# Virtual Reality Enhanced Roller Coasters and the Future of Entertainment – Audience Expectations

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# Virtual Reality Enhanced Roller Coasters and the Future of Entertainment – Audience Expectations

Roller coasters are often acknowledged as the icons of amusement and leisure with their towering structures forming an integral part of any theme or amusement parks' prestigious ride infrastructure. As with any infrastructure roller coasters come at a high cost, but inevitably also become outdated. By leveraging the power of Virtual Reality (VR) technology, there is an opportunity to integrate innovative, creative and captivating new VR experience overlays with existing roller coasters, thereby generating new interest in older ride infrastructure. While VR additions to roller coasters are still a fairly recent introduction (as of 2015), the adoption rate is high. Despite this observation, very little research has been conducted pertaining to the VR enhanced roller coaster experience – and even less so from an end user's perspective. This is a shortcoming in current research literature which merits further investigation. As a result, in this research, we examine existing literature (pertaining to the core elements of best-practice VR experiences) and original data gathered from VR roller coaster thrill seekers (pertaining to their likes, dislikes and expectations of current VR enhanced roller coaster experiences). Based on our findings we present a model, Burt's VR Entertainment Primer, which identifies six categories (Description of VR Experience, Rules of Entertainment, Queuing & Headset On/Off Boarding, Audio/Video Experience, Hardware Experience, General Findings) with supporting elements that should be taken into account in order to develop a successful VR enhanced roller coaster experience overlay. Due to the generic, user-centric nature of the model, it may possibly also extend itself to the VR amusement and entertainment industries within a broader context, thereby supporting the innovative application and assessment of VR in entertainment overall.

**Introduction**

With smartphone usage proliferating on a global scale, Virtual Reality (VR) is becoming more accessible to a wider audience through the convenience of their own smartphones. As a result, numerous opportunities exist for products and brands to engage consumers in novel ways. Virtual exploration of a hotel and its amenities, browsing products in a grocery store, previewing a seat upgrade for a particular flight, as well as taking a virtual ride on a roller coaster before it is built, are but a subset of examples that have already leveraged the power of the simulated experience as introduced by VR (Louw, 2017).

In the case of roller coasters in particular, however, the VR experience does not only have to be limited to a simulated experience. By combining the best of both physical and virtual worlds, a variety of experiences may be delivered ranging from a static VR experience in an armchair, to a simulator-driven VR roller coaster, and finally, a full blown roller coaster overlaid with a VR experience.

Roller coasters are known as the "signature attraction" of a theme park and are also one of the easiest ways to promote a park (Burt, 2016). Roller coasters have been acknowledged as the icons of leisure and amusement since their early days of inception (Neil, 1981) and more recently, have shown that they are still capable of drawing in tremendous crowds (Cornelis, 2010). While the introduction of the newest, best, tallest, longest, fastest etc. roller coaster may be seen as a new challenge for thrill seekers, the introduction of these structures comes at a great cost for theme and amusement parks (collectively referred to as 'parks' for the remainder of this article).

Roller coasters thus form not only a very costly, but also a very important component of a parks' appeal by enhancing its overarching theme, increasing its thrill levels, highlighting its ride innovation and diversity, while also contributing to the

quality of its overall ride infrastructure – aspects most certainly worth flaunting, promoting, properly maintaining and ensuring the longevity of.  As with any infrastructure, however, roller coasters do inevitably become outdated.  By leveraging the power of VR technology, parks have the opportunity to introduce a new digital experience overlay to their existing roller coaster infrastructure, thereby breathing new life into old favourites (Louw, 2018).

A VR enhanced roller coaster has the potential to alter an existing (potentially nostalgic) experience, with a digital overlay, creating a new ride experience for lower expenditure, extending the lifetime of costly infrastructure. On a VR enhanced coaster, users put headsets on which have screens, and often audio, that allow the rider to feel the same g-forces, dips, turns and accelerations of the roller coaster, but are able to see, and sometimes hear, a completely different experience. Thus the riders' body registers the drops and turns and movements in the virtual or digital experience as "real" due to the fact that they are actually experiencing these forces. The added benefit of the digital experience is that it can go further than simple mimicry of the physical experience–it can trick users into thinking drops, launches, twists and turns are in fact more extreme than they are in actuality.

Roller coaster VR experiences may, for example, simulate an underwater journey or travelling through space, and are carefully designed and synchronised to the roller coaster's movements to complement, enhance, and increase the intensity of the roller coaster ride. However, a VR overlay to an existing experience is not without challenges and limitations. Due to a familiarity with existing rides and specific types of ride, riders have existing expectations, increasing the desire that the VR experience improve the ride rather than just augment it.  This does raise one very important

question which has not been successfully answered – what do VR roller coaster audiences expect from these experiences?

This is our main research question and is also a question that all theme and amusement parks should be asking as research conducted by Louw & Louw (2018) indicated that while VR additions to roller coasters are still a fairly recent introduction (as of 2015), the adoption rate is high.  Moreover, VR is seen as a complementary asset to the roller coaster industry which may imply that it will soon become the norm to enjoy a new VR experience overlay on an old roller coaster favourite.

Despite this observation, very little research has been conducted pertaining to the VR enhanced roller coaster experience – and even less so from an end user's perspective.  This is a shortcoming in existing literature and merits further investigation as VR content sales are projected to becoming the strongest segment pertaining to revenue generation in the future (Statista, 2017).  Furthermore, the introduction of innovative new products and guest experiences, such as VR enhanced roller coasters, have also been found to be a major contributor to the continuous growth of the global theme and amusement park industry (Milman, 2010).

In this research, we subsequently address this shortcoming by presenting a model that is formulated from thrill seekers' feedback pertaining to their likes, dislikes and expectations of current VR enhanced roller coaster experiences.  A model is required to combine the exiting literature with original data. A new model was formulated for the simple fact that there was no comparable existing model available. The developed model applies point-in-time, as in a developing field, previous theories and concepts cannot be reliably applied. The model has incorporated existing literature regarding VR and entertainment broadly, when applicable. The aim of the research is to ascertain, via interviews with participants, the elements required to deliver the ideal VR

experience. These elements are used to inform a visual model–Burt's VR Entertainment Primer–which is designed to be an "at-a-glance" handout for the entertainment industry. Burt's primer is intended to be a resource for further development in the industry, and research in this emerging field.

This research is significant because it is the first time a descriptive, customer-centered model depicting key elements required for a best-practice VR amusement experience has been formulated. The model may subsequently be used by amusement professionals when exploring the possibility of providing a VR experience overlay or assessing an existing VR experience overlay for the icons of leisure – roller coasters.

We begin our discussion with a brief literature review focusing on elements of user experience, entertainment and immersive entertainment, followed by a better understanding of the traditional roller coaster's product lifecycle and how this may be impacted by the introduction of a VR experience overlay.

**Literature review**

There are many levels on which entertainment experiences operate, and these stem from the variances in the cultural background of the viewer, the intention of the experience, the "complexity of the human being's inner life and motivational structure" (Klimmt, 2011, p. 35) and even the weather, or what may have happened to the participant earlier in the day. Entertainment does not always reflect a "happy" or "sad" experience but can often trigger mixed emotions. This happens "particularly when entertainment content displays comprehensive models of the true complexity of life" What seems clear though, is that it provides a distraction from everyday life when we desire to shut out reality:

…Entertainment through media is a form of playing, i.e., a form of coping with reality… It is an intrinsically motivated action, that usually leads to a temporary change in perceived reality and that is repeated quite often by people who are, during this process, less intellectually vivid and attentive than they could be. (Vorderer, 2001, pp. 256, 257)

Audiences engage with entertainment experiences for differing reasons, and with differing expectations. The research for this project involved the analysis of user experience in entertainment, so it is useful to examine some perspectives from the literature around the term *entertainment.* Entertainment is defined in consumer terms as "*any market offering whose main purpose is to offer* pleasure *to consumers, versus offering primarily functional utility*" (Hennig-Thurau, 2019, p. 41). It has been described as "a public performance or exhibition intended to interest or amuse", (Gabler, 1998, p. 18) and also simply as "audience-centred commercial culture" (McKee et al., 2012, p. 284) in the book *Entertainment industries: Entertainment as a cultural system*. "Audience–centred" simply means the focus is on the audience: they are at the centre. This notion of audience-centredness was critical to this research project, as it sought to understand a very specific kind of entertainment experience from the perspective of the audience. It may seem obvious that the perceptions and opinions of the paying audience–who drive the entertainment economy–should be valuable, but they are not always sought out.

As this project was focused ultimately on entertainment *experiences,* it is useful to consider in more depth the views of Hennig-Thurau and Houston, from their influential book *Entertainment Science* (2018). They reveal how entertainment experiences–they refer to them as *products*–are, by their hedonic nature, different to regular, or more

utilitarian experiences. (Hennig-Thurau, 2019, p. 63). Regular experiences are in service of achieving some sort of goal, but in entertainment/hedonic experiences, the goal "is the consumption of the product itself". In this way, the entertainment experience directly produces pleasure (p.64), and thus audiences participate, or re-participate, in entertainment experiences based solely on the ability for these experiences to provide pleasure.

Entertainment itself is big business. Americans invest 160 billion hours per year of their time on different forms of entertainment, and in 2013 this equated to "11.4 hours of every day consuming entertainment and media products, an increase of 86% compared to usage rates from 1970." (Hennig-Thurau, 2019, p. 48)   Theme parks, which commodify entertainment, are also big business. According to the *Themed Entertainment Association*, in 2017 there were 476 million visits to the top ten global theme parks, up 8.6% from the previous year, (Benton, 2018, p. 67) and attendance in the burgeoning Chinese theme park market was up by twenty per cent. (p.66) The industry is large enough to have its own international trade association in the *International Association of Amusement Parks and Attractions* (IAAPA). In the IAAPA *2018 Global Theme and Amusement Park Outlook 2018-2022* report, virtual reality is reported as "gaining traction with increased deployments", and that it "drives park attendance".

IAAPA also underscores the popularity of VR entertainment experiences by pointing to installations in Denmark (VR rollercoaster), the United Kingdom (VR rollercoaster), Ohio USA (VR rollercoaster), Williamsburg USA (VR motion simulator), Japan (VR rollercoaster), France (VR simulator), Canada (VR arcade), South Korea (VR / cinema attraction), as well as full VR indoors parks in South Korea, China and Japan. (Wilofsky

Gruen Associates Inc, 2018, p. 10) Deloitte Insights have determined the global VR market was worth ~$3.7 billion in 2016, and is forecast to reach ~$13 billion by 2019. (Deloitte Insights, 2018, p. 4)

Audiences clearly want what theme parks are providing, and there is constant pressure from the public for parks to debut new and exciting entertainment experiences, hence the resurgence of VR in theme park entertainment. As discussed previously, entertainment provides escapism, and immersive entertainment in VR is primarily fun, story-driven and designed to make people think they are in a completely different space–the very definition of escapism. However, despite the industry being both highly profitable and heavily invested in securing the "next big thing" that will draw audiences in and riding a wave of public interest in VR entertainment attractions, there is still a lack of understanding as to what those audiences want from VR entertainment attractions. This research project provides a way to gain this understanding, and at the same time contribute to academic understanding of audience-centred commercial culture.

Immersive entertainment is term often used to describe a subcategory of entertainment specific to the VR experience. It is defined as entertainment in an environment designed to "draw the player into a digitally created world that also offers an experience unlike anything available by other means." (Williams, 2016, p. 79) It is a broad description, though the "drawing into another world" element may be the most useful for this project. If we step around the "digital" in the above description, we can argue that this form of entertainment has been with us since cave dwellers interacted by telling stories around campfires. It is thought that the predecessor to today's digital entertainment was in fact the playing of games in ancient times. (Miller, 2008, p.4) VR experiences are often linked, or compared to games.

This project had an audience, or user focus, so it is critical to discuss user experience. User experience is a term often used in computing and gaming, and was elegantly described in the early days of digital game development as "simply trying to play the game–and trying to understand why it was not fun in the end" and that "small changes in game play or story heavily influenced the overall user experience of the game" (Bernhaupt, 2010, p. 3), but it is also broad enough to incorporate virtual reality–which itself is often compared to a gaming experience–and the experience of users interacting with entertainment rides and attractions. A more detailed definition of user experience is that "it is the process of enhancing user satisfaction with a product by improving the usability, accessibility, and pleasure provided in the interaction with the product. Everything humans interact with has an experience associated with it." (Becker, 2017)

In the mid 1990s, the definition of user experience was extended to more broadly examine the range of experiences it could cover, and there was a "… move in human-computer interaction studies from standard usability concerns towards a wider set of problems to do with fun, enjoyment, aesthetics and the experience of use" (Blythe et al. 2003). This meant that the scope of UX broadened from simple usability to "whether it is aesthetically pleasing, engaging and so forth." (Turner, 2017, p. 1) User experience has also been "evaluated using a variety of concepts including immersion, fun, presence, involvement, engagement, flow." (Bernhaupt, 2010, p. 4) The concepts of immersion and flow are particularly fundamental to virtual reality and will be discussed later in this article. So, user experience is ultimately a broad enough term to address ways of thinking about digital products in general, and "any definition should not only recognise that they are a source of fun, aesthetics and so forth but should also reflect the complexity of human psychology and the context of use too." (Turner, 2017, p. 10)

Defining user experience in entertainment, however, is not as simple due to the way entertainment experiences are evaluated: "evaluating entertainment technology is challenging because success isn't defined in terms of productivity and performance, but in terms of enjoyment and interaction." (Mandryk et al., 2006, p. 141) This may seem vague but it makes sense when we are reminded that "Entertainment and art products, such as games, fashion, and films are designed to elicit emotional states, like pleasure, in people." (Saariluoma et al., 2014, p. 303) Hennig-Thurau (2019) underlines the increased intensity of the consumer entertainment experience by deeming it a risk that experience creators must address: "…the consumer's decision whether to spend time and money on an entertainment product carries a serious amount of risk for him or her. To overcome such risk, entertainment producers must develop powerful strategies to lower consumers' uncertainty perceptions." (p.97)

When user experience has not been prioritised in the design of entertainment experiences, it results in "negative emotional contents of different types, whereas good usability generates positive feelings…poor usability has essential emotional costs, and this explains why people are often poorly motivated in using technologies with poor usability or that are difficult to learn." (Saariluoma & Jokinen, 2014, p. 315). Consumer responses to technology, with both good and poor usability are reflected in the data obtained from experience audiences in this research project. What is clear is "The evaluation of user experience with entertainment technology is ripe for advancement." (Mandryk et al., 2006, p. 157) User experience is clearly critical in both entertainment and VR, as noted in the following key finding in a recent AR and VR industry report: "Respondents identified the user experience as the top obstacle for mass adoption of both VR (41%) and AR (39%), reflecting ongoing concerns with technical limitations and performance issues, as well as bulky hardware in the case of VR." (Perkins Coie, 2018, p. 3)

Applying a user experience lens to virtual reality and entertainment experiences is a good fit because we do not use digital products–like virtual reality–in isolated states. "User experience arises both from our direct use of digital products, from its anticipated or imagined use and from vicarious use (e.g., by watching other people use their technology). These experiences are also coloured by internal dispositions (of all kinds) and by the environment (including the product itself)." (Turner, 2017, p. 15)

**Flow and user experience**

Flow, as discussed by Csikszentmihalyi (1990, p.315), was used in the data collection for this project. The sense of being in "flow"—which describes a state of full immersion in an activity such as dancing, rock climbing and playing video games—is perhaps a useful outcome of a satisfying VR experience. Flow is described as "a mental state of operation where a person is fully and completely immersed in an activity. People in a flow state report feelings of energised focus, full involvement, losing track of time and a high level of enjoyment and fulfillment." (Fitz-Walter, 2015, p. 129) Csikszentmihalyi, who fathered the term, (1999) describes in his book *"Flow—The Psychology of Optimal Experience"* that flow to achieve a state of flow requires structure: goals, feedback, challenges, and that oddly, a flow state may be more easily accessed while undertaking work-related activities as opposed to during leisure experiences, which are often unstructured. He went so far as to say "passive entertainment leads no-where". (Csikszentmihalyi, 1990, p. 162)  Additionally, if the problem presented in a challenge is too hard, or too easy, flow may not occur—it helps if the challenge presented matches the skill level of the participant. (Fitz-Walter, 2015, p. 130) It is possible that once all other factors required to create an optimal VR entertainment experience are in place, a flow

state might be seen as the ideal outcome, and thus the ultimate sign that the experience was a success. Flow can be measured, and thus can be defined and utilized in data collection. "Flow" can be used as a way to measure an experience, and was used in formulating the topics of questions for users of the experience, and how these questions were posed.

**Traditional Roller Coaster Experience**

In both a historical and modern day sense, the lust for diversity in the roller coaster industry has created an environment where a wide variety of roller coasters can flourish, often within close proximity of one another (Timmermans et al., 2012).  This may include a broad scope of not only styles and finishes such as wooden and steel roller coasters, but also a broad scope of models such as floorless, inverted, hyper, giga, drop, launched and family roller coasters.  Naturally, with such diverse product offerings comes an equally diverse pool of manufacturers originating from various locations all over the world.

Regardless of the type, style, manufacturer or origin of a particular roller coaster, however, the international product lifecycle is equally applicable to the final product.  This is visually illustrated in Figure 1.

Figure 1.  International Product Lifecycle (Vernon, 1979).

From Figure 1 we can see that as a product's time on the market passes, sales may initially increase after its introduction and continue to do so over the growth phase. During the maturity phase, a sales plateau is reached and an inevitable decline can be

expected. This process is also applicable to roller coasters with the introduction of a new roller coaster drawing the attention of many new and/or return visitors, gradually increasing over the growth phase. The visitor peak is reached during the maturity phase and eventually, once the novelty of the particular roller coaster wears off, visitor numbers inevitably decline.

As previously mentioned, an econometric study conducted by Cornelis (2010) indicated that the introduction of new attractions (including rebranding of old attractions) had a positive long-term influence on park visitor attendance, some lasting for a period of up to 2 years. This is equally applicable to roller coasters and implies that the time from a roller coaster's introduction (as seen in Figure 1) to reaching its maturity (as seen in Figure 1) could last approximately 2 years. After this, the decline phase (seen in Figure 1) follows.

While the decline phase is inevitable for any product, in the case of parks and the leisure industry overall, the constant need for the introduction of innovative new products to attract new interest becomes evident. The introduction of a VR experience overlay to an existing roller coaster may provide just that – an opportunity to restart an existing roller coaster's product lifecycle because a VR enhanced roller coaster can be rebranded and marketed as an entirely new product. The VR experience overlay may therefore result in an increase in visitor numbers to the particular roller coaster, which also means an increase in both direct and indirect sales for parks. Moreover, an increase in visitor numbers above a certain base level could also mean more employment, which in turn will have a multiplier effect for the region around the park from which most employees are drawn (Cornelis, 2010).

By monitoring visitor attendance, whether to individual attractions or overall, parks may possibly identify the ideal time to introduce VR to an existing roller coaster

in an attempt to increase visitation after a certain decline.  This may be achieved at a fraction of the cost compared to a complete teardown and introduction of a new attraction for instance (Louw, 2017).  VR thus holds the potential of not only providing an enhanced experience for thrill seekers, but also breathing new life into a traditional roller coaster's product lifecycle by re-introduction as a VR enhanced roller coaster.

Before making the decision to add a VR experience overlay to a roller coaster, however, it is important to explore what exactly end users expect from this experience – a shortcoming in existing research literature that we now aim to address.

**Burt's VR Entertainment Primer**

As previously mentioned, regardless of exactly when during a roller coaster's product lifecycle a VR experience overlay is introduced, numerous aspects need to be taken into account to successfully deliver such a product enhancement.

In order to provide guidance in this endeavour and to ensure that the reader may follow along for the remainder of this research, Figure 2 presents a model, Burt's VR Entertainment Primer, that may subsequently be used by amusement professionals when exploring the possibility of providing a VR experience overlay or assessing an existing VR experience overlay.

Figure 2.  Burt's VR Entertainment Primer.

There are three layers of the model:

1.      Innermost layer: Core elements that may be regarded as the critical components of a VR entertainment experience;

2.      Middle layer: What existing literature indicates to be important in a VR entertainment experience; and

3.      Outer layer: Original data compiled from what consumers indicate to be important in a VR entertainment experience (and primary focus for the rest of this research).

By focusing on gathering information that forms part of the outermost layer of the model first, a user-centered, bottom-up approach to model formulation is employed.  As previously mentioned, this aims to address the shortcoming in existing research literature by approaching the research question from the perspective of the end user. We now delve into the details of the chosen research methodology employed in this endeavour.

**Method**

The user-centred methodology at the heart of this research was grounded in phenomenology or the study of  "experience as experienced from the subjective or first person point of view" (D. W. Smith, 2016),  and consisted of asking a fixed set of questions of multiple consumers as they exited VR entertainment experiences across the world. These experiences were primarily VR roller coasters. The questions are available in Appendix 1–Questions asked of VR Entertainment Experience Audiences. Additionally, three expert interviews were conducted with leaders in VR and entertainment from Hong Kong and the USA. These experts were asked to reflect on the Primer and offer any thoughts from their experiences, or suggestions.

The interviews were recorded using a handheld Zoom H5 audio recorder. The interviews were transcribed directly into a Google Docs document and this resulted in

136 pages of transcribed interviews. In an effort to condense the information, the researcher then manually selected answers that were coherent and useful. Negative and positive responses were treated equally because "A balance of positive and negative items is generally recommended to reduce response-set bias" (Willits et al., 2016). The transcripts were coded against segments of the above model and additional comments that were deemed significant. The summarising was required in order to make the remaining data more manageable and relevant, because "Given that one hour-long interview may generate a 20-page transcript, interview projects may generate hundreds of pages of data. An analyst's task is to reduce and interpret the data in order to present findings in articles, books, and dissertations that are limited in size." (Roulston, 2014)

The first round of analysis focused on meaningful comments, resulting in an edited collection of responses that was used to create word clouds, and then analysed using Atlas.ti and Leximancer. The next step was to begin employing inductive analysis in order to look for patterns. The first machine-assisted analysis of the data consisted of using the "Word Cruncher" function in Atlas.ti, which simply counts how often words appear in your selected text. It was found that the words "experience" and "story" occurred at a higher rate (they were the 163rd and 116th most used words, respectively) than "reality", "virtual" and "headsets" (75th, 72nd and 71st, respectively). This could suggest experience and story are more important from a customer perspective than the technology used to deliver them. Corruption of data via bias was avoided by using the term experience interchangeably with ride, results and prevalence of above words, still occurred at the same frequency in interview with alternate phrasing. Questions asked, although specific were intentionally broad enough that participants would not feel prompted into particular answers. The primer was

formulated based on literature review combined with gathered data, to avoid an interview bias.

**Results**

Interview participants provided data that was used to develop the primer. Data obtained from participants was varied, but when combined with literature review, assisted formulation of the primer.

Although technology utilised was largely the same, responses at the time of data collection were more favourable regarding older rides. Respondents commented that the VR revitalised rides that had lost popularity, with the VR feature being a core component for why the respondent selected that ride. Several riders did comment that their enjoyment of the ride, and expectations heading in had been coloured by previous experiences with VR on phones and other devices. Responses from participants that had previous experience indicated that this had impacted both their understanding of the technology, and enjoyment of the ride. No participant listed the specific technology utilised as core motivator for selecting the ride. Participants who made broad references to technology included comparisons to previous experience. No respondents advised they were dissatisfied with the amount of technical information provided.

Comments in response to questions regarding headset usage were largely negative, with more participants providing extended responses to these questions than those relating to story, or experience overall. Questions regarding headsets also elicited the largest number of concerned responses, with fears that headsets would come off during the experience. Participants who complained about the fit of the headset consistently commented that it detracted from the ride experience. Some riders did express improvements in headset fit since previous rides, with headsets being upgraded

on rides that had been through multiple VR iterations. Additional concerns raised regarding headsets were general hygiene, with headsets being reused.

Rides that sufficiently immersed participants, were reviewed more favourably than rides where immersion was not achieved. As immersion was not utilised in questions to prevent bias, the experience was described by several participants as "going to another place". Riders commenting on a desire for a more immersive experience listed both story and external sound as impactors. Although subject to limitations of ride duration, as listed above, participants most frequent negative comment was that rides required more story to improve the experience. When rides did not provide sufficient background for the story, or sufficient in experience development, participants commented on feeling less immersed. Similarly, external sound grounded many participants in reality, preventing immersion. Although a less frequent complaint, some participants advised their immersion was limited due to poor viewability (blurred screen, offset images, miscalibration). Comments regarding immersion potentially impacted subsequent responses, with participants advising that lines could be used to develop the story better, to aide immersion. Additional comments regarding queues were that they were too long, and poorly managed, detracting from the overall experience. Connecting to complaints over poor queue management were desire for a more efficient experience, with particular reference to faster onboarding on the ride, and the ability to take multiple payment methods to access the experience.

However, in order to conduct the final round of analysis for the research, the initial summaries, related elements from the literature review of the project were regrouped thematically in the primer–under the three domains this research is situated in (user experience, virtual reality and entertainment), and then further assessed for overarching themes and repetition. Basis for the themative grouping is provided below.

Comments indicated that what the public wants from entertainment is "escapism"–they want to be removed from their environment. They do not want too much information about their entertainment experience, as "too much information can hamper pleasure" (Hennig-Thurau, 2019) and they want the experience to be "vulgar" or "populist" or simply appealing to the masses.

Combining these elements with the critical need of escapism is perfectly suited to VR, and its ability to create immersion, which has multiple definitions, but we can be reminded by one from the literature review of this project: "the subjective experience of being in one place or environment, even when one is physically situated in another." (Witmer et al., 1998)  The ideal immersion "should offer enough stimuli that real-world sounds and stimulation is ignored", so that the senses of the participant are "tied to the alternate (entertainment) world; the "real world" is screened out and consumers make decisions that only make sense in the context of the imaginary world." (Hennig-Thurau, 2019) Current virtual reality experiences have higher framerates, greater resolution, better sound, and lower latency than previous iterations, which means we are at a point in time where VR is ideally suited to create immersion.

When a VR entertainment experience reaches the desired point of immersion, consumers react positively, and interview data from the field trips in this research confirms it. Consumers said: "I was looking around everywhere and there were no like missing spots or anything, everything was full" which suggests that the VR experience had a wide field of view and low latency. Consumers also accurately reflected the literature which suggested that well-produced VR goes beyond mere illusion and includes "… a psychologically and ontologically disconcerting quality. To many, virtual space spontaneously appeared as something "spiritual" and that "reality itself can no

longer be seen as a stable platform…because VR has an impact on the perception of consciousness and the body." (Botz-Bornstein, 2015)

Comments from consumers supporting this notion included: "It's thrilling, the animation is just so cool like looking around, like being somewhere, you know this whole world, take you to another place, it's so cool", "Like…it takes you to a whole new world", "I hop on here and I put on the headset and suddenly I'm in you know an old kingdom and I'm placed in the past", "I didn't even know that I was here until you hear the noise coming into the station…it was amazing", and "When we came back into the station, I didn't feel like I was even at Cedar Point, like when I took the goggles off, I was like, wow!". These consumers are not just recounting an experience–they are telling us they were taken to another world, via full immersion in a VR experience. This makes clear that immersion is one of the key requirements in making ideal VR entertainment experiences.

Many theme parks promote their VR experiences technology-first, seeming to imply users are more interested in technology over story, yet this does not seem to be reflected in the data. The literature suggests that game developers–remember that games are often compared to VR entertainment experiences–are benefitting specifically from pursuing rich storytelling: "The surging emphasis of rich storytelling in games is a key reason why story-driven titles are earning big" and "creators as large developers are budgeting more resources into their game narratives to create more diverse and immersive stories…." (Sanders, 2018).

This is also clearly reflected in consumer comments: "I think it's just like, not much story there, there's a lot of extras, like flashbacks or something", "I just think its flying around and stuff, I don't think there's a story, if there is, I don't know what it is", "I think it's a fun experience, but um, obviously what most people have been saying is

like the story and stuff, it needs a background" and: "The theming to me kind of lacks a little…I don't understand the backstory as well and when I get off I have a few questions". Finally, and most critically, this participant makes a comment which suggests story is not just essential, but the fact that their experience lacked story caused them to ask questions and potentially sacrificed their immersion in the experience: "…my mind wouldn't have been thinking about those questions, and I'd probably be more engrossed in the experience".

One description of user experience reflects on the fact that "small changes in game play or story heavily influenced the overall user experience of the game" (Bernhaupt, 2010) and that "Poor usability has essential emotional costs, and this explains why people are often poorly motivated in using technologies with poor usability or that are difficult to learn." (Saariluoma et al., 2014). This means that positive usability, or good user experience in VR is critical for consumers, and essential in crafting the ideal VR experience. However, there is a sense that consumers are able to overlook small issues in VR experiences–perhaps the headset was uncomfortable, perhaps the queue was poorly managed, perhaps there was no sound or no story–the data suggests this is not the case. It's useful to be reminded that primal psychology is at work when in the field of human-technology interaction (Saariluoma et al., 2014) so when presented with a series of negative issues, the entire VR experience is negatively impacted.

Consumers detail a sampling of small issues that impacted their overall experience here: "I think because the lens is so close to your eyes, a lot of people's eyes, eyelashes can touch them and one time when I rode it, I actually had to take it off, because it was a little bit greasy, so that kind of was a bummer", "It's [the VR headset] a bit loose, at the back, so I'm trying to hold onto it", "It [the view inside the headset] looks pretty good, but it's a bit blurry", "It wasn't maybe as clear as you see in

movies…it definitely had the video game effect to it", and in reference to a lack of sound in the experience; "Yes, we heard people outside… from people talking outside, and that was a bit disturbing for the experience".  One of the expert interviewees reminds us that no matter where the issues lie, creating ideal VR entertainment experiences that consumers will react positively to are "not something that can be fixed by a single company, it's the whole industry."

**Discussion and Conclusion**

Regardless of a particular roller coaster's type, style, location or manufacturer, these icons of leisure are introduced by parks after deciding to make a major financial investment in their own ride infrastructure.  Initially, the introduction of a new roller coaster may draw many visitors to the park, resulting in increased direct and indirect sales, but inevitably, visitor numbers decline as the novelty wears off.  During the decline phase, parks may be faced with the decision to decommission and dismantle older roller coasters in order to attract new attention with the introduction of new attractions.  With the introduction of a VR overlay experience, however, a roller coaster's product lifecycle may be renewed, thereby prolonging the roller coaster's lifespan and generating new interest.  This digital experience overlay may further prove to cost less than a complete teardown and rebuild would.

With VR enhanced roller coaster experiences becoming more widely accepted and arguably also anticipated, producing a VR overlay experience to complement a roller coaster experience becomes of cardinal importance.  Initial research pertaining to what end users are expecting from VR roller coaster experiences reveal the complexities of user experience, entertainment products and new immersive technologies. The research suggests there is great potential for the VR roller coaster form in the future, but

a successful end result requires many elements to work together, including headsets, queueing, hygiene, story, promotion and more.

By combining both user feedback and literature studies pertaining to VR entertainment, Burt's VR Entertainment Primer is subsequently formulated to guide amusement professionals when exploring the possibility of providing a VR experience overlay, or assessing an existing VR experience overlay.  Due to the generic, user-centric nature of the model, it may possibly also extend itself to be applied to, and be utilised by, the VR amusement and entertainment industry within a broader context.

The six categories (Description of VR Experience, Rules of Entertainment, Queuing & Headset On/Off Boarding, Audio/Video Experience, Hardware Experience, General Findings) with supporting elements presented in Burt's VR Entertainment Primer are extracted from both a literature and from a variety of end users' perspectives, thereby successfully addressing our research question.

Overall, this research provides new insights into the value-add of VR in roller coasters as a form of innovation in the leisure field.  Moreover, Burt's VR Entertainment Primer serves as a point of departure in establishing some of the core components that need to be taken into consideration when providing a VR experience overlay for roller coasters, or even evaluating an existing VR overlay, from a very important perspective – that of the ultimate thrill seeker.

**Disclosure Statement**

No potential conflict of interest was reported by the authors.

**Appendix 1 – Questions asked of VR Entertainment Experience Audiences**

The questions consisted of:

- What is your experience with virtual reality? Designed to show participant familiarity with VR, not specific to any segment of Burt's VR Entertainment Primer model

- How would you rate this ride/experience from 1-10, with ten being the best? Designed to frame the rest of the participant's responses, not segment specific

- Did you lose track of time during the ride/experience? Flow-state question designed to test if participants entered a potential flow state. Derived from "Transformation of time", Scale 8, Dimensions of flow experience (Jackson & Marsh, 1996)

- Were you thinking of anything else during the ride/experience? Flow-state question designed to test if participants entered a potential flow state. Derived from "Transformation of time", Scale 8, Dimensions of flow experience (Jackson & Marsh, 1996)

- Why did you choose this ride/experience? Informs "Advance description of ride" segment

- Did this ride/experience match the way it was promoted? Informs "Advance description of ride" segment

- Did you think the ride/experience told a good story? Informs "Rules of entertainment" segment

- How did the experience look and sound to you? Informs "Audio/video experience" segment

- What was your experience with the headsets or hardware? Informs "Queuing & headset on/offboarding", "Hardware experience" segments

- What were your thoughts on the queue? Informs "Queuing & headset on/offboarding" segment

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