Towards a Theoretical Framework of Acceptance of Virtual Reality Technology: Evidence from 360-Video Concert

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Abstract

We examine the use of 360-degree video technology in a live music event with the aim to explore the factors leading to acceptance of the VR use case and technology, to reduce the knowledge gap about this topic. We collected self-reported, quantitative data from 23 participants and investigated the user experience during the VR mediated 360-video concert and the acceptance of the 360-video for concert participation and VR technology use. We found that acceptance of the novel VR-based communication approach was correlated mainly with perceived usefulness. Furthermore, the perceived usefulness was only correlated with fun, but not flow and immersion. We outline the results in a new theoretical framework for studying and predicting the relationships between individual characteristics, user experience, VR evaluation, content and device, and the acceptance of 360-video mediated musical events and VR technology. Implications for VR acceptance theory and design practice are discussed.

Keywords: 360-Video, Virtual Reality, User Experience, Usefulness, Technology Acceptance

1. Introduction

Businesses look at new technologies to find innovative ways that satisfy customers' needs and expectations, and to anticipate novel use cases of digital innovations. An example of such technology is the 360-degree video camera which enables Virtual Reality (VR) experiences. VR uses technologies that produce interactive and realistic 3D environments for users to interact with and experience [34]. 360-degree video (henceforth, 360-video), also called panoramic, immersive, or omnidirectional video, consists of moving images that have been captured in such way that the viewers can freely look around like they were present when the video was captured [11]. 360-video can be watched as a direct broadcast or from a captured recording through a head-mounted display (HMD) or in a specially built room such as CAVE [11]. *However, 360-videos have not been so far systematically evaluated as to their user experience (UX) and acceptance in music events use cases.* A few isolated, recent studies focusing on viewing and audio experience exist [29,30], while others focus on specific metrics such as presence [10], [36], [56]. *The research problem addressed in this paper is to reduce the knowledge gap about the experience and acceptance of VR and 360-video in live, remote music events. This research is important for information systems researchers and professionals specializing in VR development and evaluation who are concerned with providing state-of-the-art experiences to users in terms of product and service quality.*

To this end, we examine the use of 360-video technology in a virtual concert context. *The aim is to explore the factors leading to acceptance of VR use case and technology and to provide a theoretical framework for researching them*. We conducted a study where participants were exposed to 360-video transmission of a live concert. We collected quantitative, self-reported data from 23 participants regarding their user experience with and evaluation of the 360-video VR mediated concert, as well as their intention to adopt the using of the technology in the future. Implications for VR acceptance theory and design practice are discussed.

2. Related Work

VR has been originally largely defined by technology, usually VR referring to a certain kind of technological system configuration, while research and definitions have lacked user perspective and UX aspects [57]. Steuer [57] argued that instead of defining VR entirely by technology, the user's perspective should be incorporated. Accordingly, the concept of telepresence defined as "the experience of being in an environment through a communication medium" [57] (p.6) is key in defining VR in terms of UX. 360-video allows the user to experience VR and telepresence freely. The user watches the omnidirectional video as he/she prefers and is not locked to a predefined point of view [7]. Viewers feel that they are present in the action that unfolds before their eyes [12]. Immersion is yet limited, because the interactions are restricted to head movements and no interaction is possible with the video content itself [49]. Technical limitations in processing the video streaming, head movements and other user inputs in real time led to higher levels of cybersickness and latency that negatively affect telepresence and UX [5], [6], [61].

Interactivity is a major factor in VR design and user acceptance [53], but the literature evaluating UX and acceptance of VR is sparse. Early empirical studies evaluated VR for health care applications (e.g., [37]). Emerging applications areas include education [3], urban planning [25], entertainment in self-driving cars [14]. Qualitative studies show that VR is in an early phase of technological maturity when it comes to mass consumption [42]. Quantitative studies explore the factors that influence targeted behaviour, UX, or acceptance [55]. The use of 360-video in music or live events has been studied in terms of quality of the listening and viewing experience and presence [10], [29,30], [36], [56]. Other studies focused on user typologies [51]. Very few studies address the UX with 360-video and immersiveness, engagement and telepresence (see [12]).

3. Theoretical Background

3.1. Technology Acceptance

Technology acceptance theories explain the individual behaviour of using technology. The most prominent models are the technology acceptance model (TAM) [18], the extended version TAM2 [58], and the unified theory of acceptance and use of technology [59,60]. These models are based on *the theory of reasoned action* (TRA, [20]) which predicts volitional behaviour and *the theory of planned behaviour* (TPB, [2]) which predicts how a behaviour, that is not entirely controlled by the individual but is conditioned by social norms, is formed. These models predict acceptance of technology or behavioural intention (BI) to use a technology, and consequently the actual use of technology. TAM explains that individuals consider the use of a new technology when they believe that the consequences of using the technology are optimistic and their subjective evaluation of these consequences leads to positive assessments [18]. Thus, theoretical constructs of *perceived ease of use* and *perceived usefulness* are employed to predict behavioural intention (BI) to use technology [18]. Among the few empirical studies examining the acceptance of VR and 360-video, one study used UTAUT2 and showed in an experiment with 56 participants that perceived usefulness, hedonic motivation, and facilitating conditions (knowledge and previous experience with the technology) predict BI to use the technology [31]. Another study used ease of use and usefulness to evaluate the experience of 16 participants with 360-video [54].

3.2. Trust

In many models of technology acceptance, trust is a direct antecedent of BI for technology use (e.g., [22]). *Trust refers to cognitive and affective perceptions about the positive consequences of a desired outcome* [22]. Trust is an antecedent of perceived risk and both influence intention to use technology [33]. Trust influences BI to use wearable devices and perceived usefulness [40]. Regarding VR and wearable technology, security, privacy, and reliability of data and information are essential for users [19], [40], [43].

3.3. Social Influence

According to TRA and TPB, behaviour is also determined by normative beliefs and motivations, such as the social norm [2], [20]. *Social influence or social norm is a construct that captures the expectations perceived by an individual from certain individuals or reference groups and his or her motivation to comply with these expectations* [2], [20]. TAM2, UTAUT, and UTAUT2 incorporate social influence as a direct antecedent of BI to use technology. In these models, social influence refers to the individual's perception that important social actors expect him or her to use a technology. In voluntary contexts, social influence affects BI through internalization and identification [59,60]. Internalization refers to the process of recognizing the merits of a technology based on the recommendations of peers or other social actors [58,59]. Identification refers to perceived gains in social status gains associated with the use of technology [58,59]. It has also been shown that social influence includes recommendations from and identification with both close others and distant social actors such as media and other users [44].

3.4. User Experience, Flow, Fun and Immersion

In games and entertainment contexts, UX is associated with *the overall quality or fun of the experience* [41]. In media research, quality of experience is associated with *flow, fun,* and *immersion* [27]. Flow is defined as an optimal experience achieved when the user's skills are in balance with the challenge of the task performed over a period [17]. Important mediating variables of the flow are the characteristics of the content (e.g., interactivity or vividness of the medium) and characteristics of the process (e.g., motivation, utilitarian, or hedonic benefits) that contribute to, moderate, or condition the experience of engagement, focused attention, and, eventually, flow [27,28]. For defining UX, we adopt the hierarchical model proposed by Brown and Cairns [13] considering *flow as an initial step, namely engagement, fun as an intermediary or the engrossment stage, and telepresence or immersion as the optimal level of UX*. Furthermore, we position UX feelings of flow, fun, and immersion as precursors of appraisal/evaluation of VR in terms of ease of use and usefulness in line with the model proposed by Helle et al. [27]. Evaluations of VR and 360-video in music experiences or live events associated UX with *presence, pleasantness,* and *enjoyment* [10], [29,30], [36], [56]. Visual discomfort and motion sickness hinders the feeling of flow and users will give up using the headset; thus, the goal of telepresence and immersion is not achieved [5]. Thus, *flow or engagement* is seen as the first level of optimal UX [13]. *Engrossment*, the second level of UX, describes a state in which users' attention and emotions are directly affected by the task in question; at this time users experience *positive emotions, fun* and *enjoyment* that allow them to continue the activity or task at hand. The final level, *telepresence, or immersion* refers to a temporary state of being completely cut off from external reality, so that the task or entertainment is all that matters [38]. In media and VR contexts, total immersion characterizes a state of deep and total involvement in a media experience [13], [27].

3.5. Technological Personality

Users' background characteristics and abilities play a key role in choosing the technology and deciding to use technology [23]. *Computer self-efficacy*, defined as the perception of one's own ability to use a computer [16], influences acceptance of using technology in different contexts [26], [35]. Other personal traits influencing technology use are different *technological personality dimensions,* namely *affinity, compatibility,* and *innovativeness* [4]. *Affinity* refers to the importance attached to the medium in the life of an individual [52] and influences intention and adoption [4], [9]. *Mobile affinity* is the individual inclination to use mobile technology in everyday life. *Compatibility* is "the degree to which an innovation is perceived as consistent with the existing values, past experiences, and needs of potential adopters." [50] (p.224). Consumers are likely to adopt a new technology if it provides similar functions (is compatible) with the ones already adopted [4]. Finally, *innovativeness* is conceptualized as being "the degree to which an individual […] is relatively early in adopting new ideas" compared to others [50] (p.22). Agarwal and Prasad [1] conceptualized the construct of personal innovativeness in the domain of information technology and showed that it has a moderating effect on intention to use technology. These empirical studies conducted across different contexts of technology adoption indicate that mobile technology skills (self-efficacy) and technological personality constructs can explain the behavioural intention to use VR and 360-video technologies. These concepts are also embedded in theoretical models of adoption as facilitating conditions (see e.g., [31], [59,60]).

3.6. Individual Characteristics and Behavioural Motivation

Individual characteristics are defined in several ways, by demographics (e.g., age, gender, education), personality type, behavioural-disposition traits, habits, human values. *Age and gender* influence the acceptance of technology [26], or moderate different relationships rather than have direct influence on a behavioural variable [59]. A construct that reflects both personality and habits is *behavioural motivation,* and it has been shown to influence behaviour [48] and acceptance of using technology in different contexts (e.g., [44]). This concept defines the tendency of people to withdraw from or act in new situations [24]. Behavioural motivation has two distinctive physiological mechanisms that determine individual behaviour: *behavioural inhibition system (BIS)* and *behavioural activation system (BAS)*. These also determine distinct personality traits; some people are more inclined towards the withdrawal or inhibition behaviour in certain circumstances, while other people are inclined towards the approach behaviour [24]. BAS regulates appetitive impulses and motivates people to move towards something they want. BIS regulates aversive impulses and influences withdrawal from something unpleasant. Carver and White [15] developed the BIS/BAS scales to measure these traits and identified three types of activation behaviour: *reward responsiveness, drive,* and *fun seeking*. BIS/BAS scales have been used as moderating variables of approach motivation in different contexts (digital reading [45], communication [32], [47], acceptance of smart wearables [44]). The studies indicated that people with a higher drive and a higher fun seeking experienced a higher approach motivation and positive emotions. These, in turn, are believed to engage people in actions and influence their behaviour (e.g., [44], [48]).

4. Methods

The theoretical background and empirical findings introduced above identified relevant factors for examining the acceptance of 360-video VR-mediated concert and VR technology. We used these constructs for collecting data and analysing the correlations between them. We assume a hierarchical structure of the constructs or variables in the model (i.e., higher levels constructs are influenced by constructs at lower levels in the model). The theoretical model is as follows. At level 1 there are individual characteristics (gender, age group, education level, behavioural motivation) and previous VR experience; Level 2, technological personality; Level 3, user experience with 360-video VR concert (flow, fun, immersion); and Level 4, VR evaluation according to the TAM extended model (perceived ease of use - PEOU, perceived usefulness - PU, trust, and social influence). There are two dependent variables of acceptance, BI to participate in a VR concert (level 5) and BI to use VR in the future (level 6). We further posit the following: Intention to use VR in the future can be influenced by one's own experience with 360-video VR-mediated concert. VR technology affects variables at levels 3-6. UX variables (level 3) influence the overall evaluation of the VR (level 4), similarly as technology use redefines evaluations and attitudes in continuance models [8] and in line with models of media experience [27].

4.1. Research Design, Equipment and Setting

The research was conducted in collaboration with an Internet service provider who configured and provided the 360-video streaming of a rock concert via Wi-Fi. The research setting was a large laboratory at University of Oulu where the participants watched the live concert of the Finnish band Amorphis. Twenty-three participants were recruited through convenience and snowball sampling. Informed consent of the participants was obtained verbally. The VR equipment consisted of PlayStation 4 VR, Samsung Gear VR, Goji VR, Bobo VR, Wave VR, and Google Cardboard and similar cardboard or plastic VR headsets. Participants selected a headset or were randomly assigned to one type of headset. The design was quasi-experimental, between-subject. Type of device was also an independent variable. Quantitative, self-reported data was collected at the end of the event or when participants left. The duration of the experiment was roughly 2 hours.

4.2. Measures, Data Collection and Analysis

The questionnaire measured the following aspects: 1) individual characteristics (gender, age group, education level, behavioural motivation), and previous VR experience; 2) technological personality; 3) UX with 360-video and VR during the live event in the lab; 4) evaluation of the VR-mediated concert; and 5) acceptance of 360-video and VR.

Questionnaire items were measured on 7-point Likert-type scales (Strongly disagree–Strongly agree; or Never–Very often) and were based on previous studies [4], [16], [21,22], [27], [35], [44], [58,59]. Variables are shown in Fig. 1. The multi-item constructs showed acceptable scores for Cronbach's alpha reliability statistic (higher than 0.6), except for two constructs with relatively lower reliability scores, namely Innovativeness and Trust in VR technologies. For Innovativeness, "own technological skills when compared to friends and family" had lower scores than "the willingness to try new technology" and the two items had poor correlation. Regarding Trust in VR, the scores of the "safety item" were very high, while the scores of the "reliability" and "accuracy" were relatively low. We divided Trust construct in two components: "trust in the safety" of the device itself, and "trust in the reliability". Behavioural motivation was measured using a simplified version of the BIS/BAS scale [15]. Thus, four items, one for each behavioural motivation type (BAS-Reward responsiveness: "When I get something I want, I feel excited and energized." BAS-Drive: "When I want something, I usually go all-out to get it." BAS-Fun seeking: "I'm always willing to try something new if I think it will be fun." BIS: "If I think something unpleasant is going to happen, I usually get pretty ‘worked up’.") were rated on a 4-point scale 1 Very true for me – 4 Very false for me. Previous experience with VR technology was captured by the questions: Have you used VR technology before? What VR technology have you used or currently use? What type of applications have you used, or do you currently use with VR most frequently? For how long time have you used a VR technology? How often have you used, or do you currently use VR technologies?

Data analysis was carried out in SPSS 25. Whenever appropriate, aggregate indicators were constructed using the average over the items. VR equipment was categorized into 4 classes: 0 (the phone without a VR headset), 1 (low-end foldable cardboard or plastic headset), 2 (mid-range headset that provided users with more comfort (e.g., Gear and WAVE), and 3 (high-end headset such as PS4). UX, VR evaluation, and technology acceptance are analysed in relation with headset used, individual characteristics, and VR experience. The relationships between variables were assessed using correlation analysis; Kendall's tau-b was used for ordinal variables (education, age group, device type), and Pearson's correlation coefficient, for variables with interval- and ratio-level of measurements. Both p-values reaching the 0.05 significance threshold and the 0.1 significance are reported (according to [39]).

5. Results

5.1. Participants

Twenty-three participants, 16 men (70%) and 7 women (30%), took part in the study. Their age ranged from under-18 to 49. The minor participated together with his parent, and both took part in the study. Fifty-two percent of participants were between 18 and 29 years old, and thirty percent were between 40 and 49 years old. Education ranged from under high school (17%), to high school (26%), bachelor's degree (35%), and master's degree or above (22%). The sample is characterized by high fun-seeking (*mean*=1.43, *std. dev.*=0.66) and reward-responsiveness (*m*=1.61, *s*=0.66), and lower drive (*m*=2.26, *s*=0.68) and withdrawal behaviour (*m*=2.43, *s*=0.79). Most participants had not used VR before but were interested in this technology (70%). Sixteen participants stayed the whole duration of the event, while six participants left before the concert ended. Duration of the experience was also included as a variable in the data analysis, but no significant effect was observed.

5.2. Correlation Analysis

Correlation analysis indicated various relationships between variables at same or different hierarchical levels in the theoretical model (see Fig. 1). Previous VR experience was negatively correlated with BIS, indicating that generally people with withdrawal tendency have been slower in adopting VR. Participants with tendency of withdrawal behaviour had lower interest in VR (Compatibility) and innovative technologies (Innovativeness). In contrast, people with higher BAS Reward responsiveness (people motivated by the perspective of gaining positive experiences and rewards) had higher Mobile Affinity scores (the mobile technology played a great deal in their life). Education was positively correlated with previous VR experience.

Regarding the relationships between individual characteristics and the intention to use VR in the future, only the education showed correlation; generally, people with higher education were more likely to accept the VR technology. When analysing the intention to participate in future 360-video concerts, age was positively associated with the overall acceptance and its indicators: willingness to pay, recommend to others, and attend future music events. As participation was voluntary, and no incentive was offered besides the concert itself, our understanding is that people were motivated by *content* (music, band, and novelty of the media or communication approach). That is, older people, who might have been more familiar with the band and more impressed by the novel concert-viewing approach were more likely to accept the use case and recommend it to others. This is supported by the in-depth analysis of the UX in relation with the demographics as age correlated positively with UX Fun. Examining closely the UX dimensions, we found that Flow and Fun were positively correlated with Immersion (telepresence), indicating that Immersion is built on both Flow and Fun. However, Flow was not correlated with Fun and thus was not seen as a prerequisite for it as expected according to [14].

The correlation analysis of UX dimensions and VR evaluation showed that Fun and to a lesser extent Flow were positively correlated with Perceived Usefulness and Trust in VR Reliability, respectively. Furthermore, all three UX dimensions (Flow, Fun, and Immersion) were positively correlated with the overall score of acceptance of a VR concert, but when analysing individual items, Flow did not correlate with intention to attend a VR concert in the future. *Thus, just ensuring an optimal flow was not enough for ensuring an optimal acceptance of the use case. The experience should also be fun and immersing, which means that the content should provide positive emotions and be meaningful.*

These observed relationships suggest *two different profiles of the participants*: one with *interest towards the use case* (the VR concert) and another with *interest towards the VR technology*. It was seen that older age groups tended to view UX experience more fun than younger user segments, which could be explained by both the familiarity with the band and the novelty of the entertainment approach (we call this, *content-driven motivation*). Moreover, Fun was positively associated with Perceived Usefulness, which in turn was correlated with intention towards participating in future 360-video concerts but also intention towards using VR. Thus, Fun or the content-driven motivation represents an important mechanism for the people with *interest towards the use case* (participating in 360-video concerts).

On the other hand, participants with considerable mobile technology skills had a low intention to attend a VR concert in the future. These people, when compared to others, perceived VR easier to use and more reliable, but not more useful. We can speculate that these participants were mainly *interested in exploring the technology in use* rather than attending the concert (*technology-driven motivation*). For this group, the VR did not have a similar value in terms of UX as for less experienced individuals; as the VR technology is not mature enough for them to elicit interest and acceptance, they have declined to attend future VR concerts. Thus, while the user group with interest in the concert is assumed to had positive experiences of Fun, the latter, with interest in technology, had not obtained similar level of experience regarding technology evaluation, while fun and enjoyment were not their goal. This user profiling might also explain the results regarding Trust in safety and BI towards 360-video concerts: Trust in Safety was generally high across the sample but was negatively correlated with the intention to participate in future VR concerts. This tells that people who are more sceptical about the safety may be still interested to attend the concerts and pay for them because they are interested in the content and fun of the VR experience, while those who are very confident in the safety, may not be interested from various reasons in attending and paying for VR concerts, so they might belong to the group interested in technology but not in the use case.

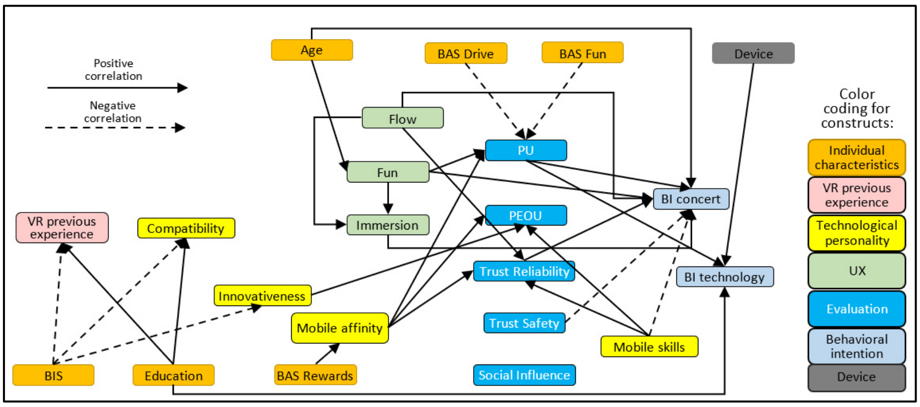

Fig. 1. Results of correlation analysis.

People driven by fun seeking and by reaching goals and achievements have not found the VR useful. In contrast, reward seeking individuals found the VR more trustworthy in terms of reliability than the other groups. Moreover, when the VR experience elicited fun and engrossment, it was also perceived useful. When the 360-video experience elicited flow and engagement, the VR was perceived trustworthy in terms of reliability. Participants utilized devices ranging from high end, mid-range, low end, to no VR. The type of device did not affect the UX nor the intention to participate in future VR concert. However, the device type was correlated with the intention to use VR technology in the future; the more sophisticated the VR device was, the more optimistic the participant was to use the VR technology in the future.

In summary, the UX operationalized as Flow, Fun, and Immersion had crucial influence on the intention to use VR in similar use cases such as attending an entertainment event. However, only Fun had a thin role in the intention to use VR technology in the future, but not Flow or Immersion. There are intricate mechanisms that involve these variables through the mediating effect of Usefulness or the moderating effects of individual characteristics (age, education, behavioural disposition). Fun was positively correlated with Perceived Usefulness, while Flow was positively correlated with Trust in Reliability.

6. Discussion

6.1. Theoretical Framework Revisited

The study shed light on the factors associated with acceptance of VR, utilizing a hierarchical model built on the TAM framework adapted to the VR context. The analysis was performed in a hierarchical manner from demographics, behavioural motivation, VR experience, technological personality to user experience with the VR-mediated 360-concert and VR technology, to evaluation of VR, and finally to acceptance of the use case and VR technology. The results showed intricate dynamics between these variables.

Furthermore, *different user profiles emerged*. To clarify these tangled mechanisms, the theoretical framework is updated based on evidence and conjectures – *the analysis pointed to the need to examine supplementary variables such as primary interest in VR (use case or technology), and content relevance* (see Fig. 2 and Fig. 3). The framework (Fig. 2 and Fig. 3) is discussed next together with its implications for acceptance and innovation research and for design practice.

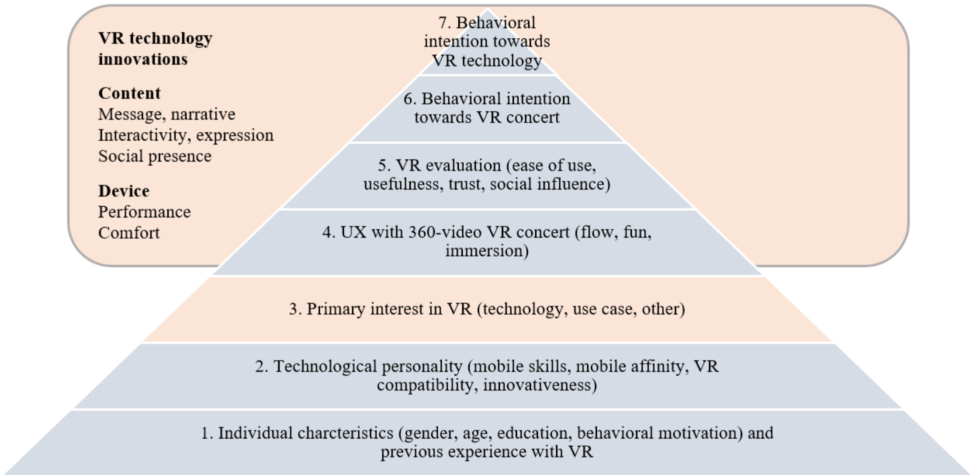

Fig. 2. Proposed theoretical framework (hierarchical model; revised constructs are highlighted).

6.2. Implications for Acceptance and Innovation Research

From a *theoretical perspective*, the results showed that the TAM-based model (VR evaluation in terms of usefulness, ease of use, trust, and social influence) did not fully capture the factors that influence acceptance of the use case and VR technology. Social influence and ease of use were not strongly related to BI to use VR in the future. In contrast, *other dimensions emerged as possible factors affecting the acceptance. The content presentation is one of these dimensions*. This can include message/information/narrative aspects (e.g., connection with the band, music, genre) but also the form of expression and additional interactive features of the VR application to engage the users in following the content (see also [53]). Interactive features when watching a 360-video VR-mediated concert can include changing the viewing angle and giving/seeing feedback and reactions to better *resemble the presence in a real concert*. Interaction with other users could be facilitated through design and evaluated if it can *create shared experience and the sense of social presence*. For future work, content-relevant dimensions should be evaluated as shown in the proposed structural model (Fig. 3).

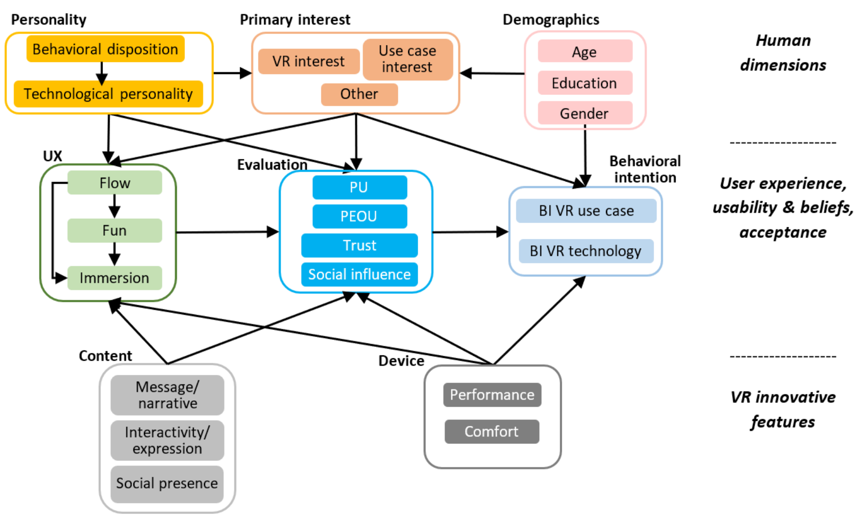

Fig. 3. Proposed theoretical framework (structural model).

We posit that participants had two distinct motivations to participate in the study: *technology-oriented* and *content-oriented*. Naturally, the evaluation would be different for these two. *Future studies should capture the users' primary interest in VR technology and use case*. We included the primary interest as a factor in the proposed framework. Also, the study showed that behavioural disposition (BIS/BAS) can affect the appraisal of and interest in technology. Thus, this variable should be kept and explored further.

Perceived Usefulness was triggered mainly by the experience of fun, but not flow and/or immersion. There are two implications of this result. First, usefulness was operationalized in terms of broad categories, rather than specific benefits. Users may not have been aware of the latent, concrete benefits of VR and did not rate this aspect high. Saving money and/or time, availability anytime/anyplace, remote interaction, sharing experiences could be potential benefits of using VR for this and similar use cases. *For future research, more specific benefits should be identified and measured in line with the use case and VR characteristics* (see also [3]). We posit that the content-oriented users had experienced fun, found the VR useful for their interest, and had higher acceptance of the use case. In contrast, the technology-oriented users, perhaps not novice to the VR technology, had not totally immersed in the concert, and therefore did not find the VR particularly useful in the way it was operationalized (i.e., helping in life, improving life and having good features). Second, Flow and Immersion had lower values than Fun, and thus the expected effects on usefulness and ease of use were not shown. Therefore, it is important for VR researchers to understand the links between 360-video user experience, flow, fun and immersion and usability (ease of use and usefulness). *Quantitative and qualitative user studies are needed to understand users' expectations, skills, interests, and assessments in order to develop optimal products and services.*

The type of device used in the study had a statistically significant association only with the acceptance of VR technology. Given that the HMD and VR exist in a wide range of sophistication, performance and comfort, *the proposed framework includes two main variables, performance and comfort, that potentially have an effect on UX, VR evaluation, and acceptance of technology and use case*. There are still limitations in terms of cybersickness and real-time data transmission and processing [5], [6], [49], [61] that need to be overcome in order that VR becomes a widely adopted and accepted technology.

6.3. Implications for Design Practice

The study indicates that *future VR designs should consider features such as social interactivity, participation, and presence to trigger social influence, theorized to affect intention to use VR*. Features that the users consider useful could be designed (e.g., social interaction could be designed to see/give feedback and emotional reactions, and interaction with the mediated content could be enabled, such as by changing the viewpoint, zooming in/out). *Behavioural characteristics* of users should be considered in the design as well. People with inherent disposition of seeking fun and people driven by reaching goals have not perceived the VR useful. In contrast, for rewards seeking individuals the technical limitations were compensated by the positive VR experience. Generally, participants were positive about recommending and attending the 360-concert in the future but *were more reluctant to pay for it*. This poses a challenge to designers who create VR and 360-video experiences. The design of VR innovation should minimize all interruptions to flow, fun, and immersion to ensure optimal usability and quality of experience (see [46]). Users have individual and personal expectations; to better understand the 360-video experience and user-content interaction, VR designers, developers and content providers need to get in touch and work with the potential customers, the users. The VR technologies and entertainment experiences cannot be developed solely technology-first. In other words, the UX of VR will make or break the VR innovation value proposition.

7. Conclusions

We examined the UX, usability, and acceptance of 360-video VR mediated concert and

VR technology use. Acceptance of the novel 360-video VR communication approach was mainly correlated with perceived usefulness. The perceived usefulness was only correlated with experiencing fun, but not flow and immersion. We proposed a new theoretical framework that includes content-relevant aspects, primary interest of users in the VR and use case, and device performance and comfort. These factors could have a decisive effect on the flow, fun, and immersion, and on the evaluation of usability and acceptance of 360-concerts, other VR use cases, and VR technology.

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