The barriers of accepting Virtual Reality in Healthcare by older generation

Mr Salman Heydari Khajehpour*
Royal Bournemouth Hospital, Castle Lane East, Bournemouth, BH7
7DW
Salmanheydari@Gmail.com
* Corresponding author

Dr Mona Seyed Esfahani
Bournemouth University, 4th floor Weymouth house, Talbot Campus,
Fern Barrow, Poole, BH12 5BB
mseyedesfahani@bournemouth.ac.uk

Abstract: Acute pain causes great anxiety in patients and is a significant challenge for the NHS staff. Chronic pain is a burden to the UK economy and causes substantial disability. Pain management is predicted to increase within the aging population in the UK. At the moment Pharmaceutical pain management techniques are commonly used, which are not only costly, but also resulting in significant side effects. Virtual Reality is an acceptable complement with minimal side effect. However there have been resistance in using VR amongst elderly population. This study explores the existing attitude and challenges expressed by elderly population in using VR technology for pain management. The study followed an experimental design and the finding indicated that pre-existing knowledge and experience of pain and VR, alongside the perceived ease of use and perceived usefulness of the technology has an impact on elderly's attitude and adoption of VR technology.

Keywords: Virtual Reality; Pain management; Health; Innovation; Elderly population

Introduction

British Pain Society reports almost 10 million Britons suffer from pain every day. Chronic pain alone affected around 8 million adults in the UK in 2018 (British Pain Society) and resulted into moderate to severe disability (Von Korff et al. 1992). Health professional have always explored ways to manage pain. Chronic pain management is predicted to increase within the aging population in the UK (McGhie and Grady 2016). Managing pain is very costly. The cost of managing back pain alone is more than 5 million pounds per year (British Pain Society). Pharmaceutical pain management techniques have been used for decades. However, there has been a shift in reliance on this form of pain relief such as common pain killers, opioids and anaesthetic techniques due to various side effects and growing addiction and death related incidents of drug abuse (Trang et al. 2016). In recent years, there has been a global effort to provide non-pharmaceutical pain management techniques. Virtual Reality (VR) is one of the advanced

technologies being tested in pain management. VR technology is growing rapidly and expected to be worth $192.7 billion by 2020 (Statista, 2019).

This paper looks into older generation's behaviour towards using Virtual Reality (VR) in pain management. The barriers of acceptance of VR technology is also explored amongst the older age group (aged 65 and above). The study follows a qualitative interview technique, using experimental research design, to uncover the existing behaviour and knowledge and barriers perceived by older generation in the UK.

Literature Review

Innovation is a crucial factor in the success of healthcare industry. National Health Services (NHS) England promotes innovation development and invests in many innovative projects. Innovation is regarded as an important factor that "help(s) to prevent diseases, speed up diagnosis, improve safety and efficiency of services and increase patient participation in decision making, self-management and research. This will lead to better health outcomes and a more sustainable NHS."[1] One innovative technology receiving a lot of attention in the UK is VR. VR is introduced in the 1990s and became commercially available. An early definition of VR is *"a real or simulated environment in which a perceiver experiences telepresence"* (Steuer, 1992, p.7). Sutherland (2016) explains VR as a three-dimensional, interactive and immersive experience. Health centres in the UK started trialling VR technologies in various areas. For example on burn patients, there was a recent large scale trial in Northern General Hospital conducted by Sheffield Hallam University in 2018. VR has expanded greatly in the last few years mainly in the area of teaching and simulation. However, there is yet a great potential in areas including training, psychological and medical management, rehabilitation and simulation. The technology remains controversial in its applicability in the extreme age groups, its potential side effects or where the infrastructure is not suitable and finally its acceptance by the healthcare professionals and organisations. This study explores VR as a pain management technology in NHS England and looks into the attitude of the elderly towards the technology. Therefore the relevant areas of literature are first examined.

Pain Management

Pain management in UK is delivered broadly in primary and secondary care. Secondary care is delivered in hospitals and specialist clinics which are mainly run by the acute pain teams lead by the anaesthetist. Pain management in primary care is mainly delivered by general practitioners, chronic pain teams lead by anaesthetists or pain specialist and allied professionals specialised in the field. They use various tools to alleviate the pain and improve patient's quality of life (Philips, 2017). Amongst the first and main methods of managing pain is use of medication in the classical WHO pain relief ladder starting from simple paracetamol and non-steroidal anti-inflammatory increasing to mild and eventually strong opiates. If the above fails there are anaesthetic methods, which are

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[1] https://www.england.nhs.uk/ourwork/innovation/

mostly invasive and proved to have numerous side effects, such as delaying recovery and increasing the risk of permanent disability (Mallari 2019) and result into long term health effect on patients and their quality of life (Stewart 2017) as well as a great cost for patients and NHS. Non-pharmaceutical options have been explored for years by medical experts with a great focus on cognitive therapy (Meldrum 2003). Distraction and Relaxation techniques are the most commonly used non-medical options for pain management (Johnson 2005). The principle is explained by Gate Control Theory (GCT), that pain signals transmitted to the brain, passing through nerve gates. If the gate is open, there is more suffering and when they are closed, there is less suffering. Focusing on pain and anxiety are amongst the factors resulting into aggravating pain. Distraction and medication closes the gate and lessens the suffering. Therefore, distraction and methods reducing anxiety can be effective in pain reduction (Melzack and Wall, 1965).

Virtual Reality and Pain Management

Virtual Reality is developed over many years and used in healthcare, in staff training, patient management and rehabilitation. VR can be experienced through a combination of technologies such as stand-alone head-mounted headsets, Mobile headsets and noise reduction headphones. The headsets include a head tracking devise that follows user's movement and creates the illusion of being completely surrounded by a virtual world. VR is widely used in managing pain and is proved to reduce levels of pain, general distress (Li et al. 2011), and act as distraction and motivational technology. For example, VR has been used to decrease pain and discomfort in patients with burn injury (e.g. Soltani et al. 2018; Sharar et al. 2008). The technology is proved to reduce the perceived pain by patients. This can be due to distraction which is based on ?GCT results into less perceived pain or as explained by Li et al. (2011, p147) it works as "exerting an array of emotional affective, emotion-based cognitive and attentional processes on the body's intricate pain modulation system".

   In a systematic review by Dascal et al. (2017), the technology deemed successful as a pain distraction tool, particularly in palliative treatment (Schmitt et al. 2011), and as a stress-relief tool. Robertson et al. (2017) looked into the application of VR stress-relief content pre-operatively and showed a marginal decrease in the level of anxiety of the patients that used VR relaxation content. Immersive VR technology is regarded as an effective pain management technology which is nowadays accessible and cost effective (Li et al. 2017). Saposnik and Levin (2020) highlights how using VR in rehabilitation in post-stroke provides the intensive training required to induce structural neurological changes. Such service is not possible without VR due to various constraints such as time, personnel and resources limitation. Therefore, using VR technology as a non-pharmaceutical alternative in pain management appears to be a feasible, cost-effective and efficient solution. However there are barriers and challenges that resulted into VR not being adopted in healthcare industry earlier, quicker and easier.

Acceptance of Virtual Reality in Older generation

VR similar to any new technologies needs to be believed as an effective solution and adopted by individuals and organizations in order to be utilized. There is resistance by patients and health professionals in adopting this technology, due to factors such as past experience, lack of information or technophobia. Technophobia is an abnormal anxiety towards advanced technology (Ha et al. 2011; Nimrod, 2018) or described as an irrational fear of technology (Giacomo et al. 2019). Giacomo et al. (2019) adds that people who feel intimated by technological objects such as computer and robots are more likely to experience technology anxiety. Technophobia is more common amongst the older generation (Wang and Chen 2015) and non-tech savvy older people are amongst the group with higher chances of technophobia (Giacomo et al. 2019;Gilroy 1986) which as a barrier prevents this group from using the enhanced medical care available via advanced technologies. Interestingly this fear is not seen in the case of mobile phones that can be attributed to socioeconomic success (Khasawneh 2018; Osiceanu 2015). Lack of knowledge is a main factor influencing individuals attitude, learning and decision making towards innovation (i.e.Rogers, 1995, Mayer and Moreno 1998). Lack of knowledge also influences individuals' perceived usefulness and ease of use of the VR technology, which consequently affects their attitude towards innovation based on Technology Acceptance Theory (Davis et al. 1989). Conclusively, older generation due to higher chances of Technophobia, their lack of interest and knowledge on VR technology and lower perception on ease of use and usefulness of the VR technologies, is inclined to have more negative attitude towards VR which directly influences their adoption and trust in the VR technology. It is also very important to acknowledge that the industry has to work harder to overcome the difficulties encountered by the older generation, such as the difficulty of interaction with the technology, the comfort of the headset and the side effects which are more pronounce in this particular group of patients amongst the other factors.

The literature surrounding the older generation attitude towards VR is of interest of academics. As many health problems are more prevalent in older adults, it is important to understand how their attitude and perception of the advanced technologies within health can be facilitated. There is an array of hope as studies reporting more positive outcomes in experiments involving advanced technologies. For example Chan et al. (2012) reported a negative attitude towards gaming consoles and a 40% refusal to take part in the experiment. Meyerbroker and Emmelkamp (2014) reported a high level of discomfort expressed by older generation in using VR head-mounted devices. More recent studies on the other hand indicated a more positive perception and attitude. Huygelier et al. (2019) reported a change from neutral to positive in attitude of older generation towards immersive VR head-mounted experience. The level of cyber sickness was also low. Roberts et al. (2019) reported that VR is reviewed positively by older adults however there was a mixed negative and positive emotional reaction to different aspects of VR experiences and modification. For example an increased interactivity is needed to improve perceived ease of use of the technology. One of the desired content expressed by older generation was self-care/therapy.

Based on the literature review and the gaps identified, this study aims to address the following questions:

RQ1: What is the existing attitude towards the use of VR relaxation content in pain management amongst the aged 65 and over?

RQ2: What are the main barriers of acceptance towards VR relaxation content as a form of pain management among the aged 65 and over?

Methodology

Research Design

A positivist approach was applied throughout this study. A controlled experiment was designed to examine pre and post exposure to VR technology. A semi-structured questionnaire was designed. An opportunistic sampling was used for the purpose of the study due to time and cost limitation. 8 volunteers, age group 65 years and older were selected to take part in the experiment.

For the experiment mobile VR headsets were used. The steps of the experiment was as follow:

1- The first step was handing in participant information sheet and consent form.

2- If participants were happy to partake, they were asked to take part in pre-VR interview.

3- Next the researcher explains how the participant can use the VR technology and set up the VR headset.

4- Participants were given the headset to watch the content for 3 minutes.

5- Researcher gently touches participant's hand, to measure for distraction.

6- VR headset was removed; participants were checked to make sure they don't suffer from VR exposure side effects such as nausea and dizziness.

7- If participants are feeling ok, they take part in post-VR interview.

Interview guide

A semi-structured interview was designed based on the objectives below:

● Obtain an understanding of the existing attitude and main barriers surrounding the acceptance of VR as a form of pain management among the elderly (aged 65 and over)

● Ensure the welfare of participants at all times

● Establish a rapport with participants

Personal audio device was used to record the interview for the purpose of transcription. The structure of the interview was as below:

1. Opening (brief and factual, establishes a common ground)

2. Introductory (Open ended introduction to topic, helps participant to connect with topic)
3. Transition (Bridging from introduction to key questions)
4. Key (Focus of the study and analysis)

    1) Questions
Structured interview questions can then be asked to the participant.
2) Using the VR headset
Here the participant should be given the opportunity to use a VR headset for 3 minutes. During this time, the interviewer should touch the participant lightly on the hand without telling them in order to assess their level of immersion and distraction.
3) Follow up questions & Scale
After having used the headset, the interviewer should ask the participant another set of questions in order to assess, whether their opinion or view on VR in pain management, has changed.

5. Ending (Summarises and closes interview)

Pilot Study

A pilot study was undertaken which resulted into two main changes. Firstly the duration of the content increased from 2 minutes to 3 minutes in view of the feedback. Secondly, few contents were explored and the 'Forest of Serenity' a 360 experience of walking through rainforest with the soothing voice of David Attenborough guiding the user through the different plants and animals, was selected.

Data Analysis

Thematic analysis was conducted to analyse the qualitative data. It is a method for identifying, analysing and reporting patterns within data and is widely used in analysing qualitative data (Braun and Clarke 2006).
    To ensure validity and reliability of the research, several methodological strategies were implemented to ensure the trustworthiness of findings. These include:
    ● Acknowledgement of biases in sampling and ongoing critical reflection of methods throughout to ensure relevance of data collection and analysis
    ● Record keeping of data to ensure that the process is consistent and transparent
    ● Establishing common themes and conflicts in the data to ensure different perspectives are accounted for, avoiding biases
    ● Engagement of all researchers throughout to avoid biases

Findings

After conducting the thematic analysis, four main themes were immerged from the data.

    1- Lack of knowledge

One of the evident themes was the lack of knowledge. When the participants were asked about their existing knowledge on VR, the majority immediately answered they have no knowledge. For example, One of the participants initial reaction was: "erm? Virtual Reality? What is that? (Participant 1), another said "I've seen the VR headset online but I didn't investigate what VR is and what it does" (Participant 2). Others included technology as a whole claiming "I'm not aware of all the new technology". Only 1 out of the 8 participants that were interviewed knew what virtual reality was, this being Participant 4, saying they had experience with VR after having watched their friend use it. Participant 7 said they have "no clue what virtual reality is, but it sounds rather interesting", expressing willingness to learn. Many struggled to answer whether they think the technology would be effective with comments like "Um I don't really know, because I haven't done it. So, um, I don't know if it would be effective or not." This suggests that lack of knowledge and understanding is a significant barrier to acceptance.

It can be argues that this theme was the most common throughout the interview and it was expressed by participants many times. This is in line with literature expressing lack of knowledge as one of the main barrier of innovation adoption, innovation learning and is also highlighted in Vroom's Expectancy Theory (Vroom 1964) as an antecedents to motivation as 'past experience'.

2- Self expectancy

Another common theme was age. This was referenced by participants in numerous occasions, in particular on questions about the suitability of the technology for the older generation. (Participant 1) made 9 references to age throughout their interview, such as "I've only seen my grandson play with the headset". Another, Participant 3 referred to their age when asked about VR and said 'oh love, at my age, I have no idea' adding on "I'm not aware of all the new technology as I'm not around children much and I don't tend to go out where I'd most likely hear about it". This suggests surprise at the notion that an older person would know about such technology, and that the people that hold this knowledge are children. The participant immediately related the use of technology with age and the younger generation.

Later comments proved very interesting. After using the headset, one participant said "it made me feel young again which was a nice change". This comment reveals that the participant seemingly enjoyed the experience, and were able to use the headset. However they still associate the product with younger age. Furthermore, "was a nice change" suggests a need for the elderly to keep up to date with technology in order to feel liberated. One question in particular was designed to uncover any potential barriers surrounding different groups in society such as age or gender. When asked 'Do you think the headset is suitable for all types of people?', responses included "as far as I know, for children yes!", "especially for children that'll be better.", "for children that have had a bad experience at the doctors or hospital" and "And I should think for children, for littles that would be very good. Yes".

It is evident that the consensus here is that VR is more suitable for children than the elderly population, therefore a barrier preventing the acceptance of the technology. Given that Virtual Reality is a computer technology to create an enjoyable 3D experience,

typically used for gaming technology by those aged 11-35 years old. Therefore, probably the acceptance of the technology by the younger generation is much more likely than from patients over 65 years old. The majority of participants that were interviewed when asked "which age group they believe VR will be recommended to be used by" they positively answered "as far as i know for children yes" and "for children that'll be excellent". They initially thought it would be a good idea for children and didn't relate themselves to use the headset.

According to Vroom's Expectancy theory (Vroom 1964), individual's behaviour is based on their motivation on making conscious choices from set of possible alternatives to maximize gain and minimize pain. Expectancy is the belief that one's effort, result in attainment of desired goal which is based on individuals' past experience (knowledge), self-confidence (one's belief on their ability to successfully perform a task, if they have required skills or knowledge), perceived control (the believe of obtaining some degree of control over the expected outcome) and perceived difficulty (the performance expectation, if they made too difficult). If older generation have a perception of lack of ability, knowledge and skill to use VR headsets, in combination with their lack of knowledge of the technology, there is no surprise why they have such low motivation to use the technology. Hence a framework (Figure 1) based on technology acceptance theory, Innovation adoption theories and expectancy theory is suggested to be tested in future studies.

3- Attitude and adoption

Participants were asked about their attitude towards the VR technology before and after the use of VR headset. A common theme here was them to be surprised

For example, one participant when asked how they found using the headset stated "wasn't what I thought it was going to be like, but I'm pleasantly surprised". Another, when asked if they felt comfortable while using the headset said "yes, which really surprised me". It is possible that the trigger of this surprise is lack of understanding/knowledge or low self expectancy, as participants did not know what to expect. Overall there was a positive change in attitude and a significant increase in use of positive language once the headset was used.

Participants were asked if they are happy to be offered VR as an alternative option for pain management during a medical procedure. Before using the headset, all answers were above the midpoint 5, which indicates a mild positive intention towards adopting the VR headset without knowing what it is and what it does. However comments suggested that if they had information about the VR headset, they could have expressed their opinion better. After using the headset all participants score was close to the highest score of 10 which indicated they were more than happy to use the VR headset if it was offered. This indicates the importance of existing knowledge.

4- Perceived ease of use and perceived usefulness

In terms of perceived ease of use, we collected evidence to support the idea that the elderly perceive technology as hard to use, yet these beliefs are easily changed by giving them a chance to use the technology. For example, before using the headset, one participant exclaimed " it looks different, it looks complicated I must say." However, when asked after using the headset whether they found it easy to use, the change in attitude was astonishing. The same participant used the phrase "Very simple". Another said "oh 100%." "Which I think is great because then anyone can have a go and no one will feel stressed at the fact they aren't sure of what to do". The face that this individual

associates ease of use with stress is interesting. If the elderly have fear about not being able to use technology easily, it is likely to stand as a significant barrier in the way of their acceptance to that technology. This is in line with the expectancy theory as explained above and the innovation adoption literature.

In evaluating the perceived usefulness of the VR headset during a medical procedure, while majority of participants were positive, they were interested to know more: "I reckon so, I believe instead of people taking medication over using the virtual reality headset if it does work it'll be very good, I'll be very interested as to whether or not it will be effective". Yet others were unsure "Um I don't really know, because I haven't done it", likely down to lack of knowledge as mentioned above. However, attitudes did change after using the technology. Many supported the fact that it distracted them; "it's a good way of distracting people and calming them down", "It took my full focus and attention so i'd say yes it would which is just amazing if you ask me". This indicates that with knowledge gain, there is a possibility of higher perceived usefulness of VR headset. This is in line with innovation literature (i.e. Irani 2000), technology acceptance and expectancy theory.

Distraction

Although not the aim of the research, we decided to take the chance to incorporate an experiment to how effective the headset is in distraction. During the interview process we decided that we would test to see how distracted each participant would be whilst they had the headset on. Whilst they were watching VR the interviewer would gently touch their hand to see if they felt anything and what their reaction would be, we did this because if the NHS was to introduce the headset it'll be completed in a similar process. By evaluating the participants reaction, would determine how good the VR headset would be. The participants were asked "Did you feel anything when you were watching the virtual reality? All patients answered "no nothing? Was I supposed to", "no nothing at all" and things like "I felt an itch if that's what you mean?". Therefore from their reaction meant that each participant was successfully distracted by the headset. As a result use of VR headset might give the desired outcome of distraction if needed.

Conclusion

The findings were in line with the existing literature. Based on our initial findings of this study and the existing literature, the framework below is proposed which has borrowed elements from the expectancy theory (Vroom 1964) and the Technology Acceptance Theory (Davis 1989).

It is evident that the element of '*pre-existing knowledge and experience*' should be explored for both pain management and VR in the elderly population. The framework needs to be tested on a larger sample of elderly population for further evaluation.
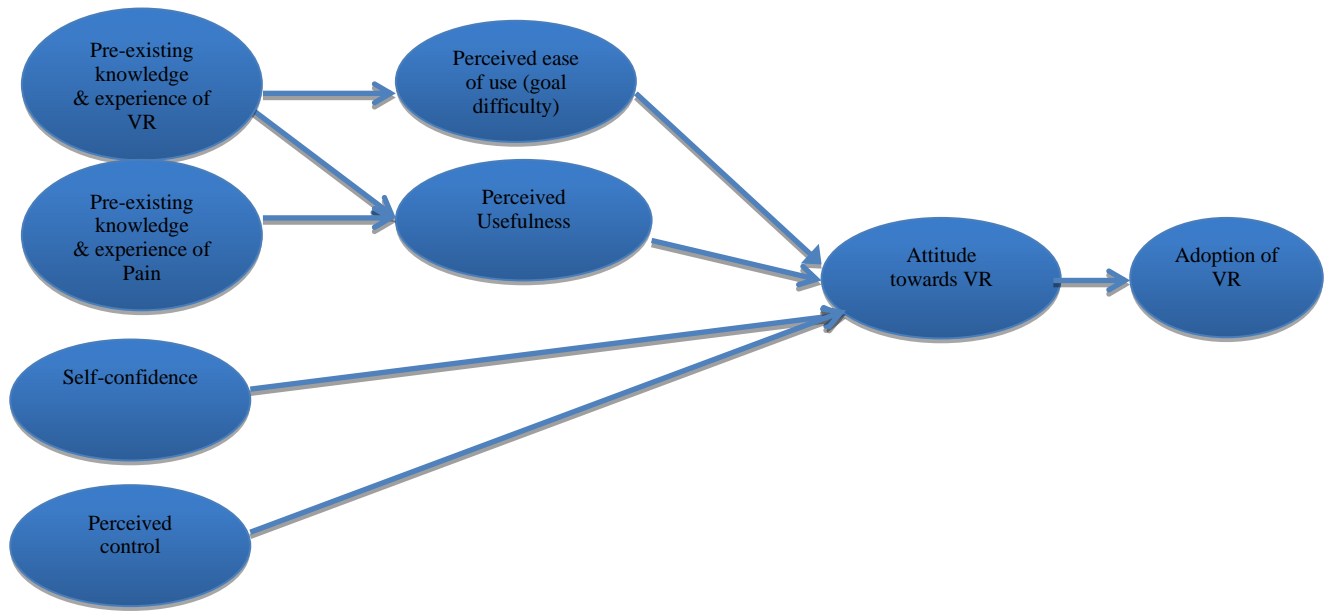
Figure 1: VR adoption framework

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