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THE HIERARCHY OF NEEDS FOR USER EXPERIENCES IN VIRTUAL REALITY

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Virtual reality (VR) is rapidly becoming more widely adopted by various industries, and virtual content is just as rapidly becoming available for consumers. However, there is a lack of guidelines and standards for VR content to be held to in terms of experiential design. Because VR is a relatively new media form for consumers, there is a high risk of user attrition due to the novelty of the service. Therefore, if the first experience of the technology is with poorly made content, users will be much less likely to use VR again. Therefore, as various industries and organizations digitalize and adopt emerging technology such as VR, great care should be given to the way the virtual content and experiences are created. This chapter discusses the key experiential elements of users' experiences with immersive journalism (IJ), particularly in the case of a virtual museum application. We present a user study of this application and introduce a model based on the results that details the most crucial user experience components for designing VR content.

Immersive journalism presents a story from a first-person perspective that fosters a connection by allowing users to actually experience the events themselves (de la Peña et al. 2010). Therefore, storytelling is an integral piece to creating an engaging and memorable experience of immersive content. In this research we focus more specifically on cultural journalism, which concerns the arts and creative work, and on individuals and institutions working in the area. In our case study of an omni-directional (360-degree) application, we aimed to tell the story of a piece of art and the artist behind the work. As shown by others, cultural journalism can be greatly enhanced with elements of immersive storytelling, adding new ways to appreciate and connect with the art (Hürst et al. 2016). To create this connection with and foster interest in the content, storytelling elements were used to create an application that explores the work of a Finnish artist with a journey from a museum to a cultural site where the art is featured.

Immersive journalism encapsulates a promise of special experiences beyond the existing. However, knowledge of the user experience of VR and IJ is still evolving, and research has yet to catch up with the needs of content creators and journalists (Shin & Biocca 2017). With the results of our user study, we present a model of user experience components that outlines the elements that affect users' experiences with VR content. The model can be used by practitioners when creating experiences for immersive journalism and by academics to study the experiences. Inspired by Jordan's Hierarchy of User Needs (Jordan 1997) for pleasurable experiences, ours is a hierarchical model for the components of user experience (UX) in immersive journalism. The model incorporates the influence of five UX elements (physical comfort, usability, audiovisual quality, storytelling, and satisfaction), along with the effects of immersion and presence, that build upon each other in the creation of a positive VR experience. The model aims to aid not only immersive journalists, but also VR researchers, designers, and, more widely, content creators in other industries.

Background

As VR becomes a more widely used medium for learning and experiencing, new VR use cases are being explored more and more. Virtual reality can transport users to new worlds and adventures regardless of where they are physically in the real world. This opens new opportunities in many different domains and institutions, as is the case in immersive journalism. Readers can experience news in a more exciting way, immersing themselves in stories that feel more realistic than ever. Immersive journalism presents a chance for a more impactful, empathy-inducing news format. Similarly, virtual cultural experiences offer a possibility to learn and explore the past and present in a deeply engaging way. In normal, everyday life, if a person would like to see an art exhibition, they must leave their home or workplace and travel to the museum or location. In the case of virtual experiences, though, users can view works of art at any time, without the trouble of traveling or interrupting their day. However, the ins and outs of creating these virtual environments can make or break the experience; journalists and other virtual content creators need to understand their users in order to create a positive and memorable experience. Through the art of storytelling, immersive content, and engaging user experience elements, creators can bring their stories to life in an impactful and extraordinary way.

Immersive cultural experiences

VR opens the possibilities for both experts and non-experts to experience art and culture (Bellini et al. 2018). The immersive experience can bring new perspectives to both, allowing museum-goers to see the art in ways that they could not in reality. Furthermore, VR can offer an interactive and more "hands-on" experience for cultural exhibits than would be possible otherwise; most cultural artifacts are displayed behind barriers and cannot be touched or examined too closely. Science museums, for example, provide many opportunities to learn by doing that intrigue, captivate,

and stimulate the minds of visitors (Carrozzino & Bergamasco 2010). VR holds the potential to bring these types of experiences to more traditional museums, allowing visitors to enjoy the art in new ways without endangering the pieces of art themselves.

Virtual exhibitions in museums are not an entirely new concept (Lepouras & Vassilakis 2004; Styliani et al. 2009; Wojciechowski et al. 2004), but with the increasing availability and decreasing cost of VR systems there is currently a need for further investigation of what exactly the technology can provide. Beyond the obvious uses of virtual museums, such as replicating a museum or its items in 3D, lie other less explored opportunities. An interesting use of VR for museums is in supplementing the museum experience and adding new ways to appreciate and connect with the exhibits. This topic was explored in a study by Hürst et al. (Hürst et al. 2016) where Van Gogh's *Starry Night* was expanded from beyond the picture frame and onto surrounding walls in a virtual environment. Participants wearing a head-mounted display (HMD) navigated a virtual museum with three differently designed rooms displaying *Starry Night*, two with artistic effects around the painting, and one with only the painting on a blank wall. The study found that participants enjoyed the rooms with the artistic effects over the blank room. Interestingly, participants expressed that this preference was only for the virtual environment and that, in a real museum, the supplementary effects would distract too much from the actual work of art (ibid.). Participants wanted that extra element in the virtual world to experience something more than what was normally experienced in reality; although a museum setting is familiar, the unfamiliar element of the morphing paintings creates a whole new perspective (Bosworth & Sarah 2019). This point is important for VR designers and content creators in that they should carefully examine whether the experience is unique or if it is too much like everyday life.

User experience

As outlined by Shin and Biocca (2018), knowledge of the user experience of VR and immersive journalism is still evolving, and research has yet to catch up with the needs of content creators and journalists. Although well-known news organizations such as *The New York Times* have been producing increasingly more immersive 360-degree content over the past few years, much of the content is still largely experimental (Sirkkunen et al. 2016). Further, a lack of unified guidelines and models that creators can follow to craft positive experiences for users presents a challenge to those in the field of immersive journalism (Shin & Biocca 2018). Although research on these experiences is growing, there is still a large amount of uncertainty as to what a "good" experience is, what a "bad" experience is, and how this can be generalized across the population of varied users and use cases. The visual quality and realism are constantly evolving; however, the quality of experience and acceptance of the quality are dependent not only on the capturing and viewing technology, but also on other vital aspects such as the content or story, context of

use, and even the quality of the audio (Jumisko-Pyykkö 2011). Immersive journalism could therefore benefit by further understanding the various UX elements of VR, as well as how they apply specifically to immersive journalism and storytelling in VR.

To create a truly immersive and engaging experience, elements of storytelling are vital. Storytelling has been utilized in the entertainment and gaming industries and is an obvious companion for immersive journalism and VR experiences, but it is not yet clear exactly how storytelling affects users' experiences in VR. However, there are promising results that highlight the additional engagement that immersive storytelling brings. Journalism in itself is a form a storytelling, a means for the public to not only receive news but also to feel involved and engrossed in the story and information presented. With immersive journalism, the public can feel that they are actually a part of the story, whether through direct participation or passive observation (Lugrin et al. 2010). This deep sense of involvement is largely due to feeling immersed and present in the story. Although immersion is given many different definitions, it is most widely defined as the sense of being in the virtual environment that is enabled by the technology, hardware, and objective qualities of the VR system (Slater 2003). Presence, on the other hand, is the subjective experience of "being there" that is derived from an individual's perception of immersion (Slater 2003). These qualities of immersive storytelling can transform traditionally extrinsic emotions into more personal, intrinsic feelings (de la Peña et al. 2010).

In addition to storytelling, there are many other elements that influence VR experiences that can be understood from the perspective of the field of UX. The Components of User Experience (CUE) model by Thüring and Mahlke (2007) has proven to be useful in examining virtual experiences (Wienrich et al. 2018; Kelling et al. 2017). The CUE model focuses on how users perceive three areas of UX when interacting with a system: instrumental qualities, non-instrumental qualities, and emotional reactions (Thüring & Mahlke 2007). The user then experiences these characteristics in a unique way and forms a certain emotional reaction, and this combination results in the user's overall experience of the system. From a somewhat different perspective, Hassenzahl (2005) approaches experience with an emphasis on the pragmatic and hedonic characteristics of a product or system. Pragmatic attributes satisfy the utility or usability of a product or system, while hedonic attributes include the functions or elements that produce pleasure or positive psychological stimulation (Hassenzahl 2005). Although the CUE model and Hassenzahl's approach serve as a solid foundation on which user experience can be studied with technology in general, they do not specifically address the experience of immersive technologies such as VR. Somewhat more specifically relevant, Jumisko-Pyykkö (2011) has extensively studied quality of user experience in the case of mobile television, taking into account the content and media as part of the system characteristics, in addition to the characteristics of the user and the context contributing to the experience. Jumisko-Pyykkö's work is closest to ours in terms of theoretical framing of user experience. Our aim here is to add to the knowledge

of what the components of user experience are in immersive cultural journalism in the case of 360-degree videos.

Hugo Simberg VR: a virtual experience of cultural journalism

We created an interactive omnidirectional (360) video prototype as part of a project examining the user experience of immersive technologies and their application in journalistic contexts (Kauhanen et al. 2017). The aim of the application was to utilize aspects of immersive journalism with respect to a piece of cultural heritage. The prototype focused on the work of Finnish artist Hugo Simberg and introduced users to his works and a piece of the story behind them. In the prototype, the user first finds themselves in front of stairs leading up to an exhibition in a room of the Finnish National Gallery's art museum, Ateneum. The user can move around the room in the museum using interactive icons, one of which leads to Simberg's famous painting, *Wounded Angel*. By looking at the painting, the user unlocks access to a different location, a cathedral in Tampere, Finland, where another version of the *Wounded Angel* is painted as a fresco on the wall of the cathedral. The user first stands in front of the fresco and can then explore several spots in the cathedral and return to the museum if they so wish (Kauhanen et al. 2017).

The application was implemented with a Unity-based editing software developed at Tampere University that allows the user to set either omnidirectional videos or images as scenes (Saarinen et al. 2017). Three-dimensional objects and two-dimensional images can be placed in the scene with a gaze interaction functionality, which allows the triggering of audio files, appearance of text, or transition between scenes. The icons leading to the transition were positioned in the direction of another scene, or the position of the next transition. The application's scenes were created with omnidirectional images captured at the museum and cathedral with a Nikon Keymission 360-degree camera (resolution: 7744x3872). The images were edited with Adobe Photoshop to reduce stitching errors. Simple two-dimensional icons were used for moving from spot to spot. Once gazed at, the icons start expanding, and after two seconds the user is transported to the next scene or viewing location. The application was intended for free exploration in any order in the two environments, with audio narration at scenes of Simberg's works.

In a previous evaluation of the initial prototype, several issues with the experience of the application were identified, including issues with navigation, poor image quality, and lack of engagement (Kauhanen et al. 2017). In further iterations of the prototype, these issues were addressed and improved, especially so with the addition of audio and narration (Kelling et al. 2018). The current study further examines the effectiveness of the improvements and also dives deeper into the complexities of the immersive experience in an attempt to provide insight for researchers and content creators to utilize and build upon.

User study

A total of 21 participants (eight male, twelve female, one other) aged between 20 and 57 were recruited via social media and email and given a cinema ticket for their participation. Nine of the participants worked in the information and communication technology sector, eight in journalism/media, and four stated a variety of professions. In self-reporting of their attitude towards technology (Jumisko-Pyykkö & Häkkinen 2008), ten participants were late adopters, five early majority and six late majority. Most of the participants had no experience with VR, or had tried it only once or twice (six and twelve, respectively), while two had used a VR device 3–5 times within the last month, and one had used VR devices 3–5 times a week during the last month.

The study was conducted in a laboratory setting in a small room free from outside disturbances. While using the application, the participants sat on a swiveling chair in the middle of the room and wore over-the-ear headphones for the narration and background music. The devices used included a Samsung Gear VR, which used a Samsung Galaxy S7 smartphone as the main device.

The post-test questionnaire administered after the experience aimed to examine participant reactions to several different aspects of the experience, such as the emotional (Thüring & Mahlke 2007), story presence (Schubert & Regenbrecht 2002), and the virtual environment itself (Witmer & Singer 1998). The post-test interview was semi-structured, consisting of two pre-set questions: "Are you feeling nauseous?" and "What feelings, thoughts, and ideas arose when using the application?" (Jumisko-Pyykkö & Utriainen 2011). The first question was used as an indicator as to whether the participant was able to continue, while the second was aimed as an open-ended interview starter, where further questions were based on the topics brought up by participants.

The testing procedure lasted 30 minutes at maximum. After signing the consent form, the participants were shown how the VR headset and headphones should be worn. The participants were asked to follow the think-aloud protocol while using the application. The application advised participants how to use the application at the start of the experience. After the participants finished using the application, a short open-ended interview was conducted, after which the participants filled in a post-test questionnaire. The participants were then asked if they had any questions regarding the study or the project, and were given a cinema ticket for their participation.

Results

Two types of data were gathered from the study. The first was quantitative and comprised of the answers to the post-test questionnaire. The second was qualitative and comprised of the participant comments during the application usage and the post-test interview.

Post-test questionnaire

The questionnaire had a total of 21 items. The statements and their responses can be seen in Figure 11.1. The responses are shown as percentages of the corresponding five-point Likert scale value (completely agree, somewhat agree, neither disagree nor agree, somewhat disagree, and completely disagree).

All participants agreed to some degree that they are interested in art, reflecting that they would be in the real-case user group for the application. Most participants agreed that the experience was pleasant (86%) and that using the application was easy (91%), and 81% agreed that they would recommend the experience to their friends or loved ones. Moving from one spot to another via the icons was reported as mostly logical (76% agreed), 67% of the participants agreed to some degree that the consequences of their actions resulted as expected, and 62% of the participants agreed that the transition from the museum to the cathedral felt natural. In contrast, the item that was received most negatively was about the image quality: only 19% agreed that the quality was good, while 71% disagreed to some extent.

The answers to the items pertaining to presence (questions 6 and 7) were some-what more divided, with 67% reporting that they felt like they were there in the virtual space and 19% disagreeing. Just under half (47%) felt aware of their outside surroundings while in the virtual experience, 33% did not feel aware, and about 19% neither agreed nor disagreed. Similarly, the feeling of being immersed in the story was also split, with 52% agreeing, 14% neutral, and 33% disagreeing to some extent. When asked where participants would like to use a similar VR application, the items with the largest agreement were, first, in an educational establishment; next, at home; then, at a museum; and lastly, at a public café. Most of the participants agreed that they would like to know more in-depth details about the story (76%) and that they would like to get to know other artists and their work in a similar way (86%). Three-quarters of the participants (76%) agreed that the music was pleasant, and that the narration was interesting. Nearly all the participants (95%) felt that the environments they visited left an impression. Finally, none of the participants reported feeling nauseous during or after use of the application.

Think-aloud comments and post-test interview results

In this section, we present the analysis results based on the comments made by the participants during and after application use. All of the comments were transcribed from the experiment recordings. Each statement was extracted into single comments so that they could be reviewed and grouped, totaling 434 comments. The comments were analyzed in a cyclical manner (Saldaña 2009), which allowed for examination of the data in several iterations. Participant comments were first transcribed, validated, and then coded according to their subject matter. The codes were then sorted into groups so that similar comments were together in one group. The initial transcription and validation was conducted by one researcher and
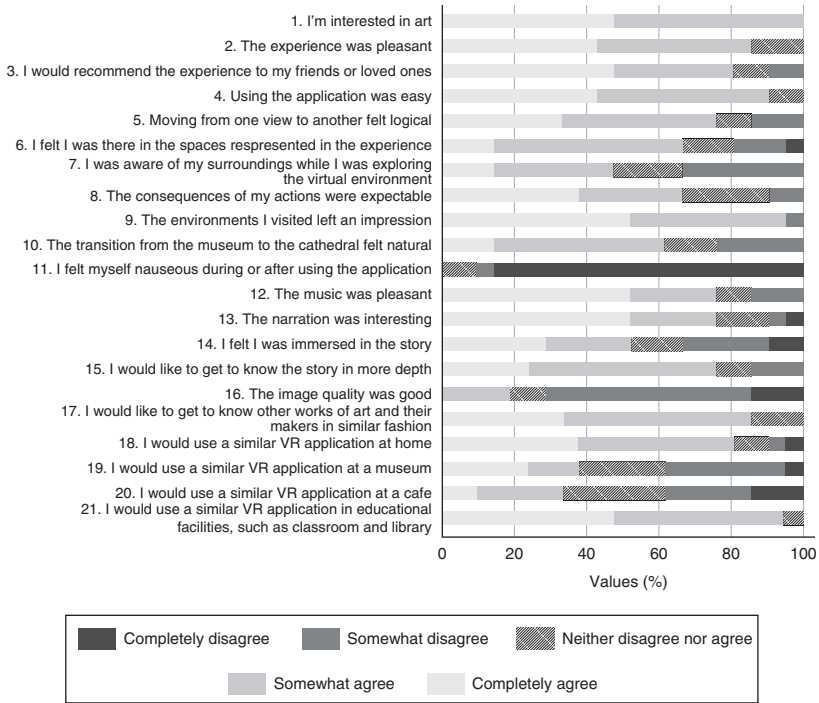
FIGURE 11.1 Post–test questionnaire results.

reviewed by a second researcher, while the coding and grouping was conducted by two researchers in an affinity wall type of setting, then further reviewed by a third researcher to increase accuracy and validity. The results of this process can be seen in Table 11.1. In the table, the main groupings are in bold on the left, subcategories in the middle, and further descriptions on the right. The number of comments is in parenthesis next to the main groupings and subcategories.

As Table 11.1 shows, the majority of the comments made by the participants was about the usability of the application (19 out of 21 participants). While 20/ 75 of these comments stated that the application was generally easy to use, most (55/75) of the category's comments concentrated on low affordability and difficulties activating the icons used to traverse the virtual environments. This somewhat contradicts the results of the questionnaire, where three-quarters of the participants agreed that the movement from one spot to another was logical. Exploration was also commented on by most of the participants (19/21) during or after using the application. The comments from this category were grouped into six subcategories representing different attributes, such as interest towards exploration, "I still have to check this [icon] out" (transl.) and elements the participants wanted to see and learn from textual and visual information in the environment, "[…] I would've wanted to go read those texts, but they were so far you couldn't see them […]" (transl.).

TABLE 11.1 The categories that resulted from the analysis of the post–test interview data. The categories are listed from most frequently mentioned to least frequently mentioned.

USABILITY	(75)	Icon Activation	(38)	Icon responsiveness
Degree of functionality and interactivity of application elements		Ease of Use	(20)	*Level of ease perceived by participants*
		Icon Affordances	(17)	*Ability to recognize & understand icons*
EXPLORATION	**(56)**	Interest in Exploration	(23)	*Desire to look around further*
Desire to explore and facilitation of exploration		Interest in Textual Information	(7)	*Wishing to read more about artworks*
		Ease of Virtual Visit	(7)	*Facilitation of virtual tours*
		Free Exploration	(6)	*Independence in examining the VE*
		Desire to Learn More	(8)	*Minting to obtain addition or re-hear information*
		Lack of Fine Details	(5)	*Minting to see closer details of artworks*
VISUAL QUALITY	**(53)**	Visual Execution	(15)	*Technical aspects of 36D photography*
Level of acceptance of visual elements		Image Accuracy	(10)	*Lack of Visual Precision*
		Expectation of Graphical Representation	(10)	*Visual quality of artwork did not meet expectations*
		Image Quality	(9)	*Elements of general image quality*
		Resolution	(9)	*Pixilation and blurriness*
STORYTELLING	**(43)**	Interest in Narration	(17)	*Degree to which narration appealed to participants*
Influence of story and narration on overall experience		Supplementing the Museum Atmosphere	(15)	*Impact of narration on museum atmosphere*
		Unclear Topic	(11)	*Inability to discern narration subject*
AUDIO	**(37)**	Narrator and Music Imbalance	(14)	*Inability to hear narrator over music*
Significance of music and narrator on virtual experience		Impact of Music	(14)	*Effect of music on general atmosphere*
		Voice of Narrator	(9)	*Inability to hear narrator over music*

TABLE 11.1 (Cont.)

PHYSICAL COMFORT	**(37)**	Body Disassociation	(14)	*Adverse reactions to lack of body in the VE*
Bodily response to virtual environment and device		Nausea	(10)	*Feelings of nausea*
		Nausea Susceptibility	(7)	*Reflections on sensitivity to VR-induced arousal*
		Vertigo	(4)	*Reactions to perceived height in the VE*
		Physical Symptoms	(2)	*Discomfort caused by head-mounted display*
ENJOYABILITY	**(36)**	Pleasantness	(12)	*Feeling pleasant, comfortable or easy*
Emotional valence and degree of interest towards the experience		Fun	(7)	*Having fun in the experience*
		Cool	(6)	*Feeling amazed and intrigued*
		Impressive	(6)	*Feeling impressed*
		Interesting	(5)	*Showing general interest*
IMMERSION	**(26)**	Realism	(17)	*Extent to which the experience felt realistic*
Loss of reality and degree of absorption in the VE		Detachment from Real World	(6)	*Loss of presence in reality*
		Captivation	(3)	*Becoming engrossed in the VE*
MOVING IN VR	**(22)**	Transition	(16)	*Attitudes towards transitions within the environments*
Movement within and between an environment		Transition Between Environments	(6)	*Attitudes towards transitions between environments*
CONFUSION	**(18)**	Disorientation	(14)	*Loss of sense of location in the VE*
Feeling disoriented and uncertain		Uncertainty	(4)	*Obscure purpose and questioning of expected actions*
PRESENCE	**(16)**			
The extent of presence in the VE		Feeling Present	(16)	*The sense of "being there"*
RECOGNITION & RECOLLECTION	**(15)**	Familiarity	(11)	*Relating virtual environments/ elements to their real counterparts*
Reactions based on personal memories and knowledge		Similarity to Guided Tours	(4)	*Associating experience with real-world museum behaviors*

Visual quality received mentions from 18/21 of the participants. These comments were concentrated on how the participants perceived the experience and the issues with it, such as remarks on visual flaws, insufficient image accuracy, and blurriness. The storytelling elements received comments from 16/21 of the participants. The comments were grouped into three subcategories: *Interest in Narration, Supplementing the Museum Atmosphere*, and *Unclear Topic*. The second subcategory discusses how the narration felt suitable in the museum atmosphere and how in turn that affected the experience positively, such as, "It made me feel that I wasn't in a hurry anywhere" (transl.). Participants also made comments on the narration being unclear, as the narration started automatically when entering a scene with narration, without warning.

The category of Audio received comments from 12/21 participants that concentrated on the quality of the audio, including the voice of the narrator and the background music, and how the music affected the experience. One participant mentioned that the background music in the cathedral, "Was very peaceful and surely an effective way to escape the mundane" (transl.). Finally, 17/21 participants made comments regarding their Physical Comfort during and after using the application. A combined total of 18 comments by eight participants noted feelings of vertigo or body disassociation, such as, "It's strange since I can't see my arm" (transl.).

Although the previous study (Kauhanen et al. 2017) and the current study are not directly comparable because of differences in the questionnaires, there appear to be many improvements with the addition of the storytelling elements and other added features. In the previous study, 58/288 (20%) comments described feeling disoriented while in the virtual environment. Comments from the current study related to disorientation and confusion amounted to only 18/434, or 4% of the total comments, resulting in a clear decrease in disorientation. Similarly, comments related to immersion also increased from 1/288 (0.3%) to 26/434 (6%), suggesting that participants in this study were somewhat more engrossed in the viewing experience.

Discussion and conclusions

The results of this study revealed numerous experiential elements that arose from stepping inside the virtual application. Upon a more holistic analysis of both the questionnaire and interview data, we found that there were many facets of the experience that could not come to fruition unless other specific aspects had already been fulfilled. Jordan (1997) introduced a model called the Hierarchy of User Needs, where functionality was placed at the bottom of the pyramid, followed by usability, and pleasure resting at the top. This model is often referred to when showing the hierarchy for the experience-related aspects. The base needs should be met before the next level of needs in the pyramid can be met. Functionality and usability are sometimes therefore referred to as "hygiene" factors in this model. Therefore, the data from our study made sense from a bottom–up approach: to be able to enjoy the more hedonic aspects of the experience, the more practical aspects must be satisfied first. Thus, we present a model for the Hierarchy of User Experience Components in Immersive Journalism, shown in Figure 11.2.
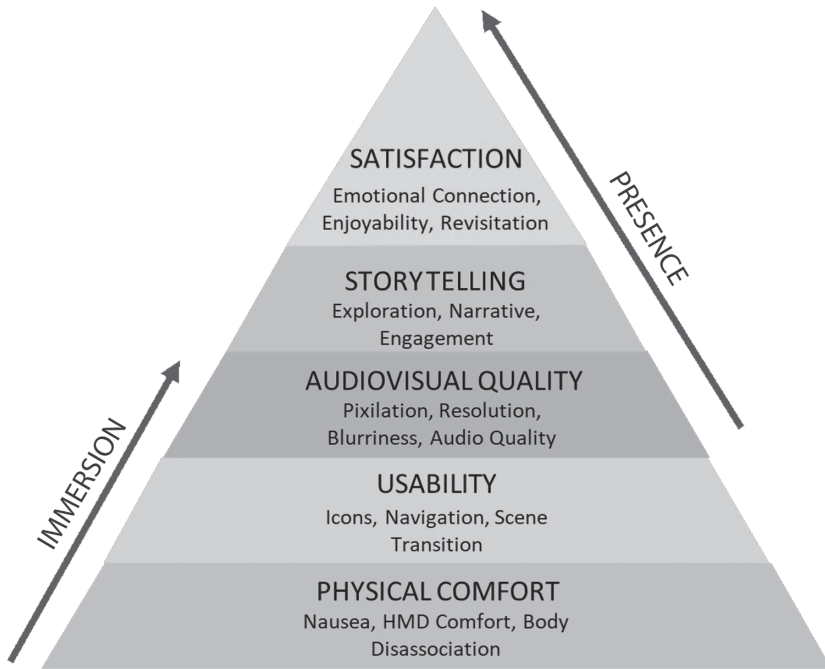
FIGURE 11.2 Hierarchy of User Experience Components in Immersive Journalism.

At the base of our model are the basic physical characteristics of the technology that can affect the VR experience. If motion sickness results from use or if the headset itself is uncomfortable, the user will be distracted from all other elements of the experience. In the next tier, the elements pertaining to usability can be found, such as issues with navigation or spatial understanding and the quality of the audio and images. Pixilation of the viewing content can be highly distracting and cause annoyance, and is therefore on one of the bottom tiers of the model. These are the basic elements that need to be of high quality for the user to be able to focus on other aspects of the experience. Storytelling sits next in the pyramid, and includes the core elements that will connect the viewer with the content, encouraging exploration and fostering engagement. As explained, storytelling is an integral piece of journalistic VR and, if the basic experiential components are first fulfilled, the story is what will grip viewers and pull them deeper into the experience and on to the top tier of the model: Satisfaction. For a user to be fully satisfied with an immersive experience, they will have most likely connected emotionally with the content and story and will be more motivated to try a similar VR experience. They will feel fulfilled and content after the experience, likely to form positive memories related to it. In addition to the elements within the pyramid, our model also integrates the influence of immersion and presence. Related to the more practical qualities of the experience, immersion increases as the bottom tiers are fulfilled. Similarly, presence increases as the more subjective needs are met in the higher tiers.

Based on previous research in the field and our own experimental observations, the Hierarchy of User Experience Components in Immersive Journalism offers journalists, researchers, and designers a basis on which to create positive VR experiences. It is also possible that these results could be applied to VR content in other fields and industries, at least when it comes to building memorable experiences and engaging UX. The novelty of VR will not last forever, and content creators can no longer rely on rollercoaster gimmicks or 360-degree content too blurry to even recognize. Users are looking for well-crafted adventures and immersive experiences that pull them away from the binds of day-to-day life. We hope our model introduces the most important experiential elements of VR that will allow journalists and other content creators to impact each viewer in a memorable way, aiding in the next level of VR creation and experiences. Future work should build upon the current model to better understand the specific elements within the tiers and discover further elements that might be missing, such as the effect of the context of use and possible differences between individual preferences and current creation standards.

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