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Virtual Reality in Healthcare: Exploring the Patients' Behavior through the Lens of Extended Stimulus, Organism, and Response Framework

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ABSTRACT:

Virtual reality (VR) is a recently emerged tool in healthcare. However, there is dearth of research since literature lacks studies on factors that enhance patients' visits to VR-health facilities. The current study has proposed a theoretical framework to engulf this gap, employing the stimulus, organism, and response (SOR) framework to investigate patients' attachment, patient's cognitive and affective response, authentic experience, and intention to visit VR-health facilities. The study has found significant influences of the patients' authentic experience on their cognitive and affective responses. It shows that patients' authentic experience plays a significant role in VR health. The results further verified that patients' cognitive and affective responses have significant mediating effects to predict the attachment and intentions to VR visit. The patients' intention to visit health facilities reveal that attachment to the VR predicts VR-health. Likewise, cognitive response shows a powerful impact compared to the affective response on the intention to visit health facilities over virtual reality. This research brings to fore why prospective patients visit healthcare facilities using virtual reality.

Keywords: Virtual Reality Healthcare, Patients' Attachment, Patients' Visit Intention, Patients' Authentic Experience, Stimulus-Organism-Response Theory.

Introduction

Like other fields, healthcare demands a logical and tactical change to train future personnel to meet patients' needs effectively. Virtual Reality (VR) in health addresses several issues and challenges for delivery of healthcare (Mazurek, Justyna & Kiper, Pawel& Cieslik, Blazej & Rutkowski, Sebastian & Mehlich, Krzysztof & Turolla, Andrea & Szczepanska-Gieracha, Joanna, 2019). VR in health is the application of an innovative three-dimensional technology that is based on a blend of visual, kinetic, and audio elements where patients can get the same experience they get in a physical visit (Matthews, 2018). Patient's performance information could be captured, analyzed, and retained to support initial health status inter alia the inform diagnostic decision-making with VR (Mishkind, Norr, Katz & Reger, 2017). Similarly, it has low cost, decreases fear & stress, and removes the risk (Standen, Threapleton, Richardson, Connell, Brown & Battersby *et al*., 2017). The health sector is among the early users of VR, which was initiated by different producers including Lenovo Technologies application of Oculus Rift S. Number of physicians are switching to the use of VR treatments like phobia, simulations of surgery, skills training, etc. (Deutsch, Merians, Adamovich, Poizner & Burdea, 2004). VR is helpful in the patient education and enhancement of the patients' experience in VR-enabled virtual clinics (Van Loenen, Scholten, Muntingh, Smit & Batelaan, 2022). Bitner (1992) used the SOR theory to study the patients' behavior toward services offered by healthcare providers since SOR model is recognized as an appropriate framework to explain patients' behavior in the health sector. Likewise, existing studies have used the extended SOR model to predate the patients' behavior by adding supplementary variables like patients' cognition and perceived service quality. It is pertinent to mention that SOR theory significantly predicted the behavior of the patients. Likewise, SOR theory is employed in association with innovative technologies for the impulsive behavior's patients to engage them online (Parsons & Rizzo, 2008). In the background of the use of VR in health, this research is an effort to investigate the prospective patients' behavior grounded on the extended SOR framework, which includes stimulus i.e., patients' authentic experience, the process i.e., cognitive, and affective response, and finally, the result i.e., patients' attachment to VR, and visit intention. According to (Malloy & Milling, 2010), quality of authenticity is imperative, which could enhance the patients' experience of VR because some of the patients' experience using VR in health services could not be perceived as an authentic because they use poor quality equipment (Borrego, Latorre, Llorens, Alcaniz & Noe, 2016). Likewise, patients' perception of their physical and or sensory participation is instrumental to experiencing a suitable level of authenticity (Maples-Keller, Bunnell, Kim, Rothbaum, 2017). Similarly, an extraordinary mark of perceived authenticity of VR-based health facilities changes the emphasis on how to visit and get treatment beyond physical boundaries (Garcia-Palacios, Botella, Hoffman & Fabregat, 2007). Matthews (2018) believes that authenticity is an unavoidable antecedent that explains patients' service acquiring intention and experience. However, according to him, authentic experience acts as a critical success factor to predict the behavioral intention. The second significant predictor identified in previous studies is patients' attachment, which according to Maslow (1943), is a primary human need and has a significant impact on the behavior. In digital health settings, attachment to online gadgets like social media, cellular phone devices, and websites play a significant role in anticipating the behavior (Riddle, 2013). Zhou & Niederdeppe (2017) studied patients' authentic experience and attachment, they found that it plays a significant role in understanding the behavior in digital health settings, yet it needs to be empirically confirmed in VR-health built on SOR theory.

To bridge this theoretical gap, the research in hand investigates the patients' authentic stimulus (experience), organism (cognitive and affective response), and attachment to VR, knowledge, and behavior intention as a response through the lens of an extended model of SOR. This study explored patients' behavior in the health sector through the extended stimulus-organism-response model, a well-established theory to investigate the factors related to VR health. SOR theory is widely used in research to explore the linkage between the stimulus, the processes organism, and the results. This study was aimed to investigate the critical factors regarding patients visit to health facilities revealed in their authentic experience and attachment. The purpose of this research was to validate the power of patients' authentic experience on the cognitive and affective responses to VR-health experience using the SOR paradigm. Further, it aimed to examine the effects of patients' cognitive responses on affective responses, among other things, patients' cognitive and patients' affective response to VR-health experience on attachment to VR; inter alia, visit intention to

the VR based health facilities. The study also aimed to assess the impact of patients' attachment with VR to predict the behavioral intentions exhibited in the VR.

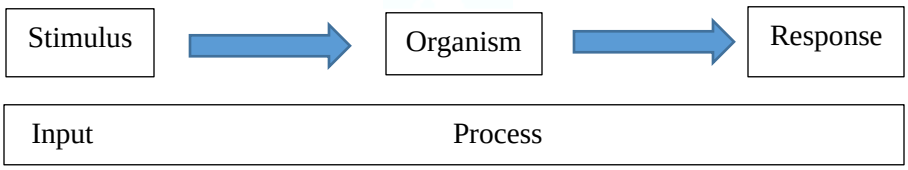
Literature Review

In the VR head-mounted display (HMD), VR device is used as an interactive digitally generated media to produce a simulated experience of the virtual settings. VR device helps VR-health facilities to provide a comprehensive view of health and minimize the patients' perceived anxiety or risk through patients' familiarity with unfamiliar treatment (Hobson & Williams, 1995). In healthcare, VR is used not only for planning, management, prevention, accessibility, education, and treatment (Park, Lee & Lee, 2014) but to communicate with patients to keep them informed about the right kind of treatment (Matthews, 2018). The proper use of VR in health results in an innovative value to patients for their experience i.e., pre, onsite and post-visits. Although VR is a very powerful means of today's digital health environments, very few studies have investigated the application of the SOR model to engulf the theoretical gap and the impact of patients' authentic experience on the cognitive and affective response. These responses also influence their attachment to VR-based health experience and visit intention to the health facility to experience VR-health.

Stimulus-Organism-Response Model

The stimulus-organism-response model (SOR) model depicted in figure 1, states that patient as an individual reacts to the health settings in one of two manners or behavior i.e., always positive actions, like the wish to explore, stay, affiliate, or work, and second is the averting behaviors, like a wish for non-positive action (Mehrabian & Russell, 1974). The model of SOR highlights the neurotic qualities of environments that are appealing provocations (Wohlwill, 1976). Recently, an integrative SOR model is introduced together with patients' cognitive and affective systems. It integrated all the experiences used in the long-term memory (Jacoby, 2002). Likewise, Kim & Lennon (2013) extended Mehrabian and Russell's framework of SOR. They included the website quality and repute as a stimulus, which could influence the patients' decision response (intention) through patients' (cognition and emotion) organisms. Parsons & Rizzo (2008b) suggested that servicecapes lead to patients' positive as well as adverse behaviors of experience through cognitive and affective processes in healthcare. Andsager *et al*. (2006) have found that the more authentic patients think physical settings are, the greater their degree of perception of the visit to VR-health facilities, and the greater the behavioral intention to revisit the same facility. In the context of health sector, SOR model is very effective in explaining the association between a stimulus (i.e., health facility), process (i.e., emotions), and response (i.e., patients' allegiance). Following the model, this study has developed and tested the extended SOR model to predict patients' behavior in VR-health services.

Figure 1
S-O-R Model: Conceptual framework



The Patient's Attachment

The concept of attachment implies one's tendency to make a strong affectional association with a specific person or an object (Bowlby, 1977: 201). In health sector, it implies affective and positive relations developed by an individual toward his goal (Ramkissoon, 2015). From the perspective of the virtual world, it is an expressive identification of one's self-conception and has moral significance comparable to attachment in one's real life. Park, Lee, & Lee (2014) reported that VR-health facilities mediate the patients' satisfaction and attachment. Concerning the use of digital technology, highly innovative patients are open to experience, making decisions that result in their attachment to VR-health facilities. Researchers believe that affective feelings emerged from the use of advanced technology in health sector; this, in turn, encourages technology-savvy patients and considerably influence their behavior and outcomes.

In eHealth settings, attachment to the websites play an instrumental role in increasing the sites' philanthropy and authenticity (Zhou & Niederdeppe, 2017). Thus, patients' attachment to eHealth services like VR-health influences the sustained use of these services. Patients who considerably use cellular phone devices for health resolve their attachment to cellular phone devices, which upsurges their intention to use digital technologies (Zhou, Shapiro, & Wansink, 2017). Though an attachment is a key to explaining the patients' behavior in digital health settings, it is still vague what makes patients attached to the contents of VR health. With this background, this research is an effort to investigate attachment to VR-health as a key variable through the SOR model.

The Patient's Authentic Experience

Few decades ago, the term authenticity was first introduced in social studies and its relationship to the patient motivation and experience. Since that, it has been a topic of researchers' interest in the field of health sector. Gilmore & Pine (2007) defined the word authenticity, according to them; patients' sensibility builds their perceptions of the new, original, exceptional, and unique experience of the services, considering it genuine. Notably, in the words of Cohen (1992), it implies a product or service, which is genuine and unfamiliar instead, the counterfeit. In the information age, patients want to be active and not passive patients, it means that patients get extraordinary understanding once their senses are actively affianced. Thus, authentic experience is a decisive factor in conducive environment in health sector. Patients get experience and services agreeing to their acknowledgment of the authenticity. In the context of digital environment in health, the concept of authenticity emerged as a significant factor for the values of the services, while in the perspective of 3-D virtual settings; it leads to a better immersing experience (Slater & Wilbur, 1997). Moreover, according to Kim, Lee, & Preis (2016), patients' knowledge for the truthfulness of VR-health is a factor for approval of VR-health being an alternative to the genuine experience. Park, Lee, & Lee (2014) assert that the technology-driven health sector has strengthened patients' beliefs by giving more attention to the suitable notch of perceived authenticity for introducing and executing VR technologies. Regardless of the considerable role of patients' authentic experience in VR-health, however, one could not find any empirical study investigating the influence of patients' authentic experience on their behavior. To engulf this overlooked aspect, this study has investigated the impact of a patient's authentic experience as a motivator for VR-health on the patients' behavior through the lens of an extended SOR model.

Association between the Patients' Authentic Experience and the Patient's Cognitive Response

Perceptions of authenticity from the decision-making context affect desire to build patients' intention and behavioral intention to visit VR-health facilities. From the perspective of cultural and religious events, the perceived existence of authenticity positively influences satisfaction, which means that an authentic experience affects the affective response of the patients since literature reports that affective response is linked to the patients' affective characteristics. Further, from a healthcare perspective, patients' perceived authenticity positively affects patient’s facility satisfaction. In health research contexts, authenticity is conceptualized as a normal, unique, real, true, and original experience (Wu & Li, 2018; Riddle, 2013). Therefore, this study has operationalized patients' authentic experience with health allied VR activities associated with exceptional and genuine features. Concerning the servicecapes, Bitner (1992) modified and developed the SOR model by incorporating the cognitive response into the SOR model initially developed by Mehrabian and Russell in 1974. Binter defined the cognitive response beliefs of the people for VR-health. Consequently, the positive (negative) cognition might develop positive (negative) beliefs and attributes linked with a person, organization, and its services. Zhou & Niederdeppe (2017) have conceptualized the perceived value through emotional response, quality, financial cost, behavioral cost, and repute as cognitive variables in the background of health services. Researchers like Ames (2004) assessed the use-value employing the practicability, corresponding needs, ease, and response time for service as a cognitive response in health settings. Further, Zhou, Shapiro, & Wansink (2017) assessed the perceived usefulness and time factors, whereas Zhou & Niederdeppe (2017) used advantages of cellular phone and use of social media as a cognitive construct. Hence, this research operationalized patients' cognitive response to patients' health-related VR experience by employing the jargon of usefulness.

Concerning the health facility's physical environment, originality as a stimulus affects the perception of user value being a cognitive response (Lee, 2004). Studies accepted that patients' authentic experience affects the cognitive

response because authenticity correlates to the novelty in the perspective of healthcare. Similarly, newness as a stimulus affects the patients' cognitive response. Furthermore, authenticity has direct and positive effects on the patients' cognitive response like patients' perceived value of using the service. Researchers have suggested that authentic experiences could also affect the cognitive response to patients' health-associated VR experience. Likewise, in the perspective of technology's use in health, patients' authentic experience concerning the technologies also positively influences their behavioral intentions (Jerdan *et al*., 2018). It means that authentic experience affects patients' cognition. In VR-health environments, if available media shows the authenticity required for the forthcoming visit of the VR-health facility, patients' perceived value of VR visits is increased. Therefore, the patients' authentic experience has an intimate and close association with the patients' cognitive response. With this background, this study proposes the below hypothesis for VR-health associated accomplishments:

H_1: The patients' authentic experience has a positive impact on their patients' cognitive response.

Association between Patients' Authentic Experience and the Patients' Affective Response

Concerning the attributes of affective response, Venkatesh (2000) defined it as a magnitude to which activity of the system is supposed to have a relaxing and profound impact on the performance, inter alia the consequence as an outcome of using the system. Experts contend that relaxation determines the amount to which patient get relaxation by using ICTs like cellular phone and social media websites, whereas relaxation of the user plays a critical role in better comprehension of the user's behavior (Morina *et al*., 2015). The effect of relaxation on change in the affective response of the patients' attitude endorses VR-health as a hedonic experience. Based on these studies, this study has operationalized this construct with pleasurable facets an attribute for the patients' affective reaction from VR-health perspective along with an emotional engagement. It is a sub-construct stands for the number of emotions, responsible for a behavior (Diemer *et al*., 2016). In VR-health; an experience of a 3D-based perception for emotional engagement is associated with greater behavior intention of the patients to pay a visit to the VR-health facility. Thus, according to Banos *et al*. (2004), an emotional engagement accessible by VR-health affects the patients' feelings of reality. Furthermore, emotional engagement is a positive affective reaction that can enhances the perception of patients regarding authentication of VR experience, and it changes the patients' behavioral intention to visit the health facility exhibited in VR-health (Falconer *et al.*, 2016). In this context, emotional engagement has been conceptualized with the help of feeling obsession and connotation with healthcare activities (Kampmann *et al*., 2016). This study has operationalized emotional engagement with the help of engagement, empathy, and impression as attributes of the patients' affective response in the VR-health domain. According to Nah *et al.* (2010), it is the universal feeling that one senses when he goes through full engagement as an optimum experience. The virtual heritage is a powerful factor, engagement in the authentic experience work as a source for patients to disrupt the routines and limitations of daily life (Morina *et al*., 2015); and it might result in an enjoyable experience. The 3D centered digital cultural legacy submits that an extra pluralistic belief about authenticity is required to investigate and comprehend the evolving circumstances. It could affect the patients' emotional engagement since perception of the authenticity is charged by the experience. It includes five senses, whereas the optical aspect is critical in the patients' experience of genuineness (Peperkorn *et al*., 2016). With this logical argument, current research has considered the patients' authentic experience as a stimulus for the patients' affective response concerning health-related VR experience for the SOR model. For that reason, this study proposes the blow hypothesis for VR-health using the SOR model:

H_2: The patients' authentic experience positively influences the Patients' affective response.

Association between Patients' Authentic Experience, Cognitive Response, Attachment, and the Patient's Visit Intention

According to developers, the content of VR aims to get the attention of patients to use VR-health and keep intact the patient's attachment to the content of VR. In this research, patients' attachment is used as a criterion variable. Particularly, in justifying the theory for the criterion variable, the healthcare studies advocate that attachment is the outcome of patients' experiences (Io & Wan 2018). They further claim that activity-based health experience affects the patients' attachment to VR-health facilities. Additionally, experience could be improved if they use cellular phone

gadgets while using VR-health facilities; it further develops their attachment to the cellular phone gadgets (Jerdan *et al*., 2018). With VR context and digital health technology, this study has used the first-order factor and multiple items that measured the construct of attachment earlier used by Oleksy & Wnuk (2017). The four items of attachment regarding VR-health experience consist of cognitive and affective physiognomies, i.e., connection, function, emotional engagement, and psychological distinctiveness. The inclusive assessment of healthcare quality (Nowlin *et al*., 2021; Novello & Fernandez, 2016) has conceptualized the patient's behavioral intention with a revisit to the facility, recommendation to his fellows, and creating a positive image in his talks. In health-related VR activities, Shiban *et al*. (2016) has evaluated the patients' behavioral intention by collecting additional information, interest in visit, revisit intention, and recommendation of the VR activities. Thus, patient's visit intention is usually measured by focusing on the behavioral intention to revisit VR-health facility in the future. Tussyadiah *et al*. (2018) validated it; hence, this research has operationalized the patient's visit intention with intention, willingness to revisit, and the planning shown for VR-healthcare. With this background for emotions and adoptions, it is evident that patients' cognitive response significantly affects their affective response. The extended SOR model asserts that in website settings, if perceived risk is greater, then patients will have more negative emotions toward digital health services. With respect to the virtual groups, patient's cognitive maps of the serviceable usefulness and system quality results in the positive attitudes toward these groups (Pallavicini *et al*. (2013), which means that patient's cognitive response is correlated to their affective response. Thus, based on the above evidence, the study in hand while employing the extended SOR theory added patient's attachment to VR-health in addition to the visit intention, especially the value of health services on the group-buying websites, for example, patients' cognitive response expressively and positively affects the patient' attachment to healthcare websites (Jerdan *et al*., 2018). Founded on the principles of servicecapes in the SOR model, patient's positive cognitions can result in furthering the positive beliefs and attitudes linked to the organization and its workforce and services yielding behaviors (Bitner, 1992). Similarly, patients' perception of the quality of service being cognitive response greatly influences their intention for a revisit (Suzuki & Tanoue, 2013). The extended SOR model asserts that if perceived risk is lesser using digital health settings, then cognitive response will also be greater to avail health services or intention associated with online health services (Shiban *et al*., 2016). The SOR model further explains that patients use ideals as a cognitive response, which affects the revisit decision of the patients (Kyaw *et al*., 2019). In VR-health, patients' perception of the usefulness i.e., cognitive response positively influences the behavioral intentions to visit the VR-health activity (Acker & MacKillop, 2013). Alexander *et al*., 2019) proposed that patients' cognitive response to VR-health experience are positively associated with their affective response, intention to visit, and patients' attachment to the VR-health experience. Therefore, this study proposes the below-given hypotheses:

H_3: *Patients' cognitive response positively influences the patients' attachment to VR-healthcare experience.*
H_4: *Patients' cognitive response positively influences the patients' visit intention to the healthcare illustrated in the VR-healthcare experience.*
H_5: *Patients' cognitive response positively indirectly influences the patients' attachment to VR-healthcare experience.*
H_6: *Patients' cognitive response positively indirectly influences the patients' visit intention healthcare experience*.

The Associations between the Patients' Authentic Experience, Patients' Affective Response, Attachment, and the Visit Intention.

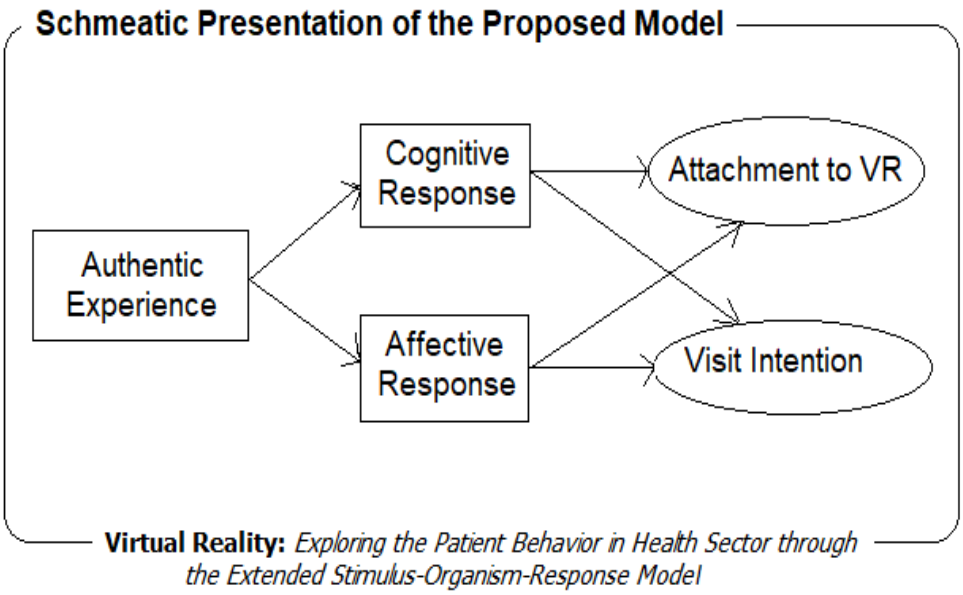
According to Holbrook & Hirschman (1982), the effect, as a full scale of related emotions, comprises varied feelings like hate, joy, love, boredom, fear, anger, pride, anxiety, lust, sympathy, and shame. Likewise, Arnould & Price (1993) believed that service suppliers could build effective content by applying engagement, skills, emotions, and an intense sense of service suppliers. They further found that a positive affective response to emotional involvement is related to patients' attachment to health-related VR experiences and behavioral intention to visit the health facility in VR-health perspective. Consequently, current study uses affective response to the health-related VR experience, including emotional engagement and enjoyment as a second-order factor being contemplative measures in our research model. Since enjoyment signifies the major reason for attachment in close relations as postulated by Bowlby (1977), it is expected that an extra pleasant and an affective response be significantly correlated to the patient's attachment. Carlos Flavian *et al.*, 2019) stated that a patient's affective response has positive influences on their attachment. Today's

patients' affective feelings are based on cellular phone usage, which enhances the effective health-related applications and boost patients' attachment with the cellular phone gadgets used in healthcare. While excitement, as an affective appraisal is the powerful predictor for patients' attachment to the VR-health facility, which means that their affective response predicts the attachment. The SOR model elucidates an organism's affective response like emotions that result in the patients' behavior to avoid the access of conditions (Peperkorn *et al.*, 2016); thus, patients' emotional response positively predicts their loyalty. According to the extended SOR model, patients' affective responses also significantly affect their behavioral intention. In VR-health, emotional engagement and positive emotions influence behavioral intentions positively (Pallavicini *et al.*, 2013). Based on evidence from the existing studies, this study states that patients' affective response to health-related VR experience has a significant association with their engagement to VR-health experience inter alia to their visit intention with the health facility as shown in the VR-health experience. Thus, this study proposes the below hypotheses:

H_7: *The patients' affective response positively predicts the patients' attachment to the VR-healthcare experience.*
H_8: *The patients' affective response positively predicts the visit intention to the VR-based health care portrayed in the VR-healthcare experience.*
H_9: *Patients' affective responses positively indirectly influence the patients' attachment to the VR-healthcare experience.*
H_{10}: *Patients' affective response positively indirectly influences the patients' visit intention healthcare experience.*

The above-proposed hypotheses are based on the model of the study shown in the figure 2, which illuminates the structural connections between the patients' authentic experience, cognitive and affective response, attachment to VR-health, and their visit intention among the VR patients by the application of extended SOR model.

Figure 2
The Proposed model of the Study.



Method

Design

A quantitative cross-sectional online survey was employed using google created form with two types of data; the demographic and the research data. Nominal and ordinal scales were used for demographic data, while responses on research constructs were collected through a continuous scale. Questionnaires were administered online and collected responses were put into a data matrix to analyze data, draw findings, and conclusions.

Measures

This study has adopted multi-measurement items from the previous studies to circumvent the issues related to inaccuracies of measuring a single item, as suggested by Churchill (1979). The instrument used for surveys initially consisted of seven constructs and twenty-seven items. Patients' authentic experience in health-related VR activities was evaluated by four items, which were taken from Chung *et al*. (2018). Patients' cognitive response to health-related VR experience was measured using four items from Kim, Bonn, & Lee (2017), while pleasurable aspect of the patient's enjoyment of health-related VR experience was also measured on four items from Huang *et al*. (2016). Four items from Saeed, Yang, & Sinnappan (2009) were used to measure the patients' emotional engagement in health-related VR experiences. Four items were taken from Oleksy & Wnuk (2017) to measure the patients' attachment to the health-related VR experience, whereas three items, which were drawn from Huang et al. (2013), assessed visit intention of the patients. This study has used a 7-point Likert scale to check the reliability and internal consistency of the instrument as well as discriminant validity recommended by Fornell and Larker (1981), Henseler, Ringle, & Sarstedt (2015), and Hair *et al*. (2017).

Participants and Procedure

The participant's list was obtained from Lady Reading Hospital Peshawar, Hayatabad Medical Complex Peshawar, and Pakistan Institute of Medical Sciences Islamabad. The identity of the sample participants' (patients with VR health experience) was verified through the official names of the individuals. Likewise, unfilled, or improperly filled surveys were excluded. Moreover, responses, which failed to qualify the screening questions were also excluded. The response bias was reduced using rotation, and at last, sample participants were requested to tell their names for the VR-health content, which they mostly experienced in recent times. Once all questions were answered, the names of the participants for the VR content appeared for each item of the instrument. Since data was clear with no omitted answers and outliers (Hair *et al*., 2017), thus all 510 questionnaires were used for the analysis. The response rate was 64.1%, which is enough according to the American Association for Public Opinion Research (2016: 58). As for as data analysis is concerned, this study employed PLS-SEM (Ringle, Wende, & Becker, 2015), which is the most suitable when model is complicated and it involves multi-group analysis as compared to the traditional SEMs (Hair *et al*., 2017). Likewise, Harman's (1967) single factor as a post hoc test was run to resolve the issue of common method variance, a precautionary measure recommended by Conway & Lance (2010) was adopted by employing numerous remedial measures to overcome the common method bias. This study also used constructs with second order, which are comely used in partial least square structured equation modelling (PLS-SEM) to evaluate various associated variables measured from multiple items (Chin, 1998). It characterizes the hypothesis, which looks dissimilar, yet; the associated variables might account for single or multiple higher-order constructs (Narayan, Rajendran, & Sai, 2008). The second-order analysis is used by specifying the first-order factors of a broader nature (Hair *et al*., 2017).

Findings and Discussion

Sixty percent of the sample participants were male (60.1%), while 36.4% fall in ages ranging from 45-57. Similarly, majority of participants (72.3%) were university qualified and 63.4% were unmarried. The office workers included 51.8%, their earnings fall in the range of 4,000/-PKR (Pakistan Rupee) to 1, 20,000/-PKR per month. A 35% of participants had prior VR-health experience i.e., 4 to 11, which constitutes 43.6% who spent 12 to 30 minutes/ experience on VR-health i.e., 48.5%. Furthermore, about 41% of the participants experienced VR health at least once a year. Additionally, 45.7% of participants shared their experience of visiting the health facility via VR-health.

Measurement Model

The discriminant and convergent validity of twenty-seven indicators were assessed through component-based PLS-SEM. The results confirmed since factor loadings for every factor was recorded above the threshold value of 0.7. Further, measurement model was analyzed to check the reliability, convergent, and discriminant validity of the research model. All constructs recorded a reliable Cronbach's alphas i.e., above 0.7 inter alia the composite reliability levels as recommended by Hair *et al*. (2017) were recorded greater than 0.70. According to Fornell & Larcker (1981), the average variance extracted (AVE) was greater than its standard value of 0.50; thus, the convergent validity was also in the acceptable range. Furthermore, to check the discriminant validity, Heterotrait-Monotrait ratio of correlations (HTMT) were assessed using Henseler, Ringle, & Sarstedt (2015), results yielded that the model meets the criteria for cross-loadings. It could be seen in table 2 that all values of the HTMT for the latent constructs are below the threshold value i.e., 0.85. This means that all constructs are unique without any similarity; hence, the discriminant validity of the instrument was established (Henseler *et al*., 2015).

Table 1

Confirmatory Factor Analysis.

Variables	Loadings	t	AVE	CR	α	Rho_Aa
Patient's Authentic Experience	0.835	51.343	0.742	0.907	0.801	0.872
	0.857	52.612				
	0.884	60.822				
	0.869	49.142				
Patient's Cognitive Response	0.887	65.166	0.721	0.916	0.800	0.884
	0.875	63.028				
	0.863	46.157				
	0.755	25.469				
Patient's Emotional Attachment	0.836	54.811	0.813	0.911	0.865	0.880
	0.921	96.841				
	0.913	92.796				
Patient's Attachment	0.866	61.722	0.837	0.941	0.921	0.925
	0.918	84.912				
	0.932	117.668				
	0.911	106.709				
Patient's Visit Intention	0.934	81.563	0.866	0.952	0.933	0.951
	0.910	114.103				
	0.920	97.036				
	0.942	133.462				

Key: Cronbach's alpha (α), average variance extracted (AVE), composite reliability (CR).

a. Threshold Value for Reliability coefficient = > 0.7.
b. Items > 0.7 were excluded following the confirmatory factor analysis.

Table 2
Heterotrait-Monotrait Ratios

Construct	1	2	3	4	5	6	7
PAE							
PCR	0.582						
PEA	0.661	0.584					
PEE	0.702	0.654	0.733				
PAT	0.587	0.672	0.567	0.673	0.524		
PVI	0.676	0.641	0.506	0.538	0.389	0.622	
The effect size (f^2)		0.387	4.4221	2.873	1.885	0.386	0.188
The effect size (q^2)		0.188	0.652	0.557	0.464	0.317	0.357
Average	4.536	4.579	4.9821	4.373	4.582	3.853	4.253
SD	1.002	1.017	1.016	1.133	1.089	1.264	1.282

Source: Results from the Seven-point Likert scale.

Key: Patients' authentic experience (PAE), patients' cognitive response (PCR), patients' emotional attachment (PEA), patients' emotional engagement (PEE), patients' attachment (PAT), and patients' visit intention (PVI).

Analysis of the Structural Model

A bootstrap with 2,000 subsamples has been run in PLS-SEM to test the model and analyze the association and hypothesis testing with t statistics (Hair *et al*., 2017). Since data were normally distributed, there was no need to use skewness and kurtosis for data normality on the seven variables. The result for the structural model in figure-3 and Table-3 shows that patient authentic experience (PAE) has a significant positive effect on patient cognitive response (PCR) (β=0.533, $p<0.01$). In the same way, PAE also has a positive effect on patient affective response (PAR) (β=0.512, $p<0.01$). It means one unit change in patients' authentic experience can bring 53.3% change in the patients' cognitive response and 51.2% change in patients' affective response. Further, PCR has a significant positive influence on PAR (β= 0.361, $p<0.01$), it implies that 36.1% change is possible in PAR because of PCR. Moreover, PCR directly affects patients' attachment (β= 0.388, $p<0.01$), whereas patients' cognitive response is responsible for 38.8% change in patients' attachment. Furthermore, PCR is directly linked to patients' visit intention (β=0.397, $p<0.01$), on the other hand, PAR is also directly associated with patients' attachment (β=0.395, $p<0.01$). It means the patients' affective response is responsible for bringing 39.5% change in patients' attachment. Likewise, PAR has a positive influence on patients' visit intention (β=0.168, $p<0.05$), this shows that 16.8% change is possible in the patients' visit intention due to patients' affective response.

The patients' affective response has a direct impact on patients' attachment to virtual reality (β=0.298, $p<0.01$). The overall variance shown by the predictors in the structural model was R^2= 0.562, i.e., 56.2% which reflects the strongest effect to the SOR theory in the research model. (Hair *et al*., 2017). Patients' cognitive response significantly mediates between patients' authentic experience, patients' attachment to virtual reality, and visit intention in the same way patients' affective response also significantly has indirect influence between patients' authentic experience, patients' attachment to virtual reality, and visit intention all beta values are significant; therefore, all mediation hypotheses are accepted.

Figure 3
The Structural Model of the Study.

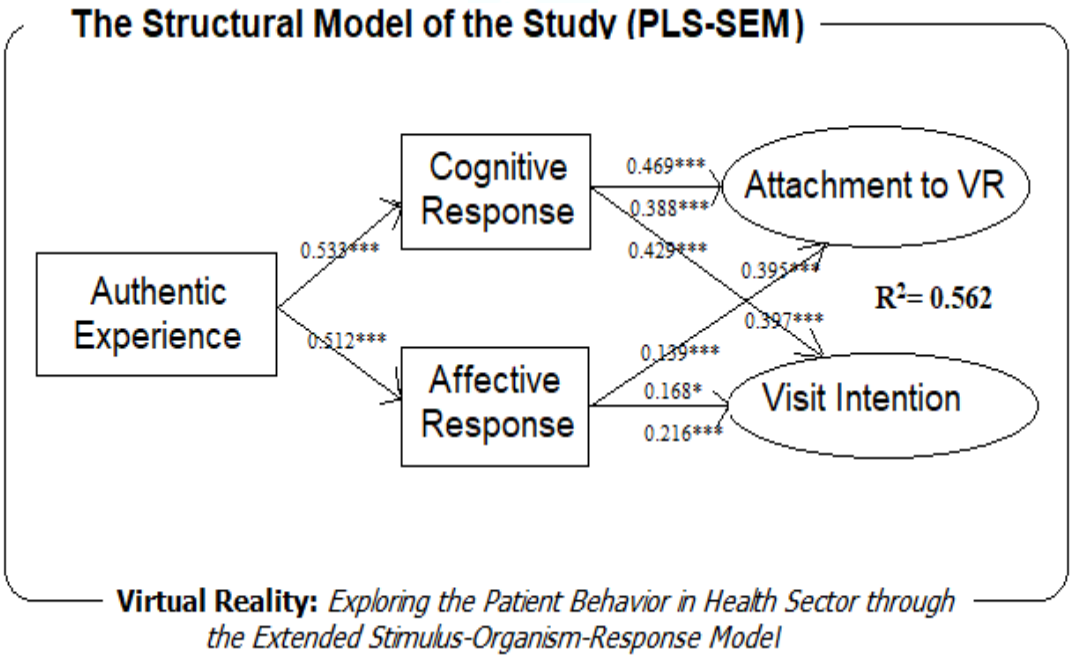


Table 3
Structural Model Results

Path	Direct Effect	Indirect Effect (Mediation)	p	Support
PAE → PCR	0.533***		0.000	H_1 Yes
PAE → PAR	0.512***		0.000	H_2 Yes
PCR → PAT to VR	0.388***		0.000	H_3 Yes
PCR → PVI	0.397***		0.000	H_4Yes
PAR → PAT to VR	0.395***		0.000	H_7 Yes
PAR → PVI	0.168*		0.050	H_8Yes
PAE → PCR→PATVR		0.469***	0.000	H_5 Yes
PAE → PCR →PVI		0.429***	0.000	H_6 Yes
PAE→ PAR→PATVR		0.139***	0.000	H_9 Yes
PAE→ PAR→PVI		0.216***	0.000	H_{10} Yes

Level of Significance: *p < 0.05, ***p<0.001.

Virtual reality is a newly emerged technology in the age of fourth industrial revolution. Notably, VR offers a chance for patients to get an advanced experience before visiting the facility physically, which is a very convenient and powerful marketing of the health facility. Remarkably, VR-health allows the patient to visit the health facility shown in VR, yet research on VR-health lacks details on the critical factors, and how the prospective patient could visit health facility shown in the VR health activities. To engulf this gap, this study initially pointed out the factors that influence the patients to visit the VR-health facility with the context of patients' authentic experience with health-related VR activities and patients' attachment to VR-health experience. In the current study, researcher has studied VR patients' stimulus, response, and behavioral intention via SOR framework. The study has constructed and then verified a

theoretical framework to get into the associations between patients' authentic experience (stimulus), patients' cognitive and patients' affective reaction (organism), patients' attachment to VR, and patients' visit intention to the health facility via VR content (reaction) with the help of SOR model. Particularly to get a better understanding, this research has operationalized patients' affective response to patients' health-related VR experience as second-order factor, and patients' enjoyment and patients' engagement as reflective measures.

The study found a strong and significant influence of patients' authentic experience on patients' cognitive and affective response to VR-health experience, which indicates that patients' authentic experience with health-related VR activities is a significant variable to commercialize VR in the health sector. Furthermore, patients' cognitive response to health-related VR accomplishments pays to affective response to VR-health experience. In addition, this study found that prospective patients' cognitive and affective responses to VR-health experience are the significant mediators to predict patients' attachment to VR-health experience and patients' visit intention to the health facility shown in VR. Findings further confirmed that patients' intention to visit health facility presented in the VR-health system proposed, tested a theoretical model to understand the association between patients' authentic experience (stimulus), patients' cognitive and affective response (organism), patients' attachment to VR, and the patients' visit intention to the health facility shown in the VR content (response) through the lens of SOR theory. Specifically, to get a comprehensive view, this research has operationalized the patients' affective response to the patients' health-related VR experience being second-order factors, while patients' enjoyment and engagement as reflective measures.

Conclusion

The study concluded that patients' authentic experience significantly predicts the their cognitive and affective response on the patients' VR-health experience, which indicates that patients' authentic experience with health-related VR activities is a critical factor in commercializing the VR in health. Further, patients' cognitive response to health-related VR activities add to patients' affective response to the patients' VR-health experience. Likewise, it has been identified that patients' cognitive and affective responses to patients' VR-health experience are the significant mediators that predict patients' attachment to VR-health experience and visit intention to the health facility shown in the VR. The result of the study also demonstrates that patients'' intention to visit the facility presented in the VR-health content is affected by patients' attachment to patients' VR-health experience. Additionally, the study suggests that patients' affective response to patients' health-related VR experience primarily comprises patients' enjoyment and emotional engagement. This study also highlighted why prospective patients' wishes to visit the health facility presented in the VR-health activities and delivers implications for practice and academics.

Implications for the Theory

Regardless, the increasing significance of VR in health, there is a scarcity of studies on factors that affect the VR patients' behavior and the prospective patients' stimulus and response. This study offers to the academia some meaningful and handy insights for knowledge building and substantiation of the SOR model. Precisely, the findings present a good theoretical contribution to the researchers in the academic world, like, the study has validated the importance and use of extended SOR model by adding patients' authentic experience to health-related VR activities being a stimulus and patients' attachment to VR as a patients' response in the VR-health environment. Similarly, this study has theoretically tested and confirmed the extended SOR theory inter alia patients' affective response to VR-health experience as a second-order variable inter alia the patient's enjoyment and emotional engagement as reflective measures. From a theory standpoint, one prominent finding of this study is that it has found that patients' cognitive response to VR-health experience significantly influence their visit intention to fascinations exist in the VR health-related content as compared to the patients' affective response or attachment to the VR. This means that patients are perhaps more attached to VR-health content instead of patients' visit to the health facility presented in the VR-health content once they enjoy, emotionally engaged in, and they are mesmerized by the VR-health activities. The result also proved the significant influence of patients' cognitive response on the patients' affective response; it explicates the theoretical association between patients' cognition and affection, which extends the studies of Tussyadiah *et al*. (2018) on virtual communities. Moreover, this study has recorded a significant association between patients' cognitive

response and attachment to VR; it offers the best chance for theory formation, which is the extension the Jerdan *et al.* (2018). The patients' cognitive response was found with a highly significant impact on patients' visit intention, which gives a start for VR-health research, this could substantially extend the studies of Acker & MacKillop (2013) and Diemer, Muhlberger, & Zwanzger (2016). Further, considerable increase and importance of VR-health experience, there are however very few studies on the patients' cognitive response and patients' affective response. Concerning, the study in hand offers the academicians some valuable insights for theoretical development and substantiation regarding patients' cognitive and affective physiognomies. The findings of the study add numerous theoretical contributions to the existing pool of literature. Since it has a value for patients' cognitive and affective models in VR-health activity backgrounds, further, it has validated the theory and found that patients' cognitive response might be a significant factor for prospective patients who visit the health facilities presented in the content of VR. Similarly, considering the impact of patients' enjoyment and emotional engagement, the current research study presents theoretical insights on patients' affective response as a critical second-order factor for the patients who are using health-related VR activities associated with the VR content.

Implications for the Practice

The result of the study suggests that VR-health content creators must work to create authentic VR content. The patients' authentic experience from the health-related VR activities have been found significant and it influences the patients' cognitive and affective responses. Therefore, VR content developers need to design and develop VR content that should result in a real and distinct element from which patients can get an authentic experience in VR-health activities. The association between patients' authentic experience and affective response to VR-health activities are powerful predictors as compared to patients' authentic experience and cognitive response. Therefore, developers of the VR-health content can accelerate the emotional aspects of patients' enjoyment and emotional engagement through the inclusion of animations. On the other hand, content developers may highlight the VR-health-related schemes that have pleasurable and fun aspects and engage an impressing and appealing edutainment. Findings of the study demonstrate that leadership of health facility must pay heed to the patients' cognitive response for getting an affective response of the patients' to be connected to health-VR-with an intention for patients' visit fascinations shown in VR-health system; because the healthcare services might stimulate VR products being useful and valuable activities performed via websites or cellular phones, and social media, etc. This way the prospective patients can get affective response, patients' attachment to VR experience, and patients' intention to visit the facility in VR-health activities. Furthermore, findings suggest that healthcare service promoters must take pain for creating such VR content, which accommodates the hedonic elements to ensure the patients' intention to visit the health facility presented in the VR-health.

The influence of patients' attachment to health-VR is significant for the prospective patients' intention to visit health facilities shown in the VR activities. This study recommends that healthcare managers encourage the patients' attachment to VR with closely related and relevant content. This means that healthcare stakeholders need to enhance patients' attachment to health-related VR activities. This way, managers can influence the prospective patients to visit the health facility shown in the health VR. More decisively, VR patients' visit intention is affected less by affective response than cognitive response, and this is why the health sector must ponder on the patients' cognitive traits. Particularly, a powerful effect of the patients' affective response through attachment to VR results in the greater visit intention as compared to patients' direct impact of affective response on their visit intention. This implies to produce VR platforms and systems in such a fashion that could leads to patients' pleasurable experience of health-VR-activities, stimulates their attachment, and enhances their visit intention. This suggests that health facility administration is required to design such applications with VR technologies that could motivate the prospective patients' appetite and liveliness. Additionally, patients' enjoyment amongst the attributes of major variables was found as one of the most vital factors for patients' affective response. Therefore, the study recommends that the content of health-VR must include pleasurable aspects, which could be done through the development of exhilarating programs including the vibrant 3-D characters and use of illustrious animations. Moreover, health facility management and policy formulators might develop an all-inclusive VR public relations scheme for health facility promotion, including

constructive, pleasurable, and affective activities for their health facilities. The tactics of health facility promotion could be developed by designing the health-VR-plans for the prospective patients to get the experience and select the right facilities before the real visitation.

Limitations and Future Research Directions

The findings of this study give useful theoretical cum practical knowledge to the academicians and practitioners. Yet, like other studies, this research has certain limitations, which serves as a guide for the future study directions. The model of this study is confined to healthcare in developing countries of the Asian region. In future, researchers could apply this model in other fields and cultures for generalizability and to determine the cultural variations if exist. Studies might investigate the variances and resemblances among the patients who visit the health facilities shown in health-VR-content and those who did not experience it through their visits depicted in the VR-health system. They can employ multi-group analysis for a comprehensive investigation into the variations that might be found due to behavioral gaps among different groups of patients. Likewise, future researchers could also assess the patients' Big-5 personality traits like extroversion, introversion, and conscientiousness, openness to experience, and neuroticism, which might result in a beneficial extension to the study of the prospective patients' behaviors contingent upon the individuals' traits. Moreover, future research needs to use the research model of this study to investigate the patients' behaviors further through augmented reality (AR) in contrast to the use of VR. This will help the health facilities to benefit from the technologies like AR, VR, and Ajzen & Fishbein (1977) introduced TRA, i.e., attitude-behavior theory; it was further refined by Glasman & Albarracin (2006) which is well documented; therefore, in future, researchers on health-VR-could consider the attitude-behavior-context theory for better comprehension of the patients' experience and behavior in the context of VR-health.

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