	1	2	3	4	5	6	7

4. Whether I purchase VR headsets or not is entirely up to me.	1	2	3	4	5	6	7

Perceived behavioral control towards using a Virtual Reality headset on a regular basis.

Please CHOOSE the most appropriate answer that best describes your experience with using VR headsets on a regular basis (A 7-point Likert Scale: Strongly Disagree to Strongly Agree)

1. I am confident that I could use VR headsets on a regular basis if I wanted to.	1	2	3	4	5	6	7
2. For me, use VR headsets on a regular basis could be easy.	1	2	3	4	5	6	7
3. The decision to use VR headsets on a regular basis is beyond my control.	1	2	3	4	5	6	7
4. Whether I use VR headsets on a regular basis or not is entirely up to me.	1	2	3	4	5	6	7

Perceived usefulness of a Virtual Reality headset

Please CHOOSE the most appropriate answer that best describes how likely using VR headsets would have the following effect (A 7-point Likert Scale: Unlikely to Likely)

1. Using VR headsets in my job would enable me to accomplish tasks more quickly.	1	2	3	4	5	6	7
2. Using VR headsets would improve my job performance.	1	2	3	4	5	6	7
3. Using VR headsets in my job would increase my productivity.	1	2	3	4	5	6	7

4. Using VR headsets would enhance my effectiveness on the job.	1	2	3	4	5	6	7
5. Using VR headsets would make it easier to do my job.	1	2	3	4	5	6	7
6. I would find VR headsets useful in my job.	1	2	3	4	5	6	7

Perceived ease of use of a Virtual Reality headset

Please CHOOSE the most appropriate answer that best describes how likely using VR headsets would have the following effect (A 7-point Likert Scale: Unlikely to Likely)

1. Learning to operate VR headsets would be easy for me.	1	2	3	4	5	6	7
2. I would find it easy to get VR headsets to do what I want it to do.	1	2	3	4	5	6	7
3. My interaction with VR headsets would be clear and understandable.	1	2	3	4	5	6	7
4. I would find VR headsets to be flexible to interact with.	1	2	3	4	5	6	7
5. It would be easy for me to become skillful at using VR headsets.	1	2	3	4	5	6	7
6. I would find VR headsets easy to use.	1	2	3	4	5	6	7

Performance Expectancy of using a VR headset

Please CHOOSE the most appropriate answer that best describes your overall experience when using a VR headset (A 7-point Likert Scale: Not at all to Extremely)

1. I would find VR headsets useful in my daily life.	1	2	3	4	5	6	7
2. Using VR headsets would help me accomplish things more quickly.	1	2	3	4	5	6	7
3. Using VR headsets would increase my productivity.	1	2	3	4	5	6	7

Effort Expectancy of using a VR headset

Please CHOOSE the most appropriate answer that best describes your overall experience when using a VR headset (A 7-point Likert Scale: Not at all to Extremely)

1. Learning how to use VR headsets would be easy for me.	1	2	3	4	5	6	7
2. My interaction with VR headsets would be clear and understandable.	1	2	3	4	5	6	7
3. I would find VR headsets easy to use.	1	2	3	4	5	6	7
4. It would be easy for me to become skillful at using VR headsets.	1	2	3	4	5	6	7

Social Influence of using VR headsets

Please CHOOSE the most appropriate answer that best describes your overall experience when using a VR headset (A 7-point Likert Scale: Not at all to Extremely)

1. People who are important to me think I should use VR headsets.	1	2	3	4	5	6	7

2. People who influence my behavior think that I should use VR headsets.	1	2	3	4	5	6	7
3. People whose opinions that I value prefer that I use VR headsets.	1	2	3	4	5	6	7

Facilitating conditions

Please CHOOSE the most appropriate answer that best describes your overall experience when using a VR headset (A 7-point Likert Scale: Not at all to Extremely)

1. I have the resources necessary to use VR headsets.	1	2	3	4	5	6	7
2. I have the knowledge necessary to use VR headsets.	1	2	3	4	5	6	7
3. VR headsets are compatible with other technologies I use.	1	2	3	4	5	6	7
4.I can get help from others when I have difficulties using VR headsets.	1	2	3	4	5	6	7

General emotions towards VR devices

Please CHOOSE the most appropriate answer that best describes your overall emotions when asked about VR headsets (A 7-point Likert Scale: Not at all to Extremely)

Positive affect

1. Active	1	2	3	4	5	6	7
2. Alert	1	2	3	4	5	6	7
3. Attentive	1	2	3	4	5	6	7

4.Determined	1	2	3	4	5	6	7
5. Inspired	1	2	3	4	5	6	7
6. Interested	1	2	3	4	5	6	7
7. Proud	1	2	3	4	5	6	7
8. Strong	1	2	3	4	5	6	7

Negative affect

1. Distressed	1	2	3	4	5	6	7
2. Upset	1	2	3	4	5	6	7
3. Afraid	1	2	3	4	5	6	7
4.Jittery	1	2	3	4	5	6	7
5. Nervous	1	2	3	4	5	6	7
6. Guilty	1	2	3	4	5	6	7
7. Scared	1	2	3	4	5	6	7
8. Hostile	1	2	3	4	5	6	7
9. Irritable	1	2	3	4	5	6	7

NEGATIVE AFFECT CRONBACH'S ALPHA: .87

Motion sickness when using VR headsets

Please CHOOSE the most appropriate answer that best describes your experience when using VR headsets (A 7-point Likert Scale: Not at all to Extremely)

1. I feel nausea when using VR headsets.	1	2	3	4	5	6	7
2. I feel fatigue when using VR headsets.	1	2	3	4	5	6	7
3. I feel dizziness when using headsets.	1	2	3	4	5	6	7
4. I feel eyestrain when using headsets.	1	2	3	4	5	6	7
5. I feel headache when using headsets.	1	2	3	4	5	6	7

Physical comfort

Please CHOOSE the most appropriate answer that best describes your experience (A 7-point Likert Scale: Not at all to Extremely)

1. It is comfortable to wear VR headsets.	1	2	3	4	5	6	7

Social comfort

Please CHOOSE the most appropriate answer that best describes your experience (A 7-point Likert Scale: Not at all to Extremely)

1. I feel comfortable wearing VR headsets in public.	1	2	3	4	5	6	7

General Comfort

Please CHOOSE the most appropriate answer that best describes your experience (A 7-point Likert Scale: Not at all to Extremely)

1. I think using VR headsets is overall comfortable.	1	2	3	4	5	6	7

Perceived Risk toward using VR headsets

How would you describe the health risks of using VR headsets for yourself?

1. Not Severe 1 2 3 4 5 6 7 Severe
2. Of no consequence 1 2 3 4 5 6 7 of great consequence
3. Negligible 1 2 3 4 5 6 7 Grave
4. Insignificant 1 2 3 4 5 6 7 Significant

Use intention of VR headsets on a regular basis

Please CHOOSE the most appropriate answer that best describes your experience (A 7-point Likert Scale: Not at all to Extremely)

1. I intend to use VR headsets on a regular basis.	1	2	3	4	5	6	7
2. I am likely to use VR headsets on a regular basis.	1	2	3	4	5	6	7
3. I have a high use interest in VR headsets.	1	2	3	4	5	6	7
4. I will never buy VR headsets.	1	2	3	4	5	6	7
5. I will probably buy VR headsets.	1	2	3	4	5	6	7

Purchase Intention

Please CHOOSE the most appropriate answer that best describes your experience (A 7-point Likert Scale: Not at all to Extremely)

1. I intend to buy VR headsets.	1	2	3	4	5	6	7
2. I am likely to purchase VR headsets.	1	2	3	4	5	6	7
3. I have a high purchase interest in VR headsets.	1	2	3	4	5	6	7

4. I will never buy VR headsets.	1	2	3	4	5	6	7
5. I will probably buy VR headsets.	1	2	3	4	5	6	7

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Yang, Q., Pang, C., Liu, L., Yen, D. C., & Michael Tarn, J. (2015) Exploring consumer perceived risk and trust for online payments: An empirical study in China's younger generation. *Computers in Human Behavior*, *50*, 9–24. https://doi.org/10.1016/j.chb.2015.03.058

Yee, N., & Bailenson, J. (2007). The proteus effect: The effect of transformed self-representation on behavior. *Human Communication Research*, *33*(3), 271–290. https://doi.org/10.1111/j.1468-2958.2007.00299.x

Zeelenberg, M., van Dijk, W. W., Manstead, A. S. R., & vanr de Pligt, J. (2000). On bad decisions and disconfirmed expectancies: The psychology of regret and disappointment. *Cognition and Emotion*, *14*(4), 521–541. https://doi.org/10.1080/026999300402781

Curriculum Vitae

Shengjie Yao

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EDUCATION

- **Doctoral Candidate in Mass Communications**, S. I. Newhouse School of Public Communications, Syracuse University, New York, United States (expected July 2023).
    Dissertation focus: Factors influencing the adoption of virtual reality
    Emphasis: new media technology, media adoption, immersive media interface, AR/VR/MR, Risk perception, Psychophysiological measurements, media psychology
    Advisor: T. Makana Chock, PhD
- **M.A. Media Studies**, S. I. Newhouse School of Public Communications, Syracuse University, New York, United States (2019)
    Thesis: How Perceived Real-world risk affects VR experience
    Advisor: T. Makana Chock, PhD
- **M.S. in New Media Management**, S. I. Newhouse School of Public Communications, Syracuse University, New York, United States (2017)
    Capstone: Voice assistant app development and management
- **B.A. in Journalism & Communication Studies**, Fu Jen Catholic University, New Taipei City, Taiwan (2015)

PROFESSIONAL EXPERIENCE

- **Public Relations Assistant**, Med-X Research institute of Shanghai Jiao Tong University, Shanghai, China (2016)
- **Public Relations Assistant (Full-time internship)**, Green Tree Hotel Management Group (Green Tree Inns), Shanghai, China (2015)
- **Director Assistant (Full-time internship)**, Shanghai Gamefy Media Co., Ltd., Shanghai, China (2014)
- **Video Editor (Full-time internship)**, China Business Network (CBN, affiliated to SMG), Shanghai, China (2013)

JOURNAL ARTICLES UNDER REVIEW

- Lee, H., Lee, Y., Bowman, N.D., **Yao, S.,** & Chen, S. (Under Review). Gaming on the Go? Translation and Validation of the Video Game Demand Scale to Korean
- Lee, H., Lee, S., Kim, S. J., **Yao, S.,** & Chock, T.M. (Under Review). Uncertainty and information Seeking During the COVID-19 Pandemic: Exploring the Mediating Role of Anxiety and Risk Perception.
- Shi, J., Mucedola, A., Canuelas, L.E., & **Yao, S.** (Under Review). "Changing Channels or

Changing Minds: The Role of Likeminded Media Perceptions and Media-Induced Emotions on News Fatigue and Civic Engagement."

JOURNAL ARTICLES IN PREPARATION

- **Yao, S.**, Lin, T., Kim, S. J., Lee, H, & Chock, T.M. "Hesitating to use VR? How personal experience, risk perception, and emotions shape the adoption of VR"
- **Yao, S.**, Lin, T., Lee, H., Kim, S. J., & Chock, T. M. "A proposed new model focusing on perceived information gathering capacity: in the context of virtual reality adoption."

PEER-REVIEWED CONFERENCE PAPERS

- **Yao, S.**, Lin, T., Kim, S. J., Lee, H, & Chock, T.M. (2021) Hesitating to use VR? How personal experience, risk perception, and emotions shape the adoption of VR, the 71st Annual ICA conference 2021
- **Yao, S.**, & Chock, T.M., (2020). Extended Abstract: What if I bump into something? How perceived fear of falling affects VR experiences, the 70th Annual ICA Conference
- **Yao, S.** & Kim, G. (2019). How perceived real-world danger affects virtual reality experiences, Intelligent Human Systems Integration 2019, ISBN:978-3-319-73888-8
- **Yao, S.** & Kim, G. (2019). How perceived real-world danger affects virtual reality experiences, 2nd International Conference on Intelligent Human Systems Integration, San Diego, California
- **Yao, S.** & Kim, G. (2019). The Effects of immersion in a Virtual Reality Game: Presence and Physical Activity, HCI International 2019, Orlando, Florida
- Lee, H., **Yao, S.**, Davis, E., Kim S. J., & Chock, T. M. (2022). The Effects of Presence on Psychological Ownership, Product Involvement, and Intention to Rent in Apartment Advertising., the 72^{nd} Annual ICA conference 2022, Paris, France.
- Lee, H., Kim, S. J., **Yao, S.**, Lee, S. Y., & Chock, T.M. (2021) The Harder the Battle, the More We Talk: The Effects of Perceived Risk of Player-death on Game Enjoyment in Mobile FPS Game, the 71st Annual ICA conference 2021
- Mucedola, A. & **Yao, S.** (2020) Trump Fatigue: Exploring the Relationship Between Perceived Media Bias and News Exhaustion, Association for Education in Journalism and Mass Communication annual conference 2020
- Lee, H., Kim, S. J., **Yao, S.**, Lee, S. Y., & Chock, T. M. (2020) Extended Abstract: Are You Engaging the Game? Effect of the Challenge and the Interaction toward Game Engagement in Mobile FPS Game, the 70th Annual ICA conference 2020
- Buntain N. K., **Yao, S.**, & Xu, D. (2018) Message or Medium? Effect of Virtual Reality on News Stories, Association for Education in Journalism and Mass Communication annual conference 2018
- Chock, T.M., Leanne, H., Costa, M. R., Kim, S. J., Zhang, J., Kim, G., Buntain, N. K., Ri, S. Y., **Yao S.**, & Pacheco, D. R. (2018). This is your brain on VR: Designing a VR/fNIRS

device, presented at the poster session of the 18th conference of the International Society for Presence Research (ISPR)

GRANTS

2021-2022 **Student Research & Creative Grant**
PI (CO-PI: T. Makana Chock), $500, funded by **Newhouse Internal Grant Program**, Syracuse University
"Understanding causes for zoom fatigue using uncanny valley theory"

2021-2022 **Dissertation Funding**
$2,500, funded by S.I. Newhouse School of Public Communications, Syracuse University

2022-2023 **CUSE Grant**
Researcher (PI: Lyndsay Gratch)
"Effects of storytelling techniques in immersive, DEIA-themed VR experiences on user engagement, emotion, and empathy"
$30,000, funded by Syracuse University

AWARDS

May 2020 **AEJMC TOP Student Paper Award, Political Communication Division**
Mucedola, A. & **Yao, S.** (2020) Trump Fatigue: Exploring the Relationship Between Perceived Media Bias and News Exhaustion, Association for Education in Journalism and Mass Communication annual conference 2020

TEACHING EXPERIENCE

Spring 2022 **Syracuse University**
Instructor
COM107 Communications and Society (undergraduate level)

Fall 2021 **Syracuse University**
Teaching Assistant & Guest Lecturer (Professor: Anne Osborne)
COM107 Communications and Society (undergraduate level)

Fall 2021 **Syracuse University**
SPSS Training Instructor (Professor: Charisse L'Pree)
COM605 Quantitative Methodology (graduate level)

Fall 2021 **Syracuse University**
Extended Reality Lab Workshops Instructor
Extended Reality Lab workshops (graduate level)

Spring 2021 **Syracuse University**
Teaching Assistant & Guest Lecturer (Professor: Qiu Wang)
EDU888 Structural Equation Modeling and Factor Analysis (graduate level)

INVITED TALKS

Fall 2021 **Weber State University**

Topic: "Extended Reality research, now and future"

Fall 2021 **University of Miami**

Topic: "T-test in the research of VR"

Fall 2021 **Middle Tennessee State University**

Topic: "Experimental design for social science"

ACADEMIC AFFILIATIONS

- Research Fellow & Graduate Instructor, S.I. Newhouse School of Public Communications, Syracuse University
- Member, International Communication Association (ICA)
- Member, Association for Education in Journalism and Mass Communication (AEJMC)
- Member, National Communications Association (NCA)

RESEARCH EXPERIENCE

- XR lab manager, XR lab at Syracuse University, 2021-present
- Student Research Assistant, Syracuse University, 2020-2022
- Research Intern, Media Interface, and Network Design (M.I.N.D) lab at Syracuse University, 2018-2019
- Researcher, Media-Nxt project at Syracuse University, 2018-2019

RESEARCH SKILLS

- Social media analysis: SEO, Meltwater, Brandwatch
- Survey: Qualtrics, Amazon Mechanical Turk, Prolific
- Statistical analysis: SPSS, STATA, Mplus, AMOS, R
- Measurement: Psychophysiological measurements, Electroencephalogram (EEG), Electrocardiogram (ECG)

PROFESSIONAL SKILLS

- Office software: Word, Excel, PPT
- Book Design: Adobe InDesign
- Photo editing: Adobe Lightroom, Adobe Photoshop
- Video editing: Final Cut Pro, Adobe Premiere, Adobe After Effects, Adobe Audition
- 3D design: Tinkercad, Maya, Blender
- Game design: Unity, Unreal