StoryFutures

StoryFutures /ACADEMY/
National Centre for Immersive Storytelling

Audience Insight Report

The story of immersive users

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Creative Clusters

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Foreword

Recently, while scrolling Instagram, an account I follow (and actually someone I do know IRL) posted this quote:

“I’ve come up with a set of rules that describe our reactions to technologies:

1. **Anything that is in the world when you’re born is normal and ordinary and is just a natural part of the way the world works.**
2. **Anything that’s invented between when you’re fifteen and thirty-five is new and exciting and revolutionary and you can probably get a career in it.**
3. **Anything invented after you’re thirty-five is against the natural order of things.”**

— Douglas Adams, The Salmon of Doubt

It’s really stayed with me as I think Douglas Adams has perfectly summed up the BFI’s growing relationship with immersive technologies.

At the BFI we often get asked why immersive is interesting to us, why are we so keen to get involved in its development? And why don’t we just make loads more 90 minute feature films on celluloid and projected only on celluloid in physical cinemas for the rest of time? I might be paraphrasing a bit.

To some, our involvement with immersive technologies feels against the natural order of things - after all, we famously know what we’re doing in the film industry all the time. Beyond the ever available response of “why not?”, at the BFI we also have a clear responsibility to continue to help storytellers realise their ambition on the right moving image canvas - be it a short animation, a 90min feature, an 8 hour documentary or an interactive VR film.

We also have an absolute and committed responsibility to ensure audiences have access to the broadest range of stories across a variety of platforms.

As this Audience Insight report from StoryFutures shows, the evidence is mounting that immersive is no longer a new medium, but increasingly an established one of genuine scale and with the clear opportunity to move beyond just the early adopter to being part of everyone’s daily lives.

With that, we’re seeing audience behaviours that offer massive potential for storytellers to engage much more deeply with their audiences and genuinely impact them in real time. This is powerful stuff that will only see more and more talented storytellers and creatives be drawn to immersive to realise their vision in the most dynamic way.

Because of our partnership with StoryFutures and the strength of their leadership, we’re all continuing to learn and understand the potential of this medium, which is daunting. But this research has given us the confidence to find ever new ways to collaborate and reimagine what we can do, including our recently announced successful bid to be part of Festival UK* 2022.

This will see screen heritage from the BFI National Film & TV archive reimagined through immersive technologies and showcased to audiences all across the UK. Our partnership with StoryFutures and their research has allowed us at the BFI to think bigger, and differently, creatively. It’s incredibly exciting for us to be a part of this, so we can inspire, develop, fund and showcase more immersive works to audiences.

Thanks to research like this, soon Immersive won’t feel against the natural order of things at all and we can all start to worry about what comes next.

Ben Luxford
Head of UK Audiences
British Film Institute

Introduction

Our focus in this report is on the users of immersive technologies. The report is based on a range of studies that span the Extended Reality (XR) gamut, including Augmented Reality (AR) apps on phones and large screens, Mixed Reality (MR) headset experiences and a long range study of Virtual Reality (VR) headset users.

This report aims to help further understanding of what the value of immersive storytelling is to users and the creative industries alike. We look at value in economic, social, emotional, reputational and cultural terms.

Whilst the jury is still out on these questions, there are some early indicators of where such value might be found that can inform creative and cultural industries practice:

Economic

AR is at a point of mass adoption, but with both AR and VR the technology is often perceived to have a large degree of friction that is a barrier to more extensive use. Developing experiences that are cognisant of these frictions will be crucial for future growth.

Social

Whilst the most common use of AR is inherently social - in the form of AR filters on social media platforms - VR turns out not to be as isolating and individualist experience as it is commonly believed to be. Users want to experience VR in a social way, as it often becomes a form of family entertainment, experienced multi-generationally.

Emotional

If part of the question of the economic value of immersive storytelling is its lack of user reach, there is early evidence to suggest its value may lie in the depth of its user engagement. Immersive storytelling can impact users emotionally in ways that can lead to at least short term behaviour or cognitive changes.

Reputational

Our case studies indicate that experimentations with immersive storytelling provide brands and makers with a positive impact on their brand and increase user engagement.

Cultural

Immersive storytelling, especially VR, offers users new ways of seeing - not only of seeing other worlds, but seeing their own world through others' eyes. In so doing the potential is for opening up a space where users can not only see, but experience, difference. At its most profound, immersive storytelling can enable new cultural understandings of difference to emerge that provide for another order of things, another kind of politics.

But who are the users for immersive storytelling experiences - audiences or users? Whilst that is perhaps not the question, it is one that may trouble many readers throughout the report. We have opted to use both terms throughout the report because the position of the viewer oscillates depending on the experience and because the term 'user' or 'audience' shouldn't be a binary choice: we perceive it much more as a continuum, on which individuals and different experiences are positioned differently at different times.

Our choice to use both terms reflects our interdisciplinary methods and background: from an Arts and Humanities point of view, 'audiences' have long been shown to be active participants in story worlds from the early days of radio and TV soap operas onwards, whilst 'users' helpfully connotes the more direct feedback mechanism involved in some VR and AR experiences. From a Psychology perspective, the notion of 'users' helps us think about the way the brain is always shaping the experience itself in an interactive dynamic between all our senses, whilst being an 'audience member' reflects a more communal position that inflects the experience.

As Digital Catapult's *The Audience of the Future Immersive Audience Journey Report* (Jarvinan, 2020) highlighted, there is no singular 'immersive user' and the users we studied are as varied as the experiences themselves. The users who we studied at Limina's immersive cinema events at Watershed in Bristol may be very different from the early VR adopters; and yet, our data tends to show that although they may not have the same motivations, there are many similar elements in their experiences.

Indeed, building on Digital Catapult's work, we propose a framework for both understanding and creating for immersive users that thinks about users' experiences as sitting at the intersection of four key factors: space, time, genre and device.

This toolkit places the user at the heart of the experience attempting to understand how these factors offer both creative constraints and affordances for engaging audiences and understanding their responses [see our Audience Toolkit, concluding the report].

The UK's creative industries are one of the jewels in the UK's economic and cultural life. Immersive storytelling offers an opportunity for growing the value of this sector in both economic and cultural terms but it is also an area that has, like the rest of the creative industries, been severely impacted by the Covid-19 pandemic. From the closure of venues that have represented a key distribution pathway through to lockdown and social distancing measures preventing or adversely impacting production, this has been a challenging time for the sector.

Audiences have, in turn, been starved of some of the magical possibilities that can be realised when great storytelling meets new technologies. As we look with optimism to the re-opening of creative, culture and economic life in the UK, immersive experiences may offer audiences the 'value add' of attending events, exhibitions, venues and rediscovering our public and entertainment spaces. A significant investment has been made in the immersive sector by commercial and public sector sources via programmes like Audiences of The Future, Creative Clusters, and programmes like Augmentor and Creative XR run by Digital Catapult. As we re-open, now is the time for this fecund groundwork to yield further economic growth and cultural value.

If the opportunity of the immersive experience economy is to be realised, understanding users' motivations, behaviours, experiences, habits and what they value about immersive storytelling is crucial. We hope this report will be useful to makers, funders, policy makers, researchers and users alike in developing this exciting landscape.

James Bennett
Director of StoryFutures &
Co-Director of StoryFutures Academy

May 2021

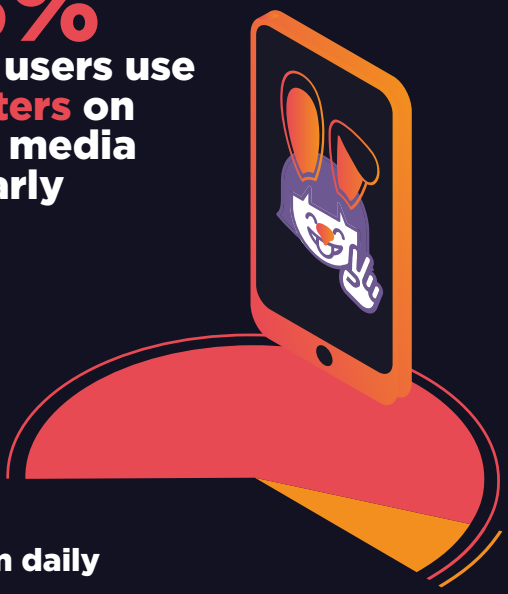
Table of Contents

Infographics

1

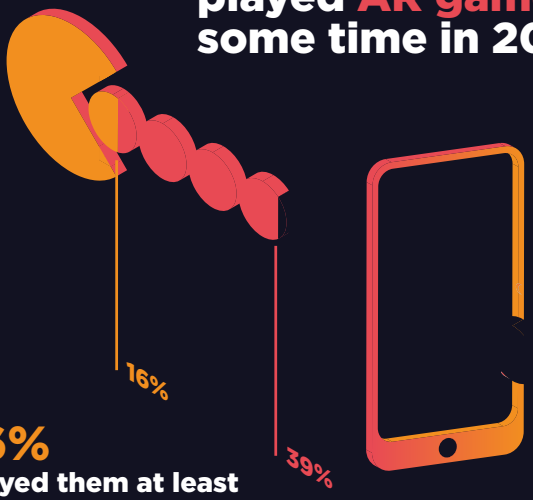
AR is at a point of mass adoption

63%
of UK users use AR filters on social media regularly



7%
use them daily

39%
played AR games at some time in 2020



16%
played them at least once per month

2

Immersive IS social, even when it's designed for a single user

Users found ways to make it social even when it was designed as a single person experience

Women are the most social users

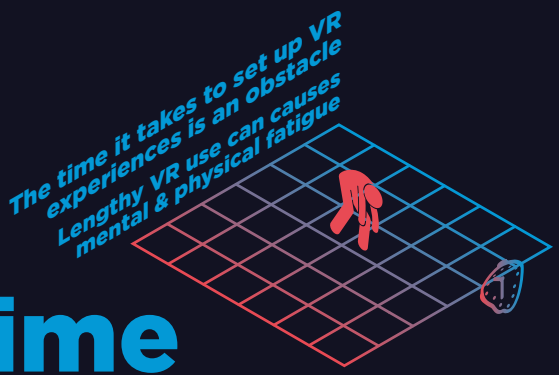
79%
of women indicated their use of immersive takes place with others

3

Barriers to VR growth

15%
of users identified the lack of physical space as a key barrier

72%
of users found VR experiences inconsistent at fostering social interactions remotely



time
is a key barrier to VR use

73%
of VR users are young, white men

4

VR Users value alternative perspectives and worlds

VR widens, and can even shift, perspectives on the world as well as opening up new worlds entirely

5

Immersion starts long before the technology

A lack of attention to the **transition of the user** in and out of virtuality results in

- physical or psychological detriment
- poor levels of enjoyment
- disengagement
- fatigue

6

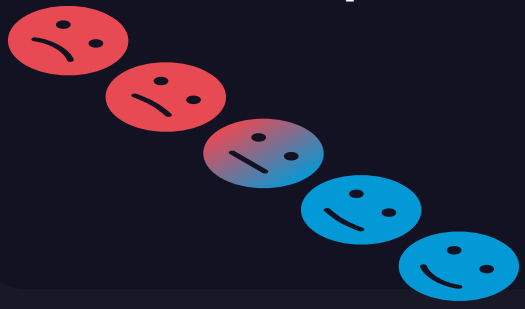
Presence is the prize

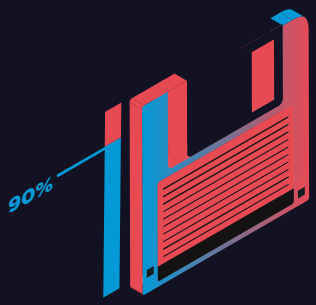
Users' sense of **presence** in an XR experience correlates with their **overall enjoyment** of the experience

7

Immersive storytelling is an emotion toolkit

Immersive storytelling offers the opportunity to tap into **strong emotional responses** that can impact user behaviours powerfully





90%
successful at evoking an emotion of nostalgia in one AR experience

130%
increase in recycling of coffee cups in an AR storytelling experience

11%
of visitors experienced a feeling of religious devotion called Kama Muta in one VR experience

8

Games dominate VR tastes but lag behind in AR

VR users' preferences gravitated towards games, comprising

50%

of all experiences reported

20%

of frequent AR users played Pokemon GO every month

compared to **38.5%** using Instagram filters monthly

9

Virtual Tours and the pandemic

51%

of our UK immersive sample reported taking virtual tours

Highlights

1

AR is at a point of mass adoption

We are at a tipping point in AR becoming widely adopted. The crucial moment when any new media technology moves from spectacle to a commonplace, routine part of people's lives is significant.

63% of UK users use AR filters on social media platforms regularly, with 7% using them daily.

39% had used AR games at some time in 2020, with 16% playing at least once per month.

2

Immersive IS social: even when it's designed for a single user

Over 50% of our participants used VR when in a social setting, with friends, family or flatmates.

Most **importantly, users found ways to make it social even when it was designed as a single person experience.**

Women are the most social users, with 79% of participants indicating that use of immersive takes place with other people, either in the same physical space or online. 62% of men report similar behaviours.

There is a need for the industry to showcase how immersive experiences are social. Platforms, commissioners and developers would be wise to invest in the development of creative experiences that facilitate group engagement whilst headset penetration remains low and likely limited to single units per household.

3

Barriers to VR growth: Social, Spatial and Temporal Frictions

Headset sales have shown significant growth in 2020-21, with Ofcom reporting one in seventeen households now owning a headset, up from one in 20 in 2018 (Eccles, 2021). However, ownership is predominantly confined to an 'early adopter' group that mirrors demographics of other new technologies, skewing male, white and young.

Our long-range study found that after an initial flurry of activity, VR headset use by home users tails off significantly (see also Fiennes, 2019; Green et al., 2020).

So what stops users from spending more time in VR?

The barriers to adopting VR into end users' cultural consumption patterns are many and varied, with respondents listing 46 barriers to spending more time in VR. These barriers can be understood as frictions that span social, spatial and temporal dimensions that link to more widely understood concerns regarding cybersickness and physical fatigue induced by the weight of headsets.

Social: The biggest social friction was the **perceived isolation of VR.** 46% of VR survey users reported frustration at VR experiences generally being very inconsistent or poor in providing the ability to foster interactions with other people remotely. 72% indicated this same level of dissatisfaction concerning the ability to interact with others in real life while inside the headset.

Spatial: 15% of headset users identified insufficient space as a key barrier to adoption. Our long-term study of youth VR user habits shed light on the practical difficulties of this, where issues ranged from feeling overwhelmed by the sheer volume of practical steps needed to be undertaken to clear space for VR experiences through to concerns about safety and an inability to fully experience presence in the virtual world because of the practical confines of domestic spaces.

Time: Not only does VR have to compete with other forms of media entertainment for users' time, users paradoxically complained of VR requiring an investment in time to set up that worked against the desire to keep VR experiences relatively short to avoid feelings of physical and physiological fatigue.

4

VR users value alternative perspectives and worlds

Our studies tend to show that **VR widens, and can even shift, perspectives on the world as well as opening up new worlds entirely.** Users 'co-produce' immersive experiences, giving meaning to them through their focus of attention, interaction and imagination.

The rewards for users here are multiple, from understanding a different point of view to escaping the real world with potential mental health and wellbeing benefits. Immersive stories can also create a space where a new kind of politics can form by enabling users to experience a differently-composed world, within which they feel emotionally, viscerally and physically present. And that's an exciting opportunity for any creative or user to explore.

5

Immersion starts long before the technology

Those working at Location Based Experiences (LBEs) know that getting users into the right frame of mind for an immersive experience is crucial to success. This 'on-boarding', however, was a crucial part of the immersion process even in our study of home-users.

Immersion begins well before picking up a piece of technology and continues after the technological experience ends. Users encounter a significant number of frictions in the transition from the real world to the virtual and back again: on-boarding and off-boarding helps mitigate and navigate these frictions. The technology in use is not neutral: rather, immersive experiences are an encounter between a technology and an individual characterised by an unlimited range of perspectives and personal histories.

A lack of attention to the transition of the user in and out of virtuality results in poor levels of enjoyment, disengagement, fatigue and potentially physical or psychological detriment. Planning on- and off-boarding into budgets, workflows, training and distribution plans is a crucial investment needed industry-wide.

6

Presence is the prize

[A cross case-study finding]

Presence can be thought of as a measure of the success with which the user is drawn into the virtual world - it describes the sense that audiences have of 'being there' in the virtual world and how 'real' that virtual world appears, as well as the extent to which users are 'captivated' by the immersive experience.

We and others have consistently found that the **user's sense of presence in an XR experience correlates with their overall enjoyment of the experience.** A combined analysis across four major StoryFutures XR experiences found that people who felt a stronger sense of presence in the experience were also more likely to rate it highly and want to repeat it.

7

Immersive storytelling is an emotion toolkit

Milk (2015) and others (e.g. de la Peña et al., 2010; Jones and Dawkins, 2018) have proposed that 'empathy' is a key emotional resonance of immersive storytelling. We suggest that the emotional range of immersive storytelling is much more flexible and wide-ranging, with compelling immersive experiences engaging the user at a combination of cognitive, emotional and behavioural levels.

This presents the potential to target, reward and measure specific short-term emotional responses. Whilst **immersive storytelling** may not have the reach of mainstream and linear media, like film, television and games, it **offers the opportunity to tap into strong emotional responses that can impact user behaviours powerfully.** Our case studies demonstrate the potential in a variety of cognitive, emotional and behavioural contexts:

- An AR experience aimed at evoking an **emotion of nostalgia was 90%** successful in triggering this response, with such users 30% more likely to engage in media consumption activities related to the immersive experience [see Retro Hunter case study].
- High levels of user enjoyment and the 'stress-free' feeling of an AR storytelling experience led to **a 130% increase in recycling** of coffee cups at Heathrow Airport [see Cupsy case study].
- 20% of users **changed their response** to a question concerning the **right to violent protest** after a VR experience about a Black character breaking out of a cell [see Violence case study]
- Extremely targeted emotional connections are possible: 11% of visitors experienced a feeling of religious devotion called **Kama Muta** in the National Gallery's *Virtual Veronese* [see National Gallery case study], whilst our AI-Spy case study shows how even making an experience feel **'creepy'** can be a significant predictor of enjoyment.

8

Games dominate VR tastes but lag behind in AR

It may come as no surprise that games dominate VR, given their persistent popularity at the top of sales charts on Steam, the Oculus Store and review sites like Upload VR and Road to VR. Our studies reveal two key findings about games and immersive technologies:

- Games dominate on VR, even with users introduced to a much wider breadth of immersive experiences. Our long-range study of 26 youth users found that across both men and women, their own preferences gravitated massively towards games, comprising 50% of all experiences reported across educational, film, music, social, app and games.
- In contrast, a survey of frequent AR users revealed that the most common AR usage was Instagram filters, with 38.5% of users reporting regular monthly usage, compared to just 20% of the most common AR game: Pokémon GO.

9

Virtual Tours and the pandemic

In the last year, **51% of our UK immersive sample reported taking virtual tours** (e.g. virtual galleries, heritage sites or city tours). Whilst people have stayed at home physically, virtually they have been travelling the world. With international travel likely to remain complicated in the year ahead, virtual tours that offer innovative access to users could be big business for locations starved of physical visitors.

About

This report was conducted by staff at StoryFutures and StoryFutures Academy.

StoryFutures is led by **Royal Holloway, University of London** and is part of the Arts and Humanities Research Council's unprecedented Creative Industries Clusters Programme. StoryFutures undertakes challenge-based research with partners in London and the 'Gateway Cluster' to deliver game-changing R&D projects that realise the potential of immersive technologies through innovation in story form and content.

StoryFutures Academy is the UK's **National Centre for Immersive Storytelling** led by the **National Film and Television School** and **Royal Holloway, University of London**. It delivers creative training and research programmes in immersive storytelling to ensure the UK creative workforce is the most skilled in the world in the use of VR, AR and MR.

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Thanks to Olivia Hinkin, Kristina Glushkova, Jura McKay, Will Saunders, Christine Singer; Catherine Allen, Freya Campbell and the entire Limina Team; our long range study research assistants: William Hertzell, Tom Holmes, Eirini Nikopoulou, Jodie Pearton, Leela Saengprathum; and all participants in our studies.

Methodology

We are an interdisciplinary team, comprised of researchers from the fields of psychology, media studies, anthropology, marketing and cultural theory. Our methods range from real world research-led experiments with creative industries partners to interpretative critical investigations and ethnographies.

This report is based on a mixture of methods and data sets developed through StoryFutures and StoryFutures Academy research:

Immersive histories survey: 271 users completed a qualitative questionnaire distributed to users involved in our long range and Limina studies and at immersive events we attended. This identified the types of immersive experiences in which respondents had engaged and the social, physical and temporal dimensions of their experiences, in line with our audience toolkit

3 snapshot surveys collectively comprising over 1,000 users:

Immersive Snapshot Survey: We surveyed 992 UK respondents in January 2021 via the Prolific online participant recruitment platform, referred to throughout as our 'UK Immersive Sample'. This sample was roughly in line with the ethnic make-up of the UK's population, according to the 2011 census, with 86% of respondents from White ethnic groups, 7% from Asian ethnic groups, and 4% from Black ethnic groups. Our sample skewed slightly female, with 56% of participants identifying as female, and somewhat younger than the overall UK population, with respondents reporting a median age of 35 compared to a UK median of 40. Our sample was educated to a higher level than the UK population average and also reported higher levels of parental income when growing up.

Heavy AR Users Snapshot Survey: The top 20% heaviest AR users identified from the Immersive Snapshot Survey were asked to complete an additional survey aimed at understanding their AR usage in more detail. 195 people completed this survey.

VR Headset Owners Snapshot Survey: 249 VR headset owners were surveyed about their VR usage in December 2020, recruited via the Prolific platform using their 'headset ownership' filter.

A long range study of 26 young adults aged 18-24, 10 female and 16 male, enrolled at Royal Holloway, University of London were recruited from 87 students who completed the immersive histories survey. They attended focus groups and received headsets for personal home use for a period of 12-14 weeks. These young adults completed regular media logs, reflexive journals and individual semi-structured exit interviews of 45-120 minutes' duration.* None of the participants had extensive experience engaging with VR prior to the study.

Limina Immersive Cinema Study: Focus groups with a total of 15 audience members were conducted in Bristol, in collaboration with Limina Immersive, in June 2019. The Immersive histories survey was completed by 88 attendees.

* The final group, whose headset study took place during the first nation-wide Coronavirus lockdown, was also asked to complete a log of all their media consumption for one week prior to receiving the headset, and another one-week log of all media consumption, including the VR headset, after they received it.

6 mixed methods case studies: StoryFutures and StoryFutures Academy immersive experiences were commissioned and made with creative industries partners ranging from individual artists to multinational media conglomerates. In these cases, we were able to include detailed user testing as a central strand of each project, allowing us to gain an in-depth understanding of users' responses to each particular experience.

Research for these experiences drew particularly on our interdisciplinary team, combining humanities and psychology user insight to carry out quantitative data collection through bespoke and previously validated survey instruments accompanied by qualitative data, including open-ended questions within surveys and brief interviews with participants immediately after the experience of interest, as well as observation work based on ethnographic methods that enabled us to watch for certain behaviours or reactions of individuals and groups during the immersive experiences.

Our selection of many of the questionnaire items used in these studies was informed by a recent immersive industry toolkit (Nesta & i2 Media Research, 2018). A different research approach was taken for each StoryFutures experience, depending on the aims and research interests of each specific project. However, some survey items were kept constant across all projects, allowing us to compare these outcomes directly between different experiences, as well as building up large combined datasets. These common items include measures of: enjoyment, presence, cognitive engagement, emotions, behavioural engagement (e.g. repeatability and willingness to pay), and possible negative effects (e.g. feeling uncomfortable or experiencing technical difficulties.

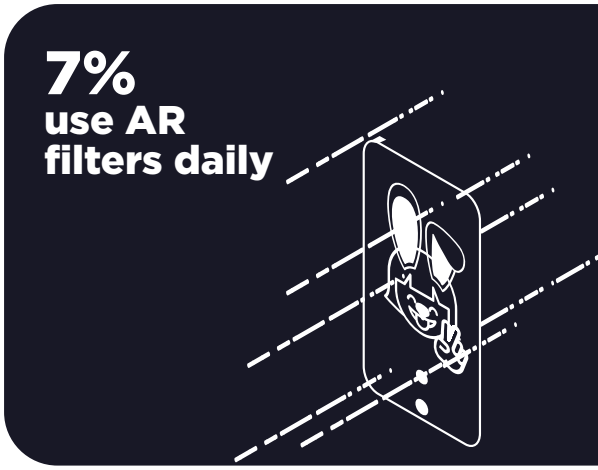
Throughout the report we cross-reference and pick out common themes and correlations in our findings that help to unpick emerging trends in this fast changing landscape.

Research data has been anonymised for this report, and pseudonyms are used for quotations taken from interviews and focus groups.

Part 1
The UK's use of immersive technologies

Our UK Immersive Sample of 992 users reveals, perhaps unsurprisingly, that AR enjoys much higher rates of penetration than VR and other immersive experiences. AR filters are by far the most frequently used, with 40% of UK users using them regularly and 7% of respondents using them daily.

Immersive experiences requiring equipment other than a smartphone (e.g. VR, MR) and/or an in-person visit to a location (e.g. immersive environments and theatre) are not being accessed regularly by the majority of our participants.*



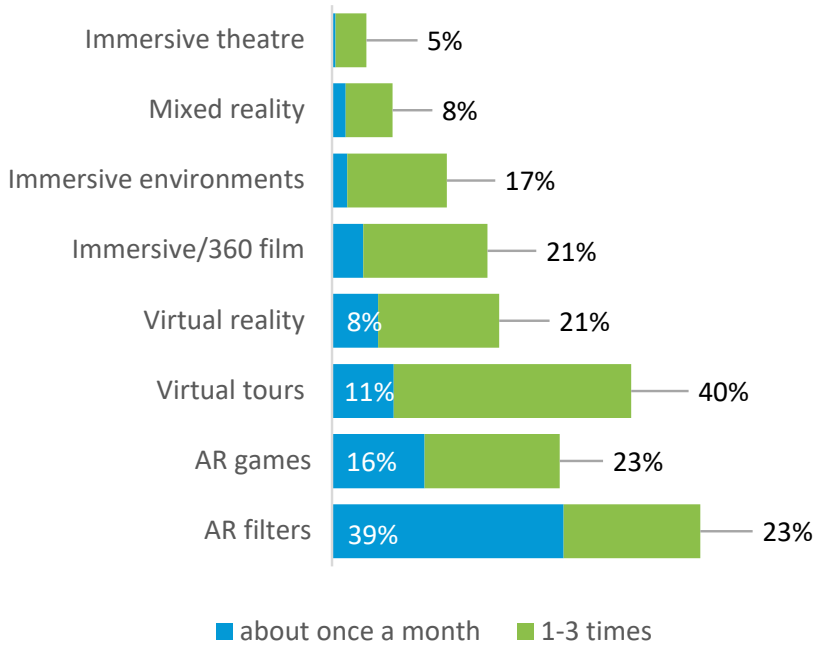


Figure 1.1: Frequency of reported usage within the 12 months prior to January 2021 of a range of immersive technologies (UK Immersive Sample)

Whilst the frequency of VR experiences may be comparatively much smaller than that of AR, there are signs that this is on the rise. A study from February 2017 (ComRes, 2017) reported that 16% of the population had tried VR whereas 29% of our UK immersive sample have experienced VR at least once within the last year, with men having dabbled with the technology slightly more: 23% of women and 36% of men had tried VR at least once (Figure 1.2).

These rates are up significantly from 16% of women and 30% of men in the UK and the US reported in 2018 (Buckle, 2018). 20% of our sample reported owning some kind of VR gear, mostly mobile phone VR (8%) or console VR (6%), with fewer owning the (more expensive) standalone VR (4%) and PC VR (3%).

* Frequency of in-person visits has been affected by the COVID-19 restrictions, which were in place for the majority of the 12 months that people were asked about.

The early AR adopter

Based on the top 20% of AR users in our UK Immersive Sample, the early adopter is young, with a median age of 32, and educated, with 68% holding a degree (compared with 61% in the UK immersive sample).

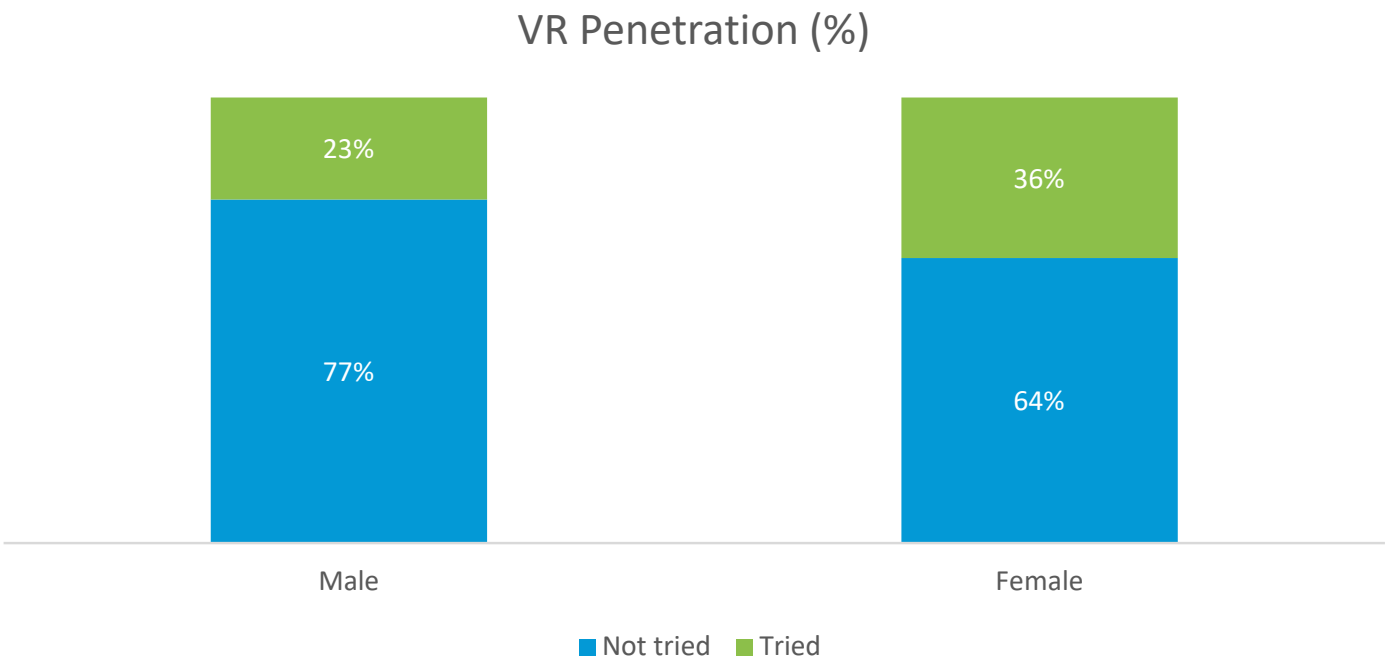


Figure 1.2: Percentages of male and female respondents reporting having tried VR within the 12 months prior to January 2021 (UK Immersive Sample)

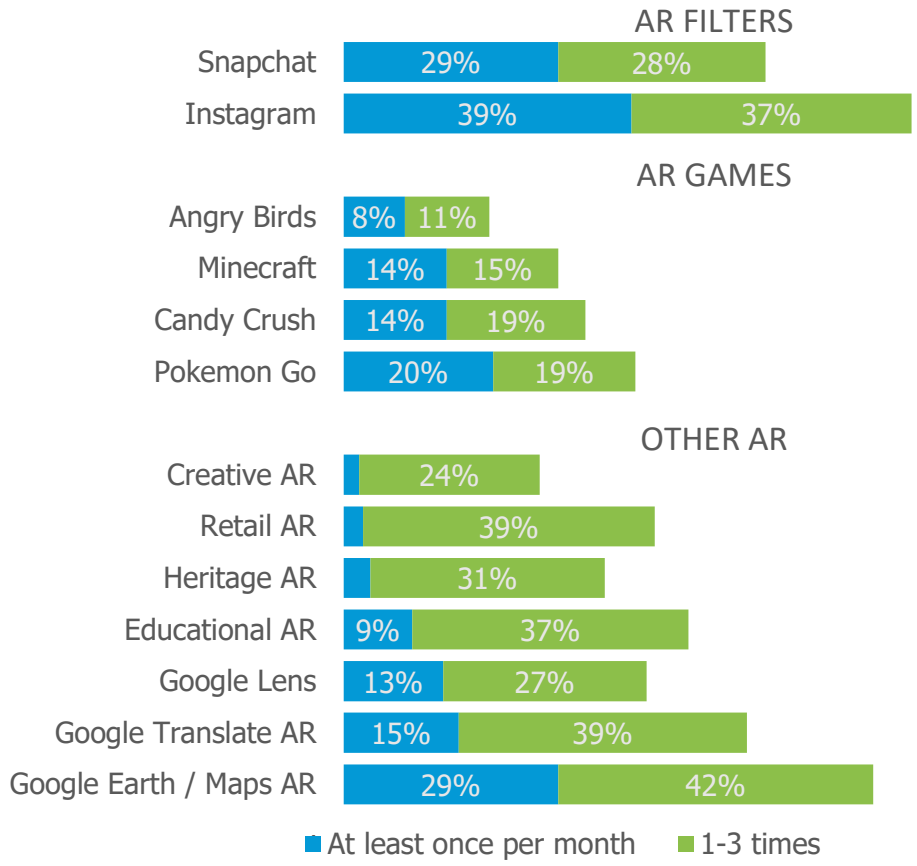


Figure 1.3: Frequency of reported usage within the 12 months prior to January 2021 of a range of AR app types (Heavy AR Users Snapshot Survey)

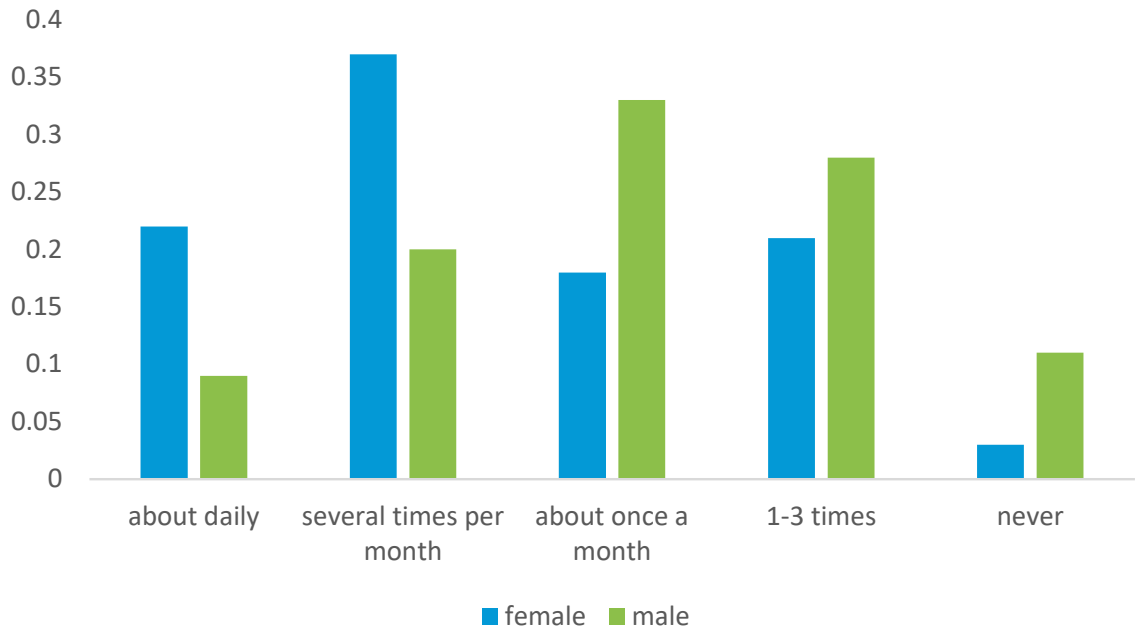


Figure 1.4: Frequency of reported usage of AR filters by women and men within the 12 months prior to January 2021 (Heavy AR Users Snapshot Survey)

Early AR adopters' usage can be understood in relation to several distinct categories of AR app:

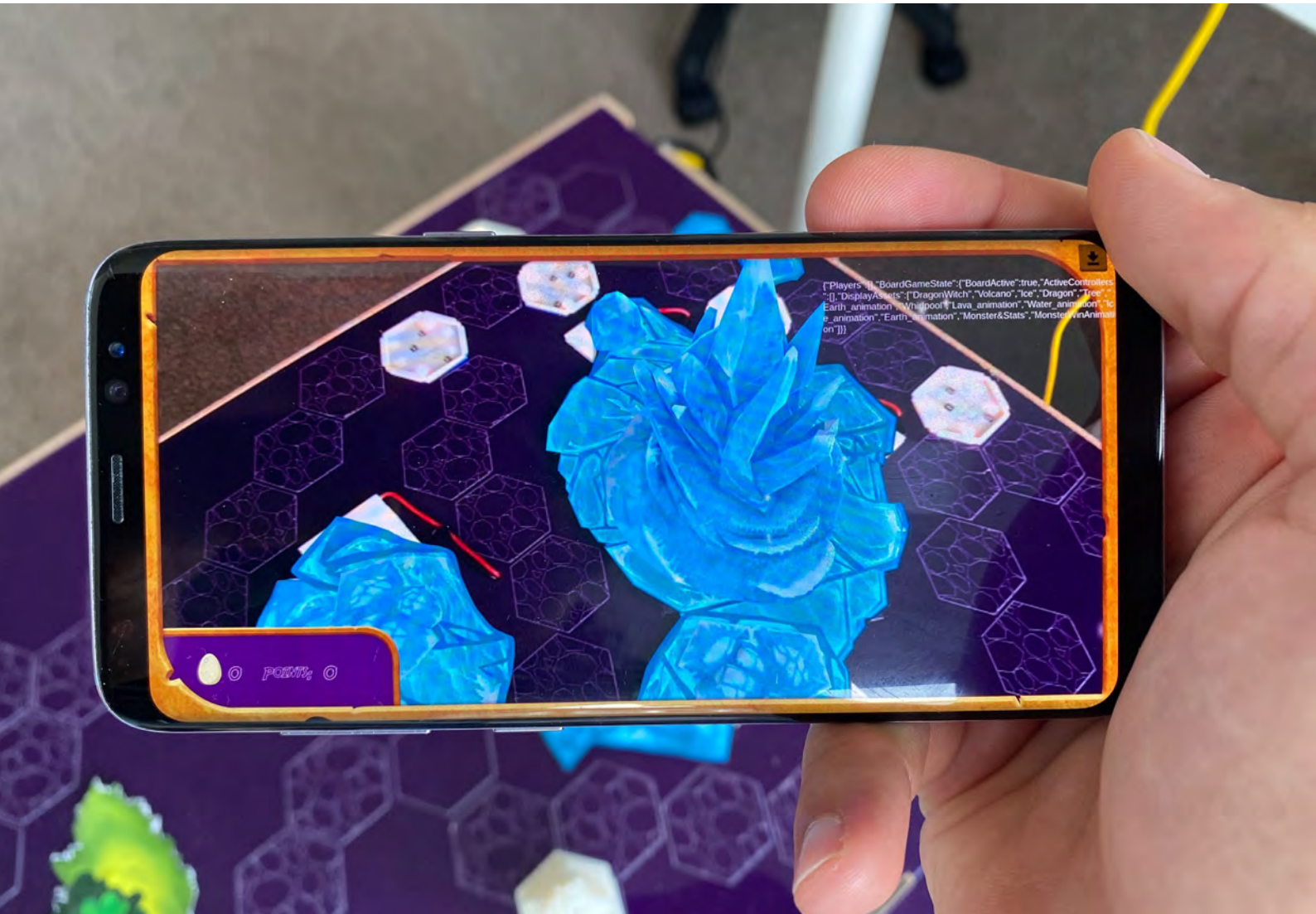
AR Filters: Over 75% use these regularly or occasionally, with women being the heaviest users. 22% of women reported using AR filters about daily, compared with only 9% of men. At the other extreme, 11% of men reported never using filters, with only 3% of women indicating this (see Figure 1.4).

Google Earth/Maps: These applications of AR are used at similar rates to AR filters. Our data suggest few differences in reported usage between male and female respondents.

AR Games: Despite the widely publicised global success of Pokémon GO, these remained niche within our sample of heavy AR users, with a significant majority reporting they never use these games.

AR Info: These apps (including Google Translate, Google Lens, and educational AR) receive relatively few regular users, but fairly large numbers of occasional users.

Other: There are a range of apps other than games that nevertheless receive similarly low usage (including retail, heritage and creative) perhaps because they are likely to be more bespoke.



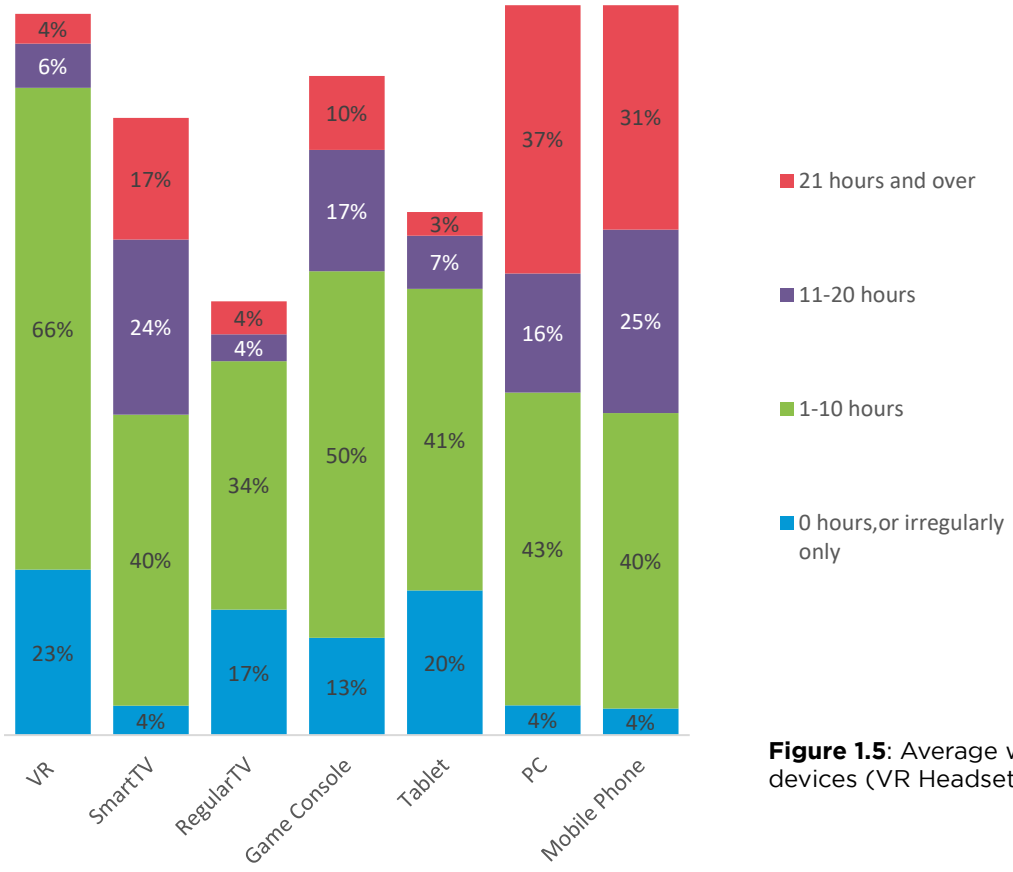


Figure 1.5: Average weekly usage of different media devices (VR Headset Owners Snapshot Survey)

The VR headset owner

Ofcom data indicates that VR headset ownership has increased rapidly over the past year, with 6% - or one in 17 - of UK households now having a headset (Ofcom 2020: 95), up from one in 20 in 2018 (Ofcom 2018: 61). In addition, 20% of our UK Immersive Sample reported owning some kind of VR gear [see above].

Our additional VR Headset Owners Snapshot Survey of 249 respondents suggests that early adopters are still overrepresented by young, white males although they are no longer confined to teenagers in their bedrooms: the median age of the owner was 29 (albeit much lower than the national average of 40).

But even the early VR adopter does not use a headset mounted display (HMD) frequently.

Figure 1.5 shows the numbers of participants reporting each level of media device usage per week. Unlike the leisure usage seen for PCs and mobile phones, where large numbers of people report usage exceeding ten hours per week, VR is rarely used this heavily, with only a very small number of people spending more than ten hours per week in VR. Indeed, the majority (36%) indicated 1-3 hours in response to this question, with the second most common selection being zero or irregular use only (23%).

Case Study: Virtual Veronese

The National Gallery
Focal Point VR

The National Gallery had an ambition to tell the story behind some of the paintings that hung on its walls, linking them to their original exhibition context. Drawing on the research of Dr Rebecca Gill (Ahmanson Research Fellow at the National Gallery) about Paolo Veronese's *The Consecration of St Nicholas*, StoryFutures partnered with the Gallery to design a brief that would allow a creative exploration of the painting and rich audience insights into how visitors would respond to immersive experiences.

The project created a VR and AR prototype to deliver an engaged and emotional experience that enabled the Gallery to test different approaches to storytelling, blending the physical environment of the National Gallery with the virtual environment of the Church of San Benedetto al Po, circa 1562.

Participants could choose between two experiences: one story-led, narrated by the monks of San Benedetto al Po; and one curator-led, narrated by Rebecca Gill.

This enabled us to test both different approaches to **genre** – namely, story-led visitor experiences vs information-led visitor experiences – and **platform** – comparing over 400 users' responses across Oculus Quest VR, Mira Prism AR and Magic Leap AR devices.

Research Questions

1. Do different immersive platforms – AR and VR – create higher levels of enjoyment, presence, engagement or willingness to pay?

2. Does the quality and level of immersion experienced by users differ according to storytelling type (monk or curator)?

Immersive Platforms

Over 90% of visitors rated Virtual Veronese as **4* or 5* experience** (out of 5). The **VR experience was slightly favoured.** The key driver of enjoyment was **presence**, that is, the sense visitors had of 'being there' within the painting's original birthplace and with the characters or curator. VR created a stronger sense of presence than AR devices, with **VR users more likely** to want to explore future immersive experiences.

Storytelling Approaches

61% of visitors chose the story-led experience told by the monks. Stories can inspire learning journeys**:** 83% of participants stated they were at least moderately likely to look up more information about the painting in the future. On-boarding and off-boarding considerations to create a safe and acoustically clean environment are nearly as important as the technology and story in developing this sense of presence.

Visitor Experience

11% of visitors reported a feeling of religious-type devotion, known as kama muta, measured in terms of whether the experience was felt to be moving, touching and heart-warming.

74% of visitors stated that Virtual Veronese had a positive impact on their impression of the National Gallery. **Most visitors (89%) would be keen to repeat** the Virtual Veronese experience. Few expected such an experience to be free. 'Immersion' is not just a property of the technology itself, but an experiment with different approaches to genre, platform and location. The role and style of storytelling should not be under-estimated.

Users place a relatively high reputational and monetary value on visitor attractions' use of immersive storytelling and innovation, so attention to on-boarding, off-boarding and user safety is crucial.

"The audience insight from Virtual Veronese shows the Gallery that actually, we can do this kind of stuff, and there's an audience for it." Lawrence Chiles, Head of Digital Services, The National Gallery.

Part 2: Valuing VR

The jury on the value of VR is still out. While there is considerable excitement about VR in terms of innovation and economic growth, VR has not yet developed fully into a *medium* in its own right.* A medium has clearly defined practices of distribution, exhibition and use, resulting in an original social dimension. A medium is also a distinct set of aesthetic practices which create experiences rather than simply a technological platform to contain another genre/medium (for instance, games in VR).

We studied users of on-site VR experiences (in museums, cultural centres, commercial spaces) as well as VR use at home. In this section, we reflect on the results of our studies in relation to the value potential of VR, which we divide into three sections: cultural, social and economic.

VR provides users with a dizzying sensorial experience, intertwining presence, bodily movement, direct participation (Grau, 2003) with simulation and abstraction. We see the cultural value of VR developing along these lines: offering users new perspectives on their world and access to other worlds.

Many media forms do this, but what is potentially unique about VR is the way in which it retains the user's sense of embodiment in these varied worlds and, in so doing, can take the user 'outside' of themself and offer a space to review and renew their own perspective.

There are some surprising findings in the social value section: VR turns out not to be the isolating individualist experience it is commonly believed to be. Users want, and *find ways*, to experience VR in a social way: it often becomes a form of family entertainment, experienced multi-generationally.

In discussing economic value, we group our findings concerning purchasing behaviour and willingness to pay together with consumer strategies in content selection.

It must be noted that in examining each type of value we open up a multiplicity of pathways for future research as our data is in no way exhaustive.

* We understand a 'medium' to be a "set of social, institutional and aesthetic (as well as technological) arrangements" (Lister et al. 2009: 107).

Cultural value

The question of what VR brings to culture and society remains open. Cultural value is a subjective appreciation of culture, intellectually, emotionally and spiritually. While it is experienced at an individual level, it is always collective and has consequences in terms of public citizenry. In line with Walmsley's (2018) research on cultural value, we suggest that rather than seeking to prove and evidence the value of culture and art forms, it is more useful to examine *how* people experience culture and art. Our data shows that VR gives our participants a capacity to experience new world orders, engaging imaginaries and the immersive sense of embodiment which may lead to, amongst other things, **a feeling of wellbeing.**

We suggest that VR therefore has the potential to develop a new way of seeing, which in turn can provide us with new perspectives. While much of the research on VR is focused on content and platform, by focusing on users we also consider how they *see* in VR and how this affects their experience.

VR requires a high level of commitment from the user: entering the VR experience is not without effort (see part 4: Frictions). Its use, therefore, has elements of ceremonial commitment that are at the core of other art forms (for example, visiting a gallery, attending a performance).

> **"I always think about VR as within the realm of art. It is like a one off experience that you commit to for maybe about half an hour or so. It is the same thing as a theatre show or a dance or a gallery. You commit your whole brain to it for a short period of time, and then you come out of it having learned something from it...."**
>
> **—Jake**

Rather than just watching or being told a story, in the case of VR, the user is inside the story, engaging with it, often resulting in emotional transformations which we discuss in the section on experience. This means that users can see their world - or indeed, a new world - from a new perspective, experiencing it in a more intimate way.

One user discussed these "more intimate shots... It could potentially be done on TV but you would never have 3 minutes of it on TV, in VR you can have that. And that's so important because it lands you in that space" (Adeel discussing viewing *Common Ground* by Darren Emerson).

VR is noted to really transport the viewer through these types of prolonged opportunities to experience virtual space. Another user said, "You had a wider awareness of what's going on, compared to when you're just watching a flat screen" (Christopher). A change in scale can simulate a feeling of motion: "You really felt the motion when you went over the car bonnet. I loved the sense of scale change because you went from something like a large perspective, to like right over the bonnet into the windscreen. It's just amazing because normal games can't do that. You can't exist in that space" (Harry).

The intimacy is linked to both the **physical and virtual proximities** made possible by VR. Physically, the headset encloses the user since the screen is in close proximity to the user's head, right in front of their eyes. This proximity can sometimes take participants by surprise, making the experience more intense. As one user said,"Basically virtual reality works best when it makes you feel when something is close, it sounds really dumb and basic because everyone's known that for decades, but it is true" (Limina audience member). This 'feeling' can be either positive or negative but it provides a 'unique perspective', "because you're never that close to someone in real life, you would never be that close to anyone's space" (Oscar).

As our participants show, this feeling can be frightening and "invasive," and indeed comes into good use for certain genres such as horror. Christopher noted, "I think the idea of personal space definitely factors into what's going to scare me. So something that breaks your personal bubble." In less threatening environments, proximity can also "make you feel like you can reach out and touch it" (Limina audience member). The experience also has more impact when it feels personalised: "I liked the grace of the swimmers/divers doing circles and diving.... at that point [I] felt involved and that they were doing it just for me" (Limina audience member).

Another affordance of the medium of VR is that it allows users to put themselves into other people's shoes. The discussion of VR's potential for empathy put forward by Chris Milk (2015) has been widely discussed and disputed. **More than empathy, we propose that it has the potential to offer users new perspectives.** A way to describe this dimension is through a possibility of experiencing another 'composition of worlds', that is, another order of things and, in this respect, another politics.

In this sense, our users felt compelled to take on a different perspective, which they found "impactful". Eleni stated, "You get to go inside their homes and see it from their perspective," and Leo elaborated, "While you can only be in someone's shoes for so long in a documentary... [in VR] you can really get that added experience of just seeing their lives."

> **"In a sense, because you've got it all in 360, in a way you're trapped there with them. It's like I could experience what they had experienced. Whenever you see a film, you watch protagonists change and grow and learn something and that changes your opinion on that character. But in VR, if you're the protagonist, or at least, much closer to being in that person's shoes, I think the effectiveness of the story, of watching someone else changing, growing is much more profound as you're experiencing it."**
>
> **— Leo**

Users reported feeling "far more connected" with the VR experience than with film, "like it was really happening. So it sort of instilled upon you to do something. Whereas in a film you remember it's a film, it's actors. It's not anything to do with you. It just feels like it's in your head rather than in front of you" (Harry).

VR's ability to let the user inhabit the space, allowing their attention and body to wander through the virtual environment, allows the meaning of the experience to be much more co-created between author and user: "It's like a film, but you get to choose what you focus on .... Suddenly I can hear it in my ears, but I can't see it, whereas you have to look, physically look around these things that are happening around you in the environment" (Blake). Whilst the creator must use new tools to direct attention, such as environmental storytelling and the use of binaural audio to cue events, this requires commitment on the part of the user that is beyond that of a book, television or film but may not be of the same order or type as an AAA video game.

There are two ways in which VR can transport users: outwards by escaping into other worlds, including other people's worlds as described above, or inwards by being projected into interior worlds and imaginaries.

Other worldly: As one of the Limina audience members told us: "virtual reality is wasted on reality". Our participants enjoyed escaping into structured storyworlds, particularly if these were "unusual" and distinctive from their own realities, and were seeking "out of this world" experiences. Immersion and presence are important in allowing for these types of escapes. Feeling present in these other worlds was compared to actual physical immersion in water: "Not because of the water but because you're in an alien environment or a totally different environment which is sealed", while everything else is "muted" (Limina audience member). Immersion here refers to much more than a technological characteristic of VR - it indicates the extent to which the user is absorbed, attentive and mentally involved in the content they are engaging with, regardless of format.

There is a sense of having been on a journey: "I feel like I've been somewhere. And as a result I've got a better awareness, learnt something new, had a new kind of experience in a different place"; and once out of it, "I've been refreshed because I've been somewhere else" (Adeel). Through VR, individuals can use the medium as a vehicle to engage with other perspectives but also other worlds, discovering their own role and identity within them. VR was seen as particularly impactful when it allowed the user to experience "things that I can't experience in real life" (Limina audience member).

> **"virtual reality is wasted on reality"**
> **—Limina audience member**

Personal imaginaries: VR also allows users to access interior imaginaries. As a recent Digital Catapult (Allen and Tucker, 2018) report noted, certain genres that allow users to explore virtual spaces, even without much ability for interactivity, have strong appeal to users. A number of our participants compared VR to dreaming: "It's just nice to have those different experiences. Especially the first one is like a lucid dream and you're kind of floating" (Limina audience member).

> **"I would compare it to when you're dreaming and you can fly. It's probably not as immersive as that because in my experience, that feels real, especially when you're dreaming. But with VR you are sitting down and you've got the headset on."**
> **— Leo**

More surreal, narrative-less VR experiences offer a sense of comfort in allowing users to "just relax and float gently on my side [in this case] over a field of mushrooms, it was lovely!" (Limina audience member). These types of more personal experiences are often "emotional" ("it really hit me in the heart") and are felt to be "empowering" (Alicia). In fact, in comparing an aesthetic experience in VR to an art installation, Alicia noted how "each experience is so subjective to the person" but for her this "came pretty close (...) to the most incredible 12 minutes of my life".

Finally, we might suggest that in opening up the possibility of new worlds and perspectives, VR has a role to play in wellbeing. Other studies on VR usage, such as Serrano, et al.'s (2013) or Riva, et al.'s (2007), have noted wellbeing benefits outside of the context of VR use for hedonic entertainment purposes. Our data demonstrates that such benefits can also be found in entertainment usage: **VR provides users an 'escape' from everyday worries and stress**, demonstrating the potential for meditation and mindfulness applications (see part 3 on experience). It also provides users a way to explore their anxieties in alternative ways, for example when discussing value for money, one user discussed how he overcame his fears:

"I've gotten more use out of that £10 game [*Richie's Plank Experience*] than I have with, you know, some £50 games I've bought on the PlayStation because it was just that that experience of being on the plank and being high up -- as somebody who is a bit afraid of heights, it was just like this really interesting challenge for me to try and kind of conquer going out onto it, and eventually it didn't become too scary for me.... Because when you see other people do it, you tell yourself like, you know, you know, it's fine, I'm just in a living room, how can you possibly be frightened? When you put the headset on and the headphones on and you just, you're tricked every time."
— Oscar

Social value

Users want to experience immersive media in a social way

Across immersive media, people want to engage *together* rather than *alone*. In our immersive histories survey, 197 users told us about 237 immersive experiences, and whether they engaged in these activities together or alone. Overwhelmingly, the experiences people told us about were social, in which they either directly engaged with someone else virtually or engaged individually with others present and observing. Fewer than one-third of participants reported individual immersive activity (Figure 2.1).

Our VR Headset Snapshot study similarly found that **78% of use was undertaken in a social setting.**

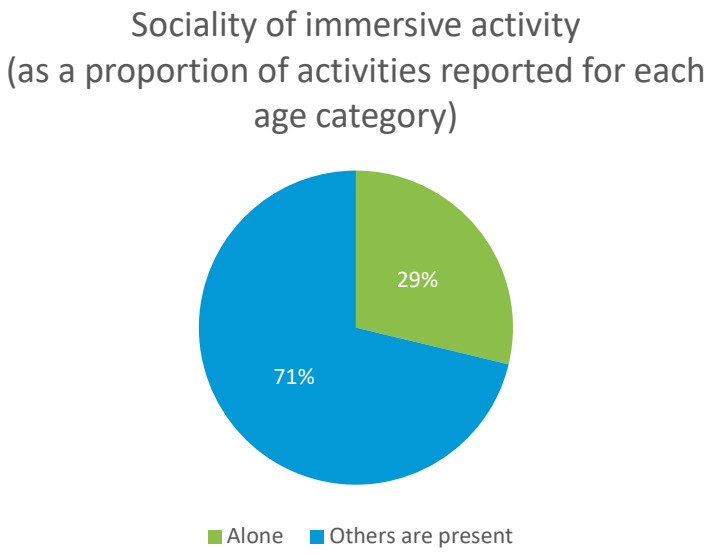
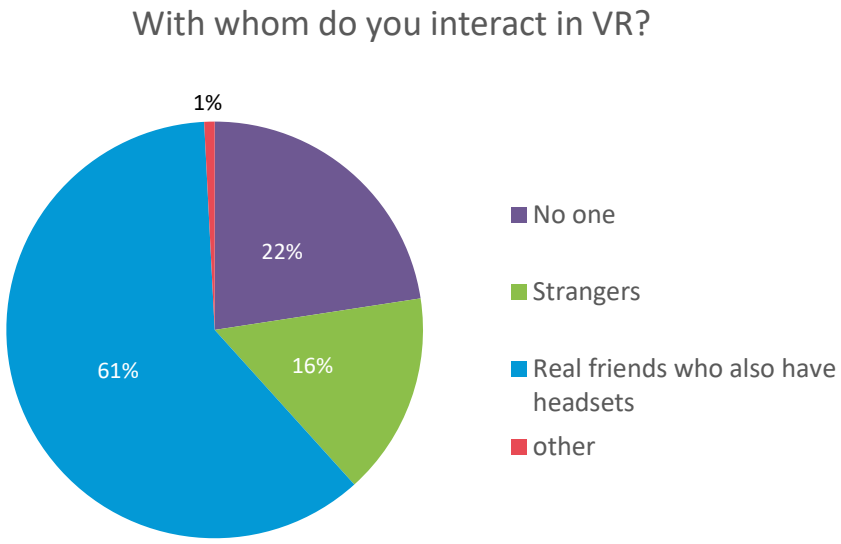


Figure 2.1: Sociality of immersive activity (Immersive histories survey, May 2019 - April 2020, n=197)

Figure 2.2: Sociality of VR (VR headset owners snapshot survey, n=249, December 2020)



Although similar findings for preference for socially-experienced VR have been reported (Lessiter, et al., 2018), the results still run counter to the popular imagination that immersive experiences are isolating, and demonstrate resounding preference to engage in immersive activities socially. Significantly, our findings indicate not only the practice of social VR use but the strong *desire* for it. In our VR headset owners snapshot survey, 46% of respondents indicated that VR experiences are currently very inconsistent or poor at fostering interactions with other people virtually in the headset. 72% indicated this same level of dissatisfaction concerning the ability to interact with others in real-life while inside the headset, and 47% saw significant room for improvement in the ability to share, screencast or stream VR content.

In this survey, we also asked people to identify the people they interacted with in VR. The 'friends' category includes both real-life and online friends; but notable is the predominance of household groups, who, taken together, double interaction 'with friends' (see Figures 2.3 and 2.4). This demonstrates again the predominance of in-person headset sharing to facilitate sociality in VR.

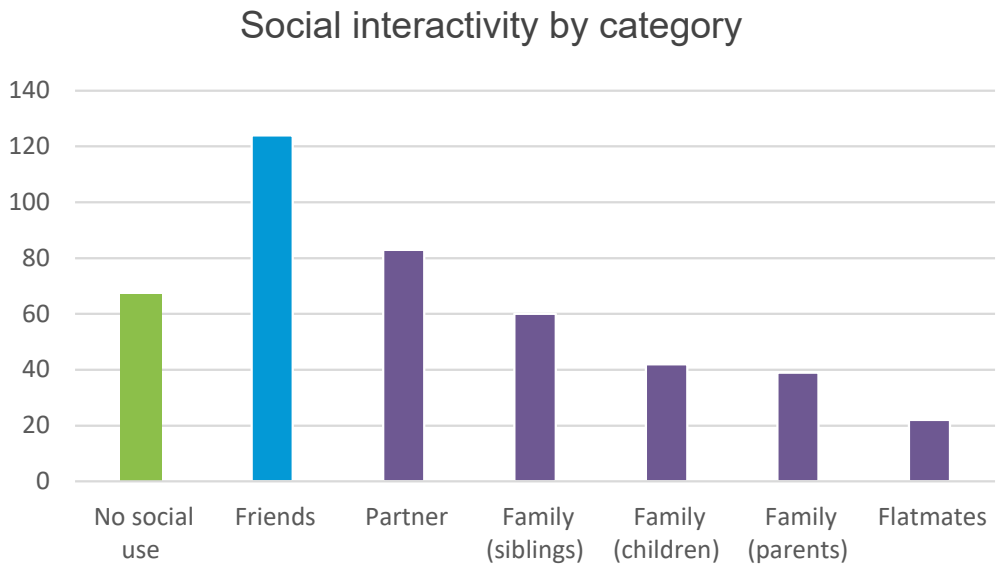
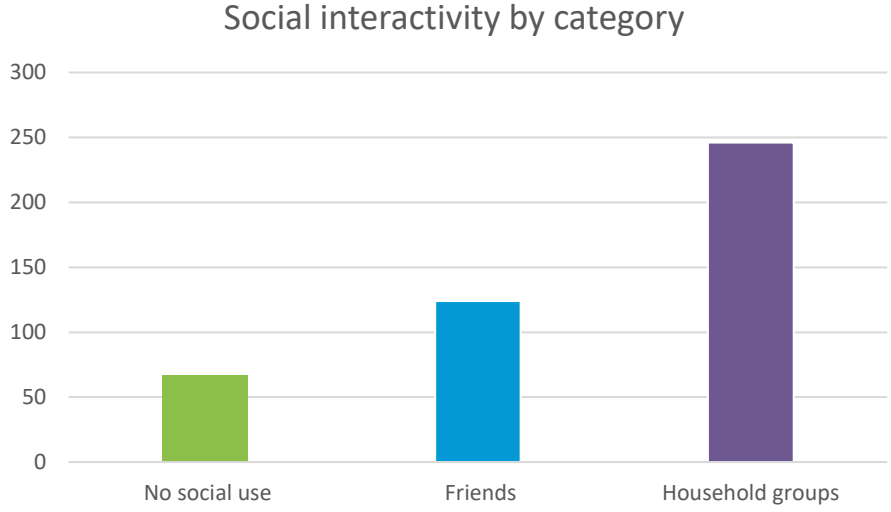


Figure 2.3: Social use of VR (VR headset owners snapshot survey, n=249, December 2020)

Figure 2.4: Social use of VR - combined categories (VR headset owners snapshot survey, n=249, December 2020)



The sociality of immersive experiences is also significantly shaped by the spaces in which they were undertaken. Our immersive histories survey revealed that the most commonly reported experiences were undertaken in users' bedrooms, followed by outdoors or in urban spaces (including many reports of Pokémon Go):

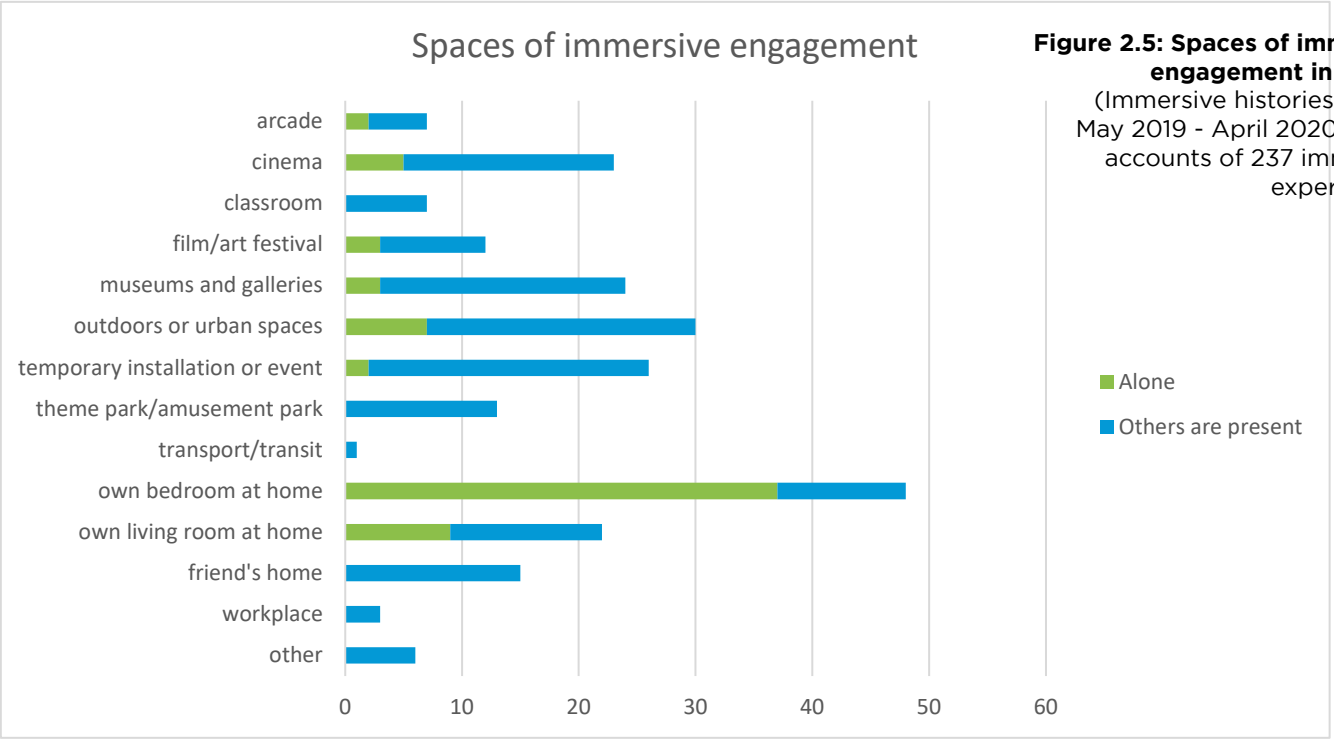


Figure 2.5: Spaces of immersive engagement in the UK (Immersive histories survey, May 2019 - April 2020, n=197, accounts of 237 immersive experiences)

Certain spaces are more conducive certain to certain kinds of immersive activity. The bedroom is the place where people are most likely to engage alone. However, focusing in on the age categories that most often report immersive engagement in this space (16-29-year-olds) reveals that **up to a third of the time that they are physically alone, they are still engaging with others virtually**.

This high level of virtual engagement with others in the bedroom space is largely linked to the type of immersive activity they undertake there. For example, the predominance of AR filter use alone (green and purple together in the Figure 2.6) is a result of the number of reports of Snapchatting with friends in the bedroom. Other immersive experiences, however, show a much stronger trend toward social use.

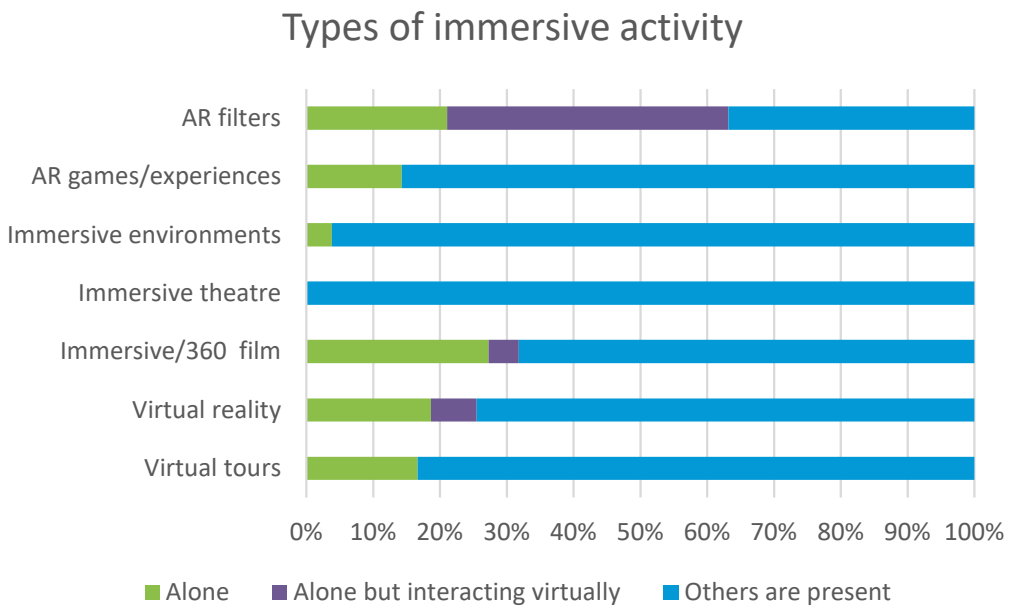


Figure 2.6: Types of immersive activity, all spaces (Immersive histories survey subset, n=197)

Finally, although all respondents value social engagement in immersive experiences, there are gender differences in the tendency to engage with others or alone: only 21% of female users report engaging in immersive social experiences alone, compared to 35% of male users.[†]

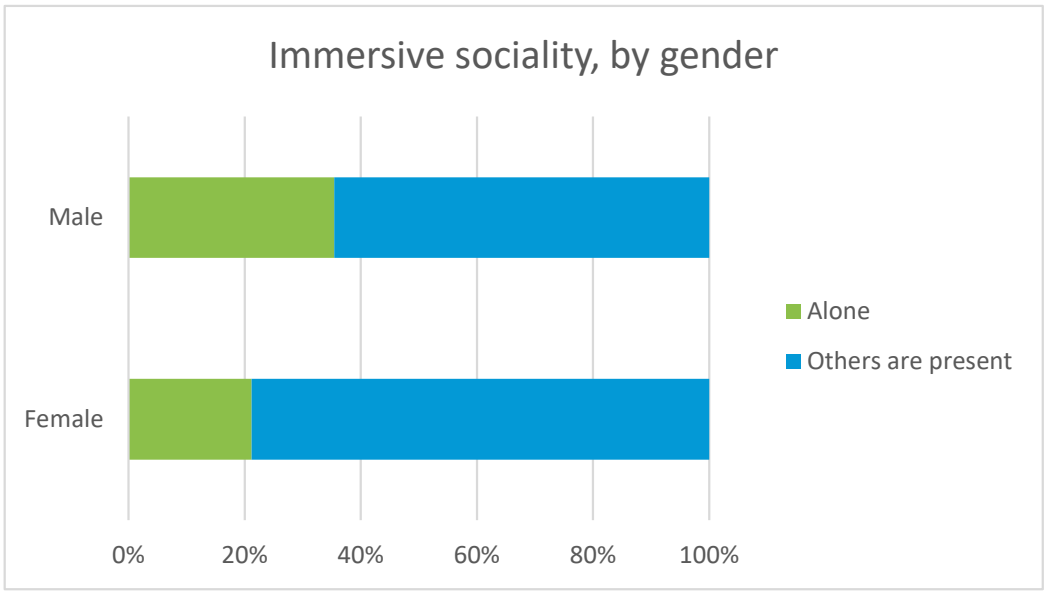


Figure 2.7: Immersive sociality by gender (Immersive histories survey subset, n=197)

[†] Although we received responses from people who identify as non-binary, other, or who preferred not to disclose their gender identity, these were insufficient at this point to provide statistically reliable data.

Focusing on VR

VR is profoundly social despite the popular conception that VR will cause increased social isolation (DCMS, 2019). Whereas a recent study found that VR documentary content did not easily find a ready fit with home use VR (Green, et al., 2020), our study shows that other genres (particularly gaming) have demonstrated more purchase in home spaces. The headset undoubtedly works best as an individual experience; however, our youth study participants found ways to experience it socially. Even when our participants weren't physically with others, they sought social experiences in VR; multiplayer games were perceived as being "less lonely."

Users repeatedly highlighted their delight at sharing their VR headsets in order to curate first-time VR experiences for their friends and families:

> **"I love seeing people trying VR for the first time... giving them that experience of being in another 'reality'... I find that something really special. Seeing their reactions to that was really special... The look on their faces."**
> **— Alicia**

As the overwhelming majority of reactions were positive - "I've never seen anyone have such a good first impression of something" (Julia) - users wanted to share this 'out of the ordinary' experience with those close to them, often resulting in memorable and pleasurable moments of bonding. By watching other people's reactions, users further contextualise, understand and process the VR experience, just as we routinely pick up on other people's reactions when watching TV socially, for example.

Social situations were the foremost motivator for our participants to get their headsets out: "I found myself not using the device on my own as often. Usually it is with my brother - we challenge each other and enjoy it together" (Noah). Watching others playing was "part of the fun. Watching them, you know, randomly swing is amusing to lots of people" (Noah).

The headset was therefore popular at social gatherings or parties: "I think when I have people around then, I'm like, oh, yeah, the Quest would be a good thing to pull out at this point... Everyone loves it. So it's always great to pull it out in the middle of a gathering" (Steven). Users happily waited their turn to play: "All I could see was huge smiles on their faces, they literally formed a line to take it in turns to use it" (Julia). This was also noted to "create anticipation for the next person who uses it" (Dorothy).

The VR headset was seen by our participants as primarily a family-oriented device, particularly by gamers who found that the content was "not challenging enough for long stretches of use [but] accessible and fun to play" in groups for shorter time periods (Noah). They noted that it was perfect for holidays and special occasions, when the whole family was present, allowing for interaction between different generations: "That's the first thing I noticed, really: it was a surprisingly good family bonding activity, it brought everyone together rather well" (Harry).

The potential for VR in the family entertainment market should therefore not be underestimated.

We found that VR experienced socially is significant in two key ways as it has a bi-directional effect:

Inwards, helping the user in the headset feel more grounded and safe in the virtual experience. Participants tended to replicate their own first-time experience on the headset, guiding others to retrace their own introduction to VR in a sort of form of 'imprinting'. In order to ensure as positive an experience as possible, participants took care in curating their friends'/ family's use of the headset. Content which rewarded participants for challenging the limits of VR or for showcasing the potential of VR (e.g. *Mission:ISS* or *Richie's Plank Experience*) was found particularly engaging and shareable. Having a seasoned VR user acting as a 'tour guide' or champion allowed for more enjoyable experiences by 'staging' the presentation of content: "Because I had [my boyfriend] along with me, kind of, in the journey, I felt like it was kind of easier because I wasn't just, it wasn't just up to me to find out for myself" (Dorothy). Some users were surprised by the strength of the headset's appeal to non-gamers (especially older adults).

> **"I've always wanted to try VR. … And so for me, it was something that I knew I'd want and something I knew I'd enjoy. But I wasn't really expecting my nan and my mum to enjoy it that much, especially if they don't really like games, I'll suggest, do you want to learn this game? They're like, 'No, not interested.' 'Well, do you want to watch me play this?' And they're like, 'Not really.' 'Okay.' Not only did they enjoy VR, not only were they interested in it, they *really* enjoyed it. And my mum was saying, 'Oh, if I can save up the money, I'd love to buy one.'"**
> **— Astarte**

Outwards, by including others in the virtual experience and making them feel involved. Some games were seen as particularly conducive to these types of social experiences. For example, one of our participants noted that the game *Keep Talking and Nobody Explodes* was perfect for "family-time" as "the game in itself is quite simple but the fact that I was constantly talking and joking around with my friends around me made the game amazing and that is why we spent so much time on it…. I discovered that we can actually create and play games with only one headset but still make everyone around feel involved" (Maud).

> **Very few genres of VR are set up for multiplayer use but users adapted in order to make them social. Our participants actively sought workarounds to make the VR experience a social activity such as through screencasting and screen sharing from their mobile phones using the Oculus App, making it a more "interactive experience for both people who aren't in the headset and those that are in the VR."**
> **— Noah**

Economic value

When conceptualising the economic value of VR, it is useful to consider how users benchmark their VR spending against other media as this feeds into willingness to pay. Based on our long range youth study, the majority of users compare their VR headset to gaming consoles and the content to computer games. It is not surprising, then, that price comparisons were made between headsets and other consoles, particularly the Playstation.

However, given the perception that gameplay would be significantly lower for a VR headset than a 'normal' game console and that accessibility and ease of use is more challenging, most participants were unprepared to actually buy their own headset.

Ultimately, the headset was not found to be engaging enough to be used regularly. One user said: "I think it's quite a novelty driven concept, virtual reality. Once that fades, it becomes something that you use because you have used everything else already. I see that... it was like a boredom killer instead of 'I'm addicted to this. I really want to, I need more and more of this'" (Noah). While time in terms of hours of use comes out as the most significant barrier to purchase, a number of other 'frictions' compound the perception of VR headsets still being a risky investment (see part 4).

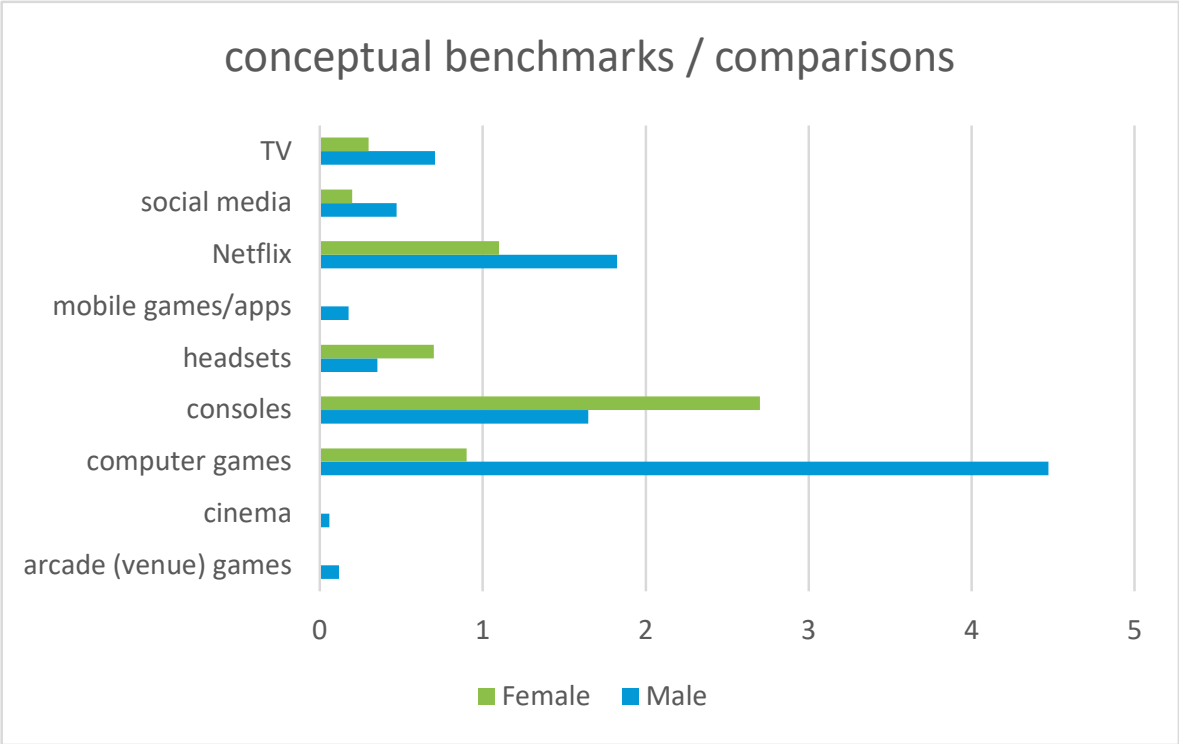
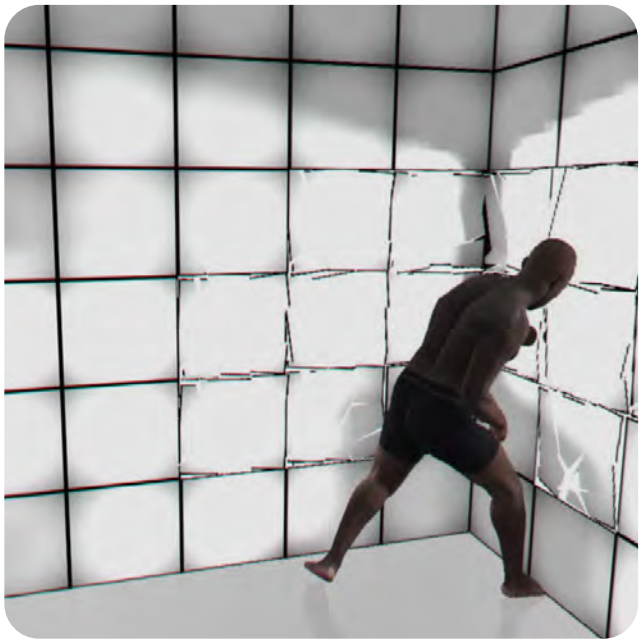


Figure 2.8: Conceptual benchmarks for VR expenditure
(code matrix analysis of long term youth longitudinal study media diaries and interviews)

Case Study: Violence

Shola Amoo and Nell Whitley (Marshmallow Laser Feast)



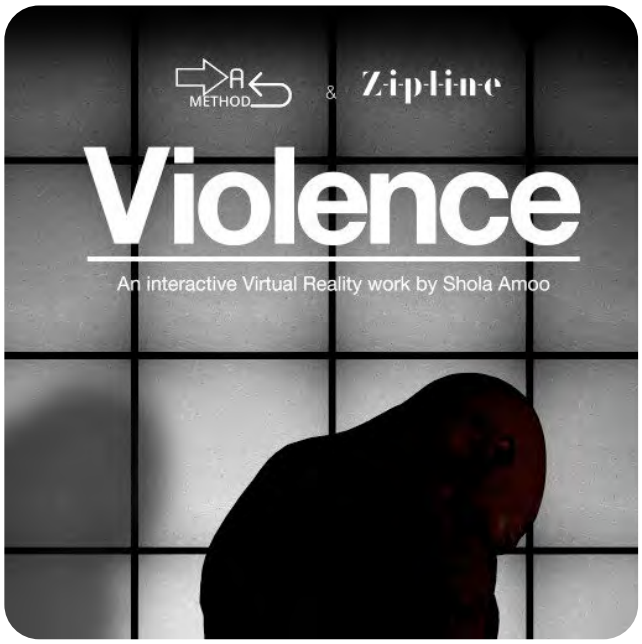
Violence is a VR piece that "recontextualises the idea of violence, by exploring it through the lens of state oppression against marginalised and subaltern groups", says Amoo, examining ideas of race, bias, empathy and control.

As a ground-breaking piece dependent upon user interaction, it demonstrates first-hand the power of immersive narrative to influence and subvert audience perception, in often surprising ways.

The project was selected for the 2020 online Tribeca Film Festival. Nearly 500 survey responses from users were collected and analysed.

Can a VR piece change people's responses to a question about people's right to violent forms of protest?

VR did alter peoples' responses concerning the right to use violent protest, at least in the short-term, with more people agreeing to the statement that "it is sometimes okay for oppressed groups to use violent forms of protest" after experiencing the VR production (59%) than before (39%).



"One of the most important things we've done is collect data from this experience to see if we are actively changing opinions on how people feel about violent or nonviolent protest and that could only be done in VR. We are really excited about the results and keen to explore this more."
— Shola Amoo (right)

Part 3: Experience

In this section, we consider a range of key components of the immersive user experience from both psychological and ethnographic perspectives. We cover cognitive, emotional and behavioural engagement, presence, interactivity and attention, as well as a widely reported sense of escapism, experienced as either stress relief or energisation.

We begin by reviewing the psychological constructs that our research suggests are key in creating compelling immersive experiences. In order for an immersive piece to be memorable and repeatable, it must seek to engage the user on some combination of cognitive, emotional and behavioural levels.

This process of engagement relates closely to the levels of presence and interactivity that the experience can provide, as well as to the ways in which it is able to engage and direct the user's attention. These psychological aspects of the user experience can perhaps be seen as the building blocks which we then develop through ethnographic methods, investigating some of their wider consequences.

In our ethnographic investigation of users reflecting on their VR experience, we focus on their feelings and emotions. While this is a narrowly defined aspect of human experience, it reveals some key and at times unexpected insights about the effects VR can have on, in this case, young users, who sometimes resort to watching YouTube in VR because it shuts off multiple other media requests for attention. Feeling relaxed or energised is why some users keep coming back to specific VR experiences.

This section reveals just a few aspects of the complex intersection of factors that influence user experience, where the technical design of the headset provides a safe haven from sensory overload triggered by multitasking, where engagement energises users and high interactivity increases a sense of immersion and presence.

Engagement

The extent to which people are engaged by an experience can be considered from cognitive, emotional and behavioural perspectives (e.g. Fredricks, et al., 2004). Separating out the elements in this way can help to pinpoint the areas in which a particular experience is working well, as well as highlighting the aspects that could be made more engaging.

Cognitive

Cognitive engagement refers to the mental involvement that people feel in the experience, for example, their desire to know how the story ends and the extent to which they understand what to do as participants in the experience. We have consistently found that cognitive engagement is important for successful experiences. For example, visitors to *Virtual Veronese* (see case study) who felt more certain that they "knew what to do" during the experience reported a higher overall level of enjoyment.

This relationship was also seen in our combined analysis across several different XR experiences, and knowing what to do was related to memorability for participants in the *Cupsy* experience at Heathrow (see case study). We have also found important influences of people's cognitive engagement with the experience's story. For example, *Virtual Veronese* visitors who agreed more strongly that they wanted to know how the story ended indicated a greater interest in repeating it and a greater likelihood of telling their friends about it.

Emotional

Emotional engagement refers to the extent to which the experience affects people emotionally, with possibilities of both positive effects (e.g. happiness, relaxation) and negative effects (e.g. anger, sadness and fear). Across experiences we have found that people who report higher levels of happiness during an experience also report higher overall enjoyment and a stronger intention to repeat the experience.

Our case studies illustrate the potential of immersive experiences to deliver a broad range of emotional reactions, including relaxation and happiness.

It is also possible to focus on very specific emotions, such as 'kama muta', which relates to the feeling of religious-type devotion. In *Virtual Veronese* we measured this by asking participants whether they felt moved or touched by the experience, and whether they found it heart-warming. The experience tried to reward such emotional responses by revealing new details to those who knelt in response to how they felt towards the story.

Behavioural

Behavioural engagement is typically measured in terms of people's future behavioural intentions (e.g. whether they will tell their friends about an experience or seek further information relating to the content that they encountered). For example, our combined analysis of several different XR experiences highlighted enjoyment, presence and feeling happy as key predictors of people's interest in repeating the experiences. Our research also suggests that the real-time behavioural demands of the experience itself can play an important role in maintaining the user's engagement. For example, one respondent from our long range study said:

> **"The key to Superhot's power to keeping me hooked was its demand of constant interaction, as every small move I made would trigger a response from my surroundings - the game didn't give me a second to feel my increasing fatigue, making me forget it."**
> — Adeel

This type of behavioural engagement is closely related to interactivity, which is discussed further below.

Case Study: Cupsy

Surround Vision
Costa Coffee
Heathrow

'Cupsy' was an immersive and interactive coffee cup recycling experience, aimed at improving recycling behaviours via its AR screen. It combined consumer behaviour psychology, computer vision and augmented reality technologies with experiential storytelling.

Previous research at London Heathrow airport had shown that, while people have the intention to recycle, they usually do not actually recycle their cups, let alone recycle them correctly. Correct recycling requires separating lid, contents and cup into different bin compartments.

Surround Vision created Cupsy to tackle this behavioural change challenge. Cupsy's story was told on special AR screens in Terminal 5 arrivals, asking passengers to help Cupsy 'get home' to the recycling bins outside Costa Coffee.

Thanks to its computer vision and AR, if Cupsy saw you holding a coffee cup, your cup magically came to life as the Cupsy character. Cupsy explained how to recycle the cup correctly and celebrated with you when you recycled your cup. It rewarded passengers who smiled at the screen with fun interactions and messages.

Cupsy was installed for four weeks, during which time user experience and recycling behaviour was measured through passenger observations, interviews and surveys.

1. Can 'Cupsy' demonstrably impact people's awareness of correct recycling, leading to better recycling behaviour?

2. How can Cupsy engage passengers in an entertaining and frictionless way in a busy airport?

Immersive AR story experiences can affect people's behaviour

Cupsy generated a 130% increase in recycling - an average increase of over 150 cups recycled each day, and over 6000 coffee cups recycled during the four-week trial. The more that participants enjoyed the experience, the more they reported reconsidering their recycling behaviour.

Recycling quality also went up, with **98%** of passengers who interacted with the display, disposing of their coffee cups **correctly** - an impressive increase, as without interaction with Cupsy this was only 1%.

Immersive AR experiences can reach large numbers of users

The use of an AR screen to deliver an immersive experience allows several people to take part simultaneously and seamlessly, simply by walking into the camera's field of view. Approximately 10,000 people saw Cupsy in action, demonstrating the ability of immersive AR experiences to reach large numbers of users quickly. Cupsy demonstrated that the interaction between immersive storytelling and clear messaging can make a significant **impact** in a busy airport environment.

Whilst large screen AR removed a number of friction points, it is important to pay attention to potential public anxieties about perceived video capture and privacy.

Assessing the success of immersive technologies and experiences on changing consumer behaviour is a complicated business, requiring all project stakeholders to establish clear baselines, goals, KPIs and methods. Trialling technologies via prototypes on a small, localised case study basis is an important part of this process that can establish points of friction, early success metrics and costs of rolling out further.

> **"Cupsy really was one of the best thought through and executed projects I have been a part of and the data capture was so insightful."**
>
> **— Alice Durrans, Project Coordinator (Global Innovation), Costa Coffee**

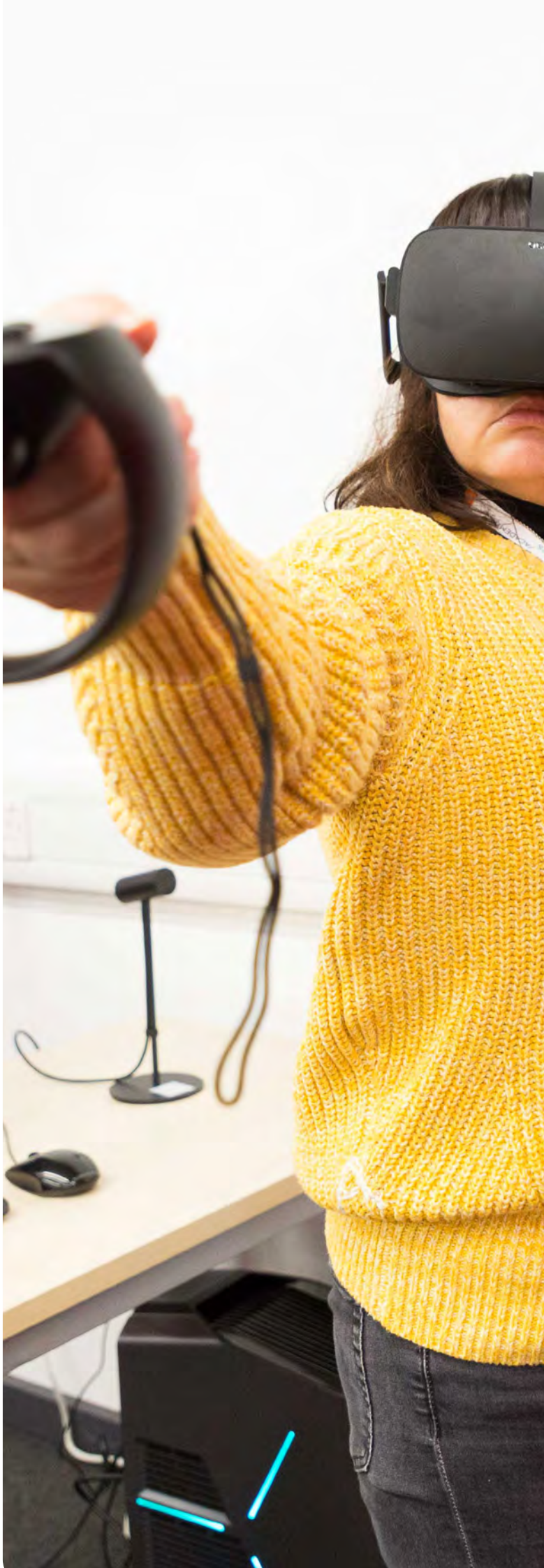
Presence

The extent to which an immersive experience provides the user with a strong sense of 'presence' in the virtual world is an important outcome measure. Across our studies, those who felt a stronger sense of presence were also more likely to enjoy the experience, more likely to repeat it and more likely to tell their friends about it.

The general concept of presence encompasses several different factors, including the feeling of 'being there' in the location that the experience depicts, as well as the plausibility of the events that occur (e.g. Slater, 2009). The sense of presence may therefore be increased, for example, by increasing the naturalness of interactions with the virtual world and by depicting a virtual body.

Perhaps unsurprisingly, we have found across several experiences that the use of a more immersive device is associated with an increased sense of presence in the virtual world. For example, visitors who experienced a version of *Virtual Veronese* (see case study) in a VR headset reported a stronger sense of presence than those who used AR headsets. Similarly, a VR version of the *AI Spy* experience (see case study) achieved higher presence scores than a 2D version.

Presence is also likely to relate closely to engagement, such that an increased feeling of presence in an immersive environment can increase engagement, and increased engagement can in turn increase the sense of presence.



Attention

The ability of VR to shut out many other sources of sensory input is a unique characteristic that may have positive and negative consequences, as is discussed throughout this report. On the positive side, this encapsulation of the user inside the VR headset reduces the likelihood of distraction and allows a level of focus that may be unusual for many people amidst the frequent multitasking of modern life, for example: "It is like a one off experience that you commit to for maybe about half an hour or so. You commit your whole brain to it for a short period of time...." (Jake). This focusing of attention that VR promotes may in turn foster feelings of escapism and relaxation. On the more negative side, this state of relative sensory deprivation reduces the user's awareness of the real world around them. This can lead to feelings of insecurity, particularly in public spaces, but also in the context of home use. For example, 35% of respondents in our survey of VR headset owners reported that the inability to see their surroundings while in the headset had a negative impact on their VR usage.

Overall, however, the appeal of VR was to cut off as many senses as possible to achieve the illusion of being elsewhere: "If you're playing with headphones and you have both cups on a high volume, you are in a different world. You can't hear a single thing that's happening around you" (Noah). This experience is often described as "an in-the-moment relief", where the headset allows the user to "lose themselves..." and "switch off from everything else" (Dorothy). It is not only the sensory investment that defines VR experiences, but also its consequence - the disinvestment from any other activity. It is impossible to be doing anything else while being in VR: multitasking is unfeasible. In fact, some of our participants even watched non-VR content in the headsets in order for it to be a distraction-free experience.

"I watched quite a lot of YouTube in the headset, especially when I was on my own... With the YouTube app, it is kind of looking at a massive screen .... just sitting and watching a normal YouTube video... in the dark environment..."
— Oscar

While the inability to multitask is a source of friction in terms of entering VR (see part 4), once inside VR, one cannot escape it. One participant said: "I have an attention span which is very low ... In VR, I cannot go look at my phone ... I have to listen to what's happening". As vision and hearing are "blocked out", users find themselves "locked into paying attention" (Harry).

Although immersive experiences typically receive a large proportion of the user's focused attention, they also allow the user a high level of freedom over where their attention is focused within the experience itself. This means that directing the user's attention successfully can be an important aspect of a successful immersive experience. However, many of the methods traditionally used to steer attention in more linear media – such as cuts, zooms and pans – typically do not transfer well to immersive experiences. For example, as also noted in the discussion of cybersickness (see part 4), if used within VR these techniques can be jarring and induce nausea. They can also detract from people's feelings of presence within the virtual environment. Important scene elements in immersive environments therefore need to be able to attract attention reliably in their own right.

A person is likely to pay attention either to items that are important for their current task or to 'salient' items that capture attention by virtue of being unusual, distinctive or simply by delivering a very strong sensation. For example, elements that are distinct from their neighbours on some attribute (e.g. colour, brightness or motion) are likely to attract attention, as are faces, as well as threat-related stimuli such as snakes and spiders. The combination of stimuli in more than one sensory modality (e.g. a bright item that also makes a distinctive sound) can also capture attention very effectively.

Relaxation and stress relief

The sense of full immersion achieved by focusing on the experience is characteristic of 'flow', felt as cognitive absorption, enjoyment, loss of self-consciousness and one's sense of time and space. Users in our various studies reported losing track of time: "While playing, I didn't see the time flying by" (Thomas), and experiencing time differently.

> **"We've all seen slow motion in films: escaping bullets while shooting guns... In VR, ignoring the physical limitations and using the virtual world to mess with time and space is what I really enjoyed." — Harry**

These new space-times were felt to be transformative, overcoming all previous negative affective states. In general VR was thought to "generally lift the mood" (Jake), leaving participants feeling "surprisingly calm" (Josh). Indeed, although VR was seen as demanding significant physical and cognitive effort from the users, the reward was an observable transformation of emotional states for those users who worked past the various frictional hindrances. "It brought me a lot of happiness and was a great way to be part of another world when needed" (Julia).

Within our youth study, the transformation was experienced as stress-relief. The feeling of relaxation was directly related to the sense of escape provided by immersion. Some youth users compared it to meditation. Many of our participants used their headsets in the evening in order to relax, "chill out" (Leo) and unwind in order to "calm yourself down before bed" (Harry).

Some types of content that were found particularly conducive to relaxation include:

- experiences with abstract animated visuals;
- experiences whose aesthetics transported users to art installations, which left some "weirdly euphoric" (Alicia);
- natural environments and encounters with animals, or fantastical environments that replicated activities such as fishing that would occur in natural environments;
- simple, repetitive games were considered "therapeutic," since "[I could] let my brain shut off for a while" (Ben).

Energisation and exercise

Although the physicality of the VR experience was often experienced as a friction, it is worth pointing out that the physical interaction required in some games could provide an effective boost, much as conventional exercise would, and engage users: "I felt less lethargic and tired in general" (Astarte).

A number of participants considered VR to be on par with physical exercise in terms of leaving participants "filled with adrenaline", "stimulated" (Thomas) and "mentally and physically active" (Eleni).

In this sense VR is effective in "breaking up a routine" (Eleni) and providing an escape from "boredom" (Noah). Experiences that took full advantage of the affordances of VR as a medium were found particularly exciting as they were felt "viscerally" (Jude), often resulting in feelings of "omnipotence" (Astarte). Examples of these include space walks where users were floating around and could imagine feeling weightlessness.

> **"I still feel really pumped and powerful. VR experiences always make me feel positive afterwards."**
> **— Astarte**

ZoomHeadz is a prototype AR game built for video conferencing. Created in response to the Covid-19 pandemic and the shift to online working enabled by platforms such as Zoom, *ZoomHeadz* provides a unique solution to the growing problems of remote working, including boredom, disengagement and challenges that come with remote team-building and collaboration.

Computer vision allows computers to recognise objects in the real world. In *ZoomHeadz*, the computer recognises head movements and uses this to create a Sway to Play™ (STP) element, whereby users can control the game by moving their bodies rather than through the use of a more traditional manual control. StoryFutures' audience insight research team tested the AR ZoomHeadz game against a keyboard-only version of the game, to understand the added value of STP™ AR versus a more traditional execution with a keyboard.

By bringing together two key mental engagement strategies – gaming and physical movement – ZoomHeadz demonstrates the potential for AR in creating more meaningful, enjoyable and rewarding interactions during online meetings.

How can gaming enhance fun and engagement when using Zoom for remote work?

What is the added value of body movement as the 'game controller', using the STP™ mechanism, versus using a keyboard?

Analysis

Groups of 4-10 people played the game together via Zoom, with 43 people using a keyboard to control an animated car and 42 people using STP™ to enable a comparison.

Users preferred the more naturalistic STP™ control interface

STP™ received higher user scores for enjoyment, happiness, relaxation, repeatability and likelihood of recommendation than a comparison version of the game with keyboard controls.

The more naturalistic STP™ controls supported stronger feelings of presence

People who used the STP™ controls agreed more strongly with key measures of presence ("I had a sense of being there" and "I was completely captivated by the virtual world") than those who used the keyboard controls. This is in line with previous findings suggesting that more naturalistic interactions are associated with higher levels of presence, but interestingly this work extends those findings to AR (in contrast to most of the existing work which has focused on VR).

There is demand for more experiences like *ZoomHeadz*

The study demonstrated a significant appetite for AR games within a video conferencing context, with 76% of users in the keyboard control group and 88% of users in the STP™ group agreeing that they would like to play more games like *ZoomHeadz*. Many users also agreed that the game would make a good ice breaker and that it was likely to facilitate collaboration.

The growing familiarity of video conferencing AR filters offers significant possibilities for experimenting and capturing attention and engagement through immersive technologies that can enable users to feel more 'present' in the experience. STP™ added physical proximity and presence to the often repetitive nature of online video calls, giving workers a break from their daily routines.

" ... great ice breaker. Would work brilliantly in a virtual team meeting as we enter this new era of limiting contact."
— *ZoomHeadz* Participant

Part 4: Frictions

A 2020 Nesta report (Allen, et al., 2020) on early VR adopters highlights the fact that there are still significant barriers to entry in terms of public adoption of immersive technologies, particularly VR. The imbalances in cultural participation, socioeconomic level and gender in VR adoption highlighted by Nesta's report make it clear that more work needs to be done in terms of user development.

However, our research shows that even when different groups of individuals are provided with access to VR headsets, the technology struggles to live up to its potential and its appeal is curbed beyond any initial excitement. As we set out in Part 1 of this report, VR is used much less than other entertainment devices. The reasons for this may lie in the barriers that are encountered by VR users that are specific to this medium.

These barriers can be thought of as **'frictions'**: **a friction is defined as a bodily contestation, a technical obstacle, or a contextual factor which is felt as some kind of clash, discomfort and/ or lack of 'fit' with 'embodied ways of sensing, feeling, and moving within digital environments'** (Hollett et al., 2019: 57). Frictions can act as barriers that will either prevent engagement or can accumulate to eventually cause the user to decide to stop engaging entirely.

This approach broadens Ash, et al.'s (2018) definition of frictions to include those that emerge from the social context, place and time in which the user is located. Ash, et al.'s definition focuses on the "practical, affective or emotional contestations that interrupt or stop" (p. 1136) the user from completing or continuing to use a digital interface. They also point to three key 'sites of friction':

- Before picking up a device or accessing an experience
- Within the interface or experience itself, as a result of the choices made by the creator to direct the experience of the user
- The moment of interaction between interface and user during any given instance of engagement

We further acknowledge that frictions can also occur **after the immersive experience has ended** – in the process of transitioning away from the virtual into the real world. Therefore frictions are part of the entire immersive 'customer journey' (Jarvinan, 2020).

46 Barriers to VR use

Respondents of our VR snapshot survey were asked in an unprompted way to list the top three factors preventing them from spending more time in VR, and their freeform responses were then categorised. The frequencies of mentions of each factor are shown in the chart below (there were 46 different barriers listed, with 712 factors mentioned in total).

There are seven key types of friction: **content-related, contextual, financial/market, logistical, physical, psychological and social.**

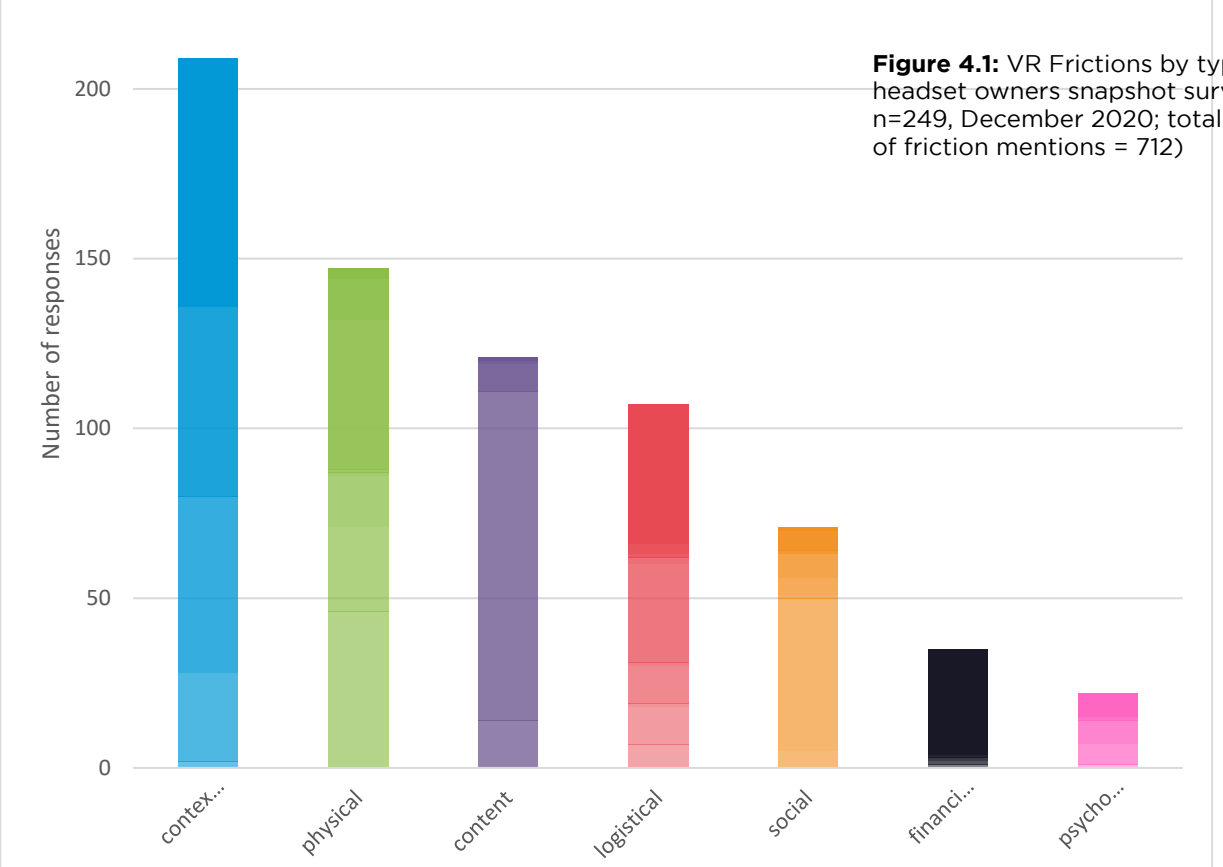


Figure 4.1: VR Frictions by type (VR headset owners snapshot survey, n=249, December 2020; total number of friction mentions = 712)

Content	
lack of content	97
appeal/motivation	14
lack of multiplayer	8
other interesting content	1
sound	1
Contextual	
work/study	73
time	56
family	52
duties and obligations	26
data/accounts concerns	2
Financial	
money (too much/don't spend on this)	31
Logistical	
setup	41
lack of space	29
battery	11
dated technology	11
accessibility	7
privacy	3
lockdown	2
cables	1
lack of ability to multitask	1
poor broadband	1
Market	
knowledge	1
lack of cross-platforming	1
lack of information	1
lack of penetration	1
Physical	
discomfort	46
motion sickness	44
eyestrain	25
headaches	15
tired	12
too many screens	3
health	1
too heavy	1
Psychological	
disconnection from real world	7
poor graphics	7
addiction	6
acclimatisation	1
intensity	1
Social	
competing media activities	45
social circle doesn't have VR	7
social life	6
not as good as gaming	1
antisocial	5
other people want device	5
social embarrassment	1
wasting time	1

Figure 4.2: VR Frictions by category (VR headset owners snapshot survey, n=249, December 2020; total number of friction mentions = 712)

The most frequently mentioned category of friction was contextual factors (29%), such as lack of time, work or study demands, or family responsibilities. The second most commonly-cited category in the unprompted responses encompassed physical factors (21%), such as discomfort from the headset, motion sickness, eyestrain and headaches. Importantly for content creators, 14% of the spontaneously elicited frictions referred to a lack of new, interesting or varied content as a barrier to spending more time in VR.

Although VR can be a transformational experience, friction prevents users from integrating VR into their daily "cultural constellation" (Baron, Patterson & Harris, 2006: 119). In fact, users often note with surprise that despite excitement at receiving headsets, they "thought [they]'d be a lot more stuck into it" and sometimes "might forget about it for a few days" (Alicia). Lacking a "compelling enough reason to put on the headset" (Jake), VR fails to "replicate other media experience or other rituals you ha[ve] in your daily routine" (Josh). Rather than "an everyday activity," VR usage is for "special occasions (...) when you want to feel something completely different" (Eleni).

As a result, VR often ends up being relegated to novelty and is "put to one side in [one's] room" (Jake). Our long range study evidences this; in the course of 3 months even some of the most avid users went from four to five hours a day of headset use to abandoning it almost completely. Users experience a sense of "saturation," whereby once experienced, they are "ready to move on" and don't necessarily return. Green, et al.'s (2020) home study saw a similar drop in engagement and therefore, there is a need to unpack the reasons behind this.

"The experience is too arduous, too taxing, to enjoy whenever I'd like to; one must prepare before journeying back into the [headset]."
— Adeel

Notably, however, not all users experience frictions in the same way. The reason for this is precisely because frictions arise in this encounter between the technology and the individual, and individuals are infinitely varied. Moreover, frictions arise from the affordances of the technology, and what is experienced negatively by one person may be experienced positively by another.

To explore this further, we probed several specific frictions evident from the ethnographic work undertaken in our long range study in the quantitative section of our VR Headset Owners Snapshot Survey. As can be seen in Figure 4.3, the majority of respondents rated eyestrain, headaches and nausea as having negative impacts on their VR usage. For some users, these were not significant problems, and a minority of users seemed to indicate perceived benefits of VR for problems such as eyestrain or fatigue. Most notably, a larger proportion of users (30%) found that VR had a positive effect on their overall mood, and very few (9%) noted a negative effect.

In the freeform barriers question, insufficient play space and other logistical concerns, including the logistics of setting up the space and headset, were also reported as key barriers (15% of responses overall), along with competing media activities (6%). These findings were paralleled in the quantitative responses, as shown in Figure 4.4, where setup of physical space was the logistical friction that the greatest number of users (55%) rated as negative.

Again, however, the variability in how users experienced these frictions is notable: for example, the inability to see or hear one's physical surroundings in VR is in fact one of VR's main affordances. Some people (35%) experienced this negatively, indicating potential feelings of vulnerability or inconvenience; for others (16%) this was a positive feature, representing the ability to immerse and escape into the virtual.

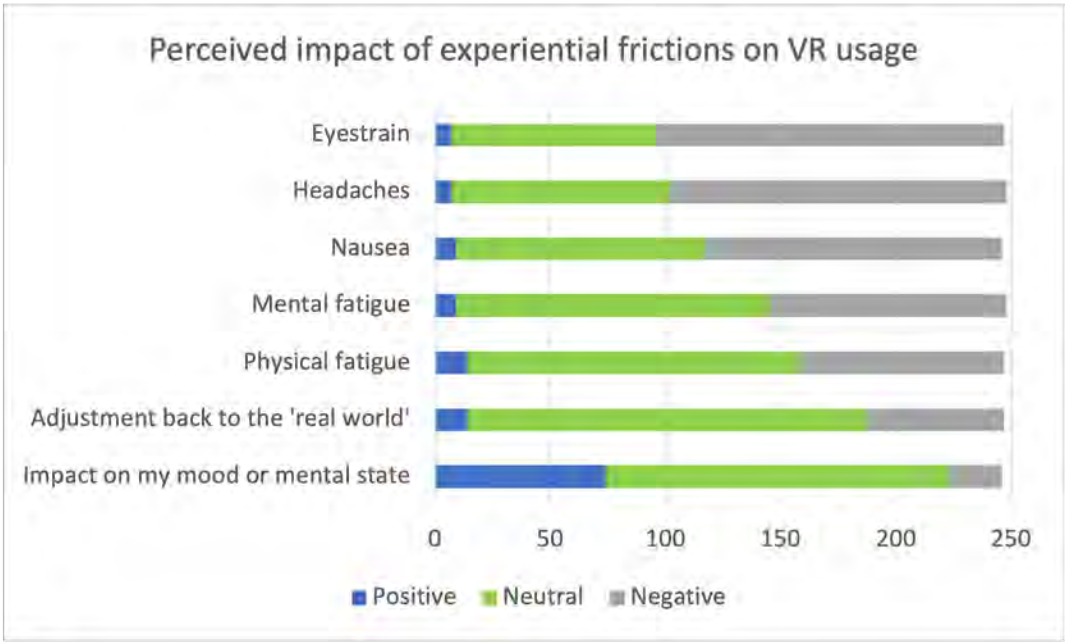


Figure 4.3 VR owners snapshot survey, December 2020, n=249

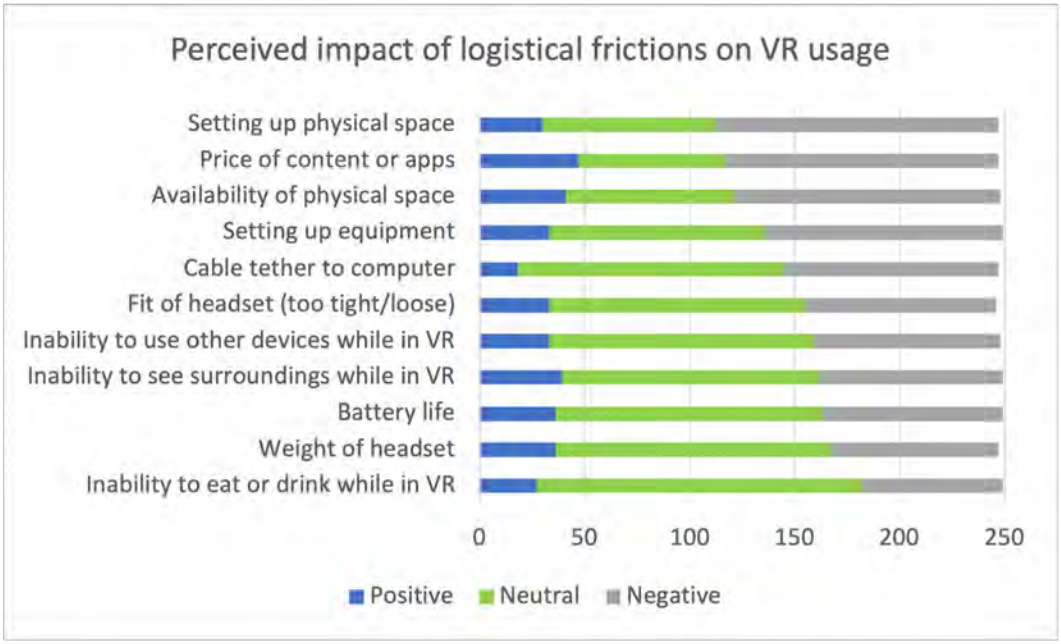


Figure 4.4: Logistical frictions on VR use (VR owners snapshot survey, December 2020, n=249)

Our research, therefore, not only identifies a large range of frictions heretofore unexplored, but it also presents an argument for flexibility and attention to user difference in approaching these frictions. The challenge is to help users experience the affordances of VR as positive (or at least neutral) and minimise the negative experience.

In order to explore this more fully, we here turn to our ethnographic research, focusing primarily on home use of VR using Oculus Quest headsets by our long range study participants, referring back to the VR snapshot survey findings. By focusing on these areas of friction in more detail, and exploring these themes as they emerged in our ethnographic research, we build on existing considerations of barriers to entry, demonstrating that these are not just concerns of 'entry' but ultimately can lead to abandonment by even the most avid users. Therefore, if the industry wants repeated and sustained engagement with home users, these frictions are worthy of further consideration in ensuring a smoother interaction between users and the technology.

This section also addresses some of the practicalities and risks which arise as a result of these frictions, which lie at the intersection of the physical and the virtual. In examining these, we consider some of the affordances of VR in more detail. For example, as suggested above, in subsuming the senses, 'immersing' users and providing them with a sense of 'presence' which, as we have seen is at the heart of the value of the medium, VR also cuts users off from the real world. As a consequence, users' physical presence in the real world can, at times, come into conflict with their virtual activity. Putting the user at the centre of immersive experience therefore reveals how many of the affordances of VR have implications for immersive design and the delivery and consumption of immersive media - thus arguing for sustained user scoping and testing throughout the development process (Jarvinen, 2020).

Here we focus on three specific categories of frictions that emerged from our long range study as particularly significant in preventing home VR users from becoming fully immersed in the VR experience - space, time and fatigue - and some of the practicalities that arise as a result of these.

Space

Spatial frictions are the most common set of frictions to come up in users' media diaries and during interviews. This is primarily due to a lack of space in users' homes. While this may be the result of many of our participants being students and living in student accommodation, even when in their family homes, space was still a struggle, as also reflected by the VR headset owners survey.

Spatial frictions emerge as a result of the technical requirements of the headset, that is, the need for a guardian boundary in order to engage with the content properly. The set up required for VR is perceived as an onerous "investment" or "commitment" (Victor) - for example, it often requires the movement of furniture: "If I hadn't had to move the sofa, probably, that would have been the biggest thing. **It was just making that space… I'd kind of get sidetracked**, go on my phone or something … It's more setup than watching on your phone or TV" (Ben). As a result of the effort this setup requires, users often discount VR as an entertainment option: "I think because moving things around, I'm like, oh, that takes too long and my brain just counts it out when I was looking for things to do" (Ben). This results in the choice to opt for other activities: "I could always feel that there was something dissuading me from putting the headset back on as soon as the opportunity to do so again arose; mysteriously and inexplicably kept me away from VR… It's just easier to take my phone out of my pocket" (Adeel).

As many of our participants live in shared accommodation, there was the added embarrassment of "getting in people's way" (Dorothy). "When I'm at home, actually finding space to use [the headset], it was obstructive to other people, because the only place I would be able to use it in was in my living room. And of course, [flatmates] are already in the living room watching TV or doing something else there. So, I can only use it when no one's in there… because in my room I didn't have enough space to use it" (Gordon).

Use of the headset was often perceived as unsociable due to "this complete barrier to the real world" (Oscar), resulting in another layer of friction. Use therefore often required negotiation with flatmates: "If I was in the kitchen with my friends in my flat, would I just say, 'Guys, I'm just gonna be in here, I'm gonna do this…'? I'd say definitely no, just because, it's such a kind of, you're stepping out of where you currently are, so I wouldn't want to do that. I feel like the only space I'd really happily do it is in privacy or in front of like friends who want to get involved with it" (Adeel). In practice, this means either waiting until shared spaces are unused or intentionally including others, either by turn-taking or by screencasting content to laptops or televisions, as otherwise their exclusion is felt to be rude.

These findings parallel those documenting the perceived unsociability of VR in the home in a study of users' engagement with documentary VR (Green, et al., 2020); however, what is notable here is that our participants demonstrated a drive to make VR a social experience, and found creative ways of negotiating or adding sociability to it (see also the section on social value).

Once in the VR experience, lack of space also prevents full immersion due to the resulting restriction of movement: "I was limited by the space, having nearly smashed my arm into the wall" (Julia), and this can lead to "wariness … no matter how engrossed you get, you still feel… am I going to hit something?" (Adeel). For some users, it was the fear of not knowing what was happening in their physical environment that put them on edge: "I found that it maybe increased my anxiety to people, making me jump quite a lot" (Noah).

A result of users feeling constrained in their space was the selection of less interactive content which did not require big movements and could be experienced in restricted conditions. **Space is therefore found to determine what content VR users engage with and the manner in which they will engage with that content.**

Time

Following on from the effort of setting up for VR headset use, temporal frictions emerge due to the perceived time commitment that VR requires. One participant of our study said:

> **"It feels like an investment to use [VR]. ... because there's a bit of setting up, moving stuff out of the way ... it felt like more of a kind of commitment. If I'm getting it out, then I'm committing myself to playing for an hour. It's kind of hard to bring myself to do it."**
> **— Victor**

The headset is not considered to be something "quick to pick up and play" (Leo) but rather, something which requires uninterrupted blocks of time.

This perceived time commitment persists, despite our data showing that most participants only use headsets "in shorter stints" (Noah) of around 20-40 minutes, significantly less than the time invested in playing on gaming consoles. This paradox was noted by the participants themselves: "It's a very weird thing. I've never thought about, like, playing a traditional video game that I'm going to have time for it, it normally just happens. If I wanted to [play], I try and find a way to satiate that desire. Whereas with VR ... I thought, 'Okay, Tuesday I've got a lecture until 10 and the rest of the day is free.' And for some reason, I'd still be like, 'Hmm, I've got to find the right hour....' It didn't make any sense. But I always felt that way" (Adeel).

In considering these temporal frictions alongside spatial frictions discussed earlier, we begin to understand why headsets are often not integrated into users' entertainment spectrums. As one of them explained: "[The headset] didn't really find itself integrating into my routine, or how I use technology. ... I didn't find myself reaching for it." Other entertainment options are perceived as more accessible, and as a consequence, VR takes "more steps to get comfy" (George).

Once time has been put aside and users are wearing headsets, physical discomfort such as eyestrain, headaches, nausea and fatigue from the weight of the headset prevents users from using the headsets for long periods of time. This means that **content that cannot be broken down into short sessions is deemed largely unwatchable,** including films. One participant explained: "After about 25 minutes, as the headset was heavy, this made me take breaks to massage my face and cool it down. This is why I usually choose to engage with content outside of VR" (George). Similarly, another participant, Astarte, found that while she was willing to spend no longer than 15 minutes in VR, she would happily spend hours on her gaming console, and she considered this an accessibility issue with VR. Of course, this has implications in terms of willingness to pay (see the section on economic value).

The headset is also perceived as "demanding a lot from you" in that immersion isolates individuals from the 'real world' for a period of time: "Thinking, oh God, has someone been knocking at my door for ages, you know? I haven't checked my phone, have I got a message from mum or something?" (Oscar).

> **"There were a lot of times where I'm like, Okay, I just want to play a game now. And I'm just already sitting on my computer because it's just right next to my bed and I'm like assessing my brain, like, I could just click two times on my computer to just pull up a game or I could grab that Quest if it's charged, then turn it on, yeah hope it's charged, turn it on, set the boundary again and then get the controllers and then start playing something."**
> **— Steven**

Fatigue

Although VR headsets are getting lighter and more streamlined, our participants still reported that the design does not yet permit long, sustained periods of use. Much of this is due to a lack of comfort. Some also reported feeling hot and/or flushed, chafing under the face pad, tired faces and necks from the weight of the headset, fatigued eyes, and having difficulty adjusting head straps comfortably.

For example, some participants reported having sore faces with red marks at the end of their VR experience, albeit with a sort of fascination - "as if I was an astronaut taking off my helmet" (Adeel). Others observed this kind of fatigue was not a feature of video games, with one invoking video games as a benchmark, noting that "if you're just playing PlayStation or PC, it's more comfortable" (Leo).

Fatigue therefore constrains individuals' usage of VR headsets. As noted above, some participants experience the headsets and controllers as somewhat obtrusive which, in turn, limits the time they spend in VR. One explained: "After I ended my final session, I also pondered upon whether or not a lighter headset and absence of controllers would allow me to spend increased amounts of time within VR" (Adeel). Motion sickness (see also the section on cybersickness) and physical fatigue frequently left users feeling "exhausted after a short session of play of about 15 minutes" (Dorothy).

The physicality of the headset is part of the investment participants must make in using the headset: "...It's just kind of heavy and hot. And also your hands get sweaty and that kind of thing.... I was just like, Okay, I put on a headset, make sure my guardian boundaries are okay, put on the game. Click, click, click over. I'm kind of tired. Okay. Turn it off. Put the controllers away. Put the headset away and put in your wires. It was a bit much" (Jake).

All participants in our study perceived VR as a more intense form of entertainment and consequently less usable in daily life: one has to "work up to a VR experience", unlike other media activities such as "watching Netflix" (Maya). Once inside VR, some content kept users "hooked," allowing participants to distract themselves from any feelings of physical fatigue. However, the toll the experience takes was often felt afterwards:

> **"Upon taking off my headset, I felt physically taxed by the experience. I needed to rest and regain my strength before resuming.... the stored fatigue, waiting to settle in, struck me, compelling me to immediately find a place to rest."**
> **— Adeel**

While the VR industry expects equipment manufacturers to find solutions to the discomfort experienced by users, discomfort is a burden that accumulates and has the potential to drive people out of the experience. In the interim, those working on design and delivery/exhibition of VR will need to consider the physical toll of immersive activity and seek ways to minimise it, taking into account the duration of activities, physical positions required for the experience, users' ability to customise kit to their personal needs, and on-boarding and off-boarding procedures (see the on-boarding and off-boarding section below).

IN FOCUS: Cybersickness

In our December 2020 survey of 250 VR headset owners, 52% agreed that nausea had a negative impact on their VR usage. Headaches and eyestrain, both of which are also components of cybersickness, were rated as having a negative impact by 59% and 61% of respondents, respectively. Cybersickness therefore remains a significant challenge for the immersive industry.

Cybersickness can occur across the full range of immersive technologies, including both AR and VR. Disorientation and nausea are key indicators, but many other symptoms have also been identified, including headache, eyestrain, sweating and drowsiness. VR usage is more likely to lead to disorientation and nausea, whereas AR usage is more closely associated with symptoms relating to eyestrain (e.g. Hughes et al., 2020).

Some aspects of cybersickness may arise due to sensory mismatches. This is because many immersive experiences represent motion only via visual displays, without the accompanying stimulation that is normally available to the other motion-sensitive senses (e.g. the vestibular system, which provides us with much of our sense of motion and balance).

Our long range youth study demonstrates that home users of VR continue to negotiate cybersickness in their VR activity. Some reported that they felt dizzy and even "almost fell over a couple of times" (Leo). However, it is worth noting that several embraced the realistic roller coaster simulations and the incumbent nausea, while others cut short their time in the headset to recover from headaches and disorientation. This willingness to experiment with cybersickness-inducing content seems to arise from a perception of cybersickness as an indicator of authentic experience. Jake explained, "The most impressive thing I think was the space station because it was really great, and it was really kind of fantastic how fast it gave me motion sickness that replicated that feeling of being in space, just like... being free from gravity and all that. And it really gave me a headache super-fast and it made me want to hurl." Users (particularly young users) may be willing to tolerate cybersickness if it serves the purpose of lending authenticity to the experience.

In location-based experiences, users can experience cybersickness, or its warning signs, after even a short duration in the headset. Audience members who participated in our focus groups at Limina Immersive identified jerky movements (either of the participant within the virtual environment, or of the environment itself) and reverse motion as recognisable triggers of cybersickness.

None of the participants reported actually being sick, but several echoed one female participant: "I think if that continued for a long amount of time, I could have been [sick]." It is worth noting two factors: that the 'jerky movements' in VR were sometimes caused by the user's inability to sense where the focus of attention should be, and driven by a **'fear of missing out'**, spinning around to look at different parts of the virtual environment; and second, that some participants valued reverse motion in particular, finding it soothing and relaxing, demonstrating the non-universal nature of such triggers. This suggests that behaviour adaptation likely plays a role in VR users' ability to overcome cybersickness.

Case Study: copernic360

Kagenova
Dr Elisa Ferré (Royal Holloway)
Prof Jason McEwen (Kagenova)

Current 360° VR experiences support 3 degree-of-freedom (3 DOF) rotational motion so the user can look around but no matter how the user physically moves, they remain frozen in the virtual world. The inability to move in the virtual world causes visual-vestibular conflict, which might easily trigger cyber motion sickness, a serious ailment causing disorientation and nausea. Kagenova has developed copernic360 to bring 6 DOF motion to 360° VR experiences, allowing the user to move about in the virtual world and thus alleviating cyber motion sickness.

We compared copernic360 to standard 360° VR in a controlled laboratory experiment focusing on both explicit (questionnaires) and implicit (physiological responses) measures of cybersickness to study the effectiveness of coperinic360 in alleviating cybersickness in a reliable, safe and statistically powerful way.

To eliminate visual-vestibular conflict in VR, it is necessary to restore harmony between the visual and vestibular systems of the body. This can be achieved if the user's visual system experiences movement in VR which matches physical motion experienced by the vestibular system. The problem occurs when the 360° footage is taken; the camera captures only one viewpoint of the scene at each moment in time. Kagenova's copernic360 leverages their geometric AI techniques for 360° photo and video content to synthesise novel viewpoints of the scene that were never captured when shooting the 360° footage.

The study shows that symptoms of cyber motion sickness such as nausea were dramatically reduced when using Kagenova's copernic360 6 DOF technology. In-fact, the study showed a statistically-significant 33% reduction on the nausea component of the test, according to the results of the Simulator Sickness Questionnaire, with participants feeling less nausea-related symptoms in copernic360 compared to Standard VR.

While 360° VR can transport users anywhere in the world – to enjoy, for example, virtual entertainment, tourism, cultural or educational experiences – today's technology supports only 3 DOF motion, so users cannot move around in the virtual world. This limits realism and can induce cyber motion sickness. Recently developed geometric AI techniques tailored specifically to 360° photos and videos, realised in Kagenova's copernic360 technology, can synthesise 6 DOF to allow users to move about in the virtual world, alleviating cyber motion sickness and substantially enhancing realism. copernic360 is available for integration into existing apps, platforms and streaming pipelines to enhance existing content in order to provide more natural and engaging experiences.

"It's fantastic to have independent scientific evidence verifying that copernic360 significantly reduces cyber motion sickness, making immersive experiences more natural and engaging."
— Prof Jason McEwen, Founder & CEO of Kagenova

IN FOCUS: On-boarding, Off-boarding

The processes of on-boarding (preparation and steps taken to move from the real world into virtual reality) and off-boarding (steps taken to move out of virtual reality and to re-adapt to the real world) have a significant impact on the VR user experience, whether this is in a location-based experience or at home. The purpose is to overcome or avoid the frictions that users may encounter where their experience meets the technology, these points of friction can occur well before the experience, during, and after.

When someone leading an experience, whether a researcher, an event host, or a user demonstrating content to a friend or family member, takes steps to avoid friction at the beginning and end of the experience, this constitutes on-boarding or off-boarding.

The ability to immerse several of one's senses in the virtual, blocking out the real world and moving in 3-dimensional environments, presents enormous potential for valuable VR experiences. It does, however, put the user at potential risk of injury, vulnerability, or disorientation, to name a few risks that need to be mitigated during careful on-boarding. The ability of VR to virtually transport the user comes with a need to ensure that this transport occurs safely and enjoyably.

Similarly, the transition out of a virtual world is not always straightforward, so there can be a need for a period of 'decompression' while the user readjusts to 'reality'. Behr, et al. (2005) highlight that these challenges can be cognitive (involving confusion between real and virtual information), emotional (involving a continuation of the emotions that were prompted by the experience) and behavioural (relating to adaptations that have occurred during the experience, such as adapting to a different body type).

Van Schneider (2016) has described a feeling of "post reality sadness" whereby the real world seems dull, disappointing and less 'magical' following a period of VR exposure.

The sense of fatigue reported earlier is not purely physical; **psychological fatigue is also commonly felt.** Users need to be in the 'right frame of mind' before entering VR.

Furthermore, the psychological transition back to the real world can be even more challenging than transitioning into VR: "When you're watching obviously you're in that place. So you're completely focussed on that. Definitely the biggest transition is going from being in that world back into the real world, that's by far the biggest transition. And it's much more amplified coming out of the VR into the real world than it is being in the real world, going into the VR" (Noah).

There is therefore a need for "a big adjustment back to real life" as it is "jarring" (Gordon) to return to reality. VR takes not just a physical toll but a cognitive toll as "all your senses [are] deceived" (Adeel), which is more demanding than other forms of entertainment. This highlights the importance of careful on-boarding and off-boarding in order to help users transition successfully and limit psychological fatigue.

Location Based Experiences (LBEs)

As pointed out in Digital Catapult's 2018 report, clear on-boarding for immersive experiences has a strong impact on user experience (Lessiter et a.,l 2018). The importance of clear on-boarding instructions for location-based immersive experiences was demonstrated by visitors to *Virtual Veronese* (see case study). Individuals who felt more certain that they "knew what to do" during the experience reported higher willingness to pay for it and a greater interest in repeating it.

Careful on-boarding can amongst other things, lead to a greater sense of shared experience (Allen et al., 2020) that can enhance what might otherwise be an isolating or intimidating activity. Good on-boarding is user-centric, with care and attention to the participants, the location, the genre, the time and space the experience is taking place within. Poor on-boarding pays little attention to these factors or to the relationship between user and technology: LBEs where headsets are handed to the user with little or no guidance, supervision, or orientation receive much lower user experience ratings. For example, users we surveyed at such events complained that they felt concerned about their safety, feeling "like they would fall down", and about hygiene, which is likely to become even more significant post-pandemic, e.g. "sweaty headsets" or "headsets that smelt of smoke" and "dirty optics".

In contrast, at Limina's immersive cinema, during on-boarding, users were welcomed into a quiet lobby where they could wait to enter the screened-off area for their experience. As users are often self-conscious in the headset, they noted that it was "nice knowing that you're not observed by the outside world". Hosts explained how the headsets would work and how the screening would proceed. Users were put in control of the experience by donning their own headsets, having had the adjustment explained to them, and could summon a host in case of difficulty. Similarly, Limina's hosts paid a great deal of attention to off-boarding, ensuring that users were allowed to remove the headsets in their own time, to readjust their senses to the real world where they sat, before having headsets collected and being invited to move to a 'decompression zone' where they could sit in a quiet environment, in low light, with access to water and comfortable seating, to transition at their own speed to the real world before heading back out to the busy Bristol waterfront. This calm environment was noted to help user groups to "travel somewhere and back."

There is an opportunity to further enhance the multi-sensory nature of immersive technologies: for example, one audience member noted that "we had some interesting smell in that room, like some trees and some herbs" which could enhance the immersion of content. User groups enjoyed talking through their experiences after transitioning back to the real world; some indicated that provision of a social space (distinct from the more 'calm' decompression zone) with invitations to share reactions would be appreciated.

The on-boarding and off-boarding procedures of Limina were congruent with providing a particular type of 'calm' experience for their audiences (many of whom were first-time users of VR), which began well before the experience, inviting them into a calm environment, and carried on after the experience ended, allowing them to readjust. Other LBE experiences have different emotional or experiential goals, and will need to consider on-boarding and off-boarding relative to these. However, from our research of location-based events, we can generalise three principles for user-centric LBE on-boarding and off-boarding procedures - they must:

- **consider users' diversity of experience and needs**
- **resonate with the genre of the experience**
- **be as integrated into the overall experience as possible.**

At home

Until the release of the Oculus Quest in spring 2019 and the Quest 2 in autumn 2020, the assumption in much user research has been that the majority of VR users would not be engaging with immersive content at home (Jarvinen, 2020). While our prototype research has to date mostly comprised location-based content, our long range youth study specifically set out to explore the potential for home use with future users. This has revealed several practicalities that have an impact on the uptake of VR.

Our participants pointed out several practical matters that affected on-boarding. The first is a temporal friction of VR: the readiness of the headset. Several reported that headset and controller batteries were quick to run down, and finding the batteries low had an impact on their ability to jump straight into VR content when the desire struck. Overcoming spatial frictions was also key in terms of feeling successfully immersed: this is part of the preparation for feeling safe while immersed in VR, with a tendency to think of VR as a 'confined space' that needs a 'safe space' to engage in: "I enjoyed using it in my bedroom the most because **it felt like a kind of safe space**' (Alicia).

Users noted that some content transitioned or oriented people to the virtual world better than other content. Even the perennial favourite *Beat Saber* was criticised for not having a better or more accessible orientation that would reassure novice users: "If they just gave you a little thing that you could find and put on just to explain that... Just relax... It's fine" (Adeel).

The different assumptions that content developers make about the user's skill level was also evident to our participants, particularly those who were sharing their headsets with friends or family. Many noted a bias towards gamers, noting that the non-gamers they introduced to VR struggled with controllers and navigation in particular. Over time, users do grow into their own 'VR legs' but this requires a commitment to corporeal learning that some of our participants lacked. Standardisation within the industry in user design and interactivity conventions across content might also go a significant distance toward quicker establishment of VR literacy.

Our participants mainly noted the practicalities of setup and on-boarding, but did also recount the physical adaptations required in off-boarding as a result of the experience, leaving participants tired and needing to rest: "After the session, all I wanted to do was grab a bottle of water and lie on my sofa to regain some energy" (Thomas). They reported the challenge that they and others they shared the headset with experienced in re-grounding themselves physically: "Most seemed surprised about how jarring it is to take the headset off and move around again" (Gordon). Beyond physical recovery, several noted they found the psychological transition more challenging, taking a cognitive toll. One user claimed that "the adjustment in immersion is more apparent when taking the headset off rather than putting the headset on" (Dorothy). A period of decompression was often required. Indeed, some content left participants finding themselves "**still thinking in that sort of world when I came [out of] it [for] a good 10, 20 minutes**" (Victor).

AI-Spy was an innovation in artificial-intelligence-driven (AI) storytelling for immersive environments, delivered at Broadgate in London. The project investigated the potential of AI for reading and responding to users' emotions and verbal responses.

The experience itself threw users into the lair of AI 'Spy Master' Alistair, who tested players emotionally and psychologically for a role in a new counter-intelligence agency. The interview was highly personalised, depending on how the AI detected and processed participants' age, gender, interview answers and emotions. Users' genders, ages and emotional responses were estimated through bespoke facial recognition software based on facial characteristics that were captured in real-time by a small camera. Their interview answers were registered through voice recognition. All this information combined to trigger a personalised path through the interview questions that was different for each user.

AI Spy was experienced by over 200 users in the heart of London's Broadgate district, with users randomly selected to take a 2-D or VR version of the experience. By doing this, we could compare how VR affected users' levels of enjoyment.

1. Can AI effectively read and respond to human characteristics, verbal and emotional feedback?

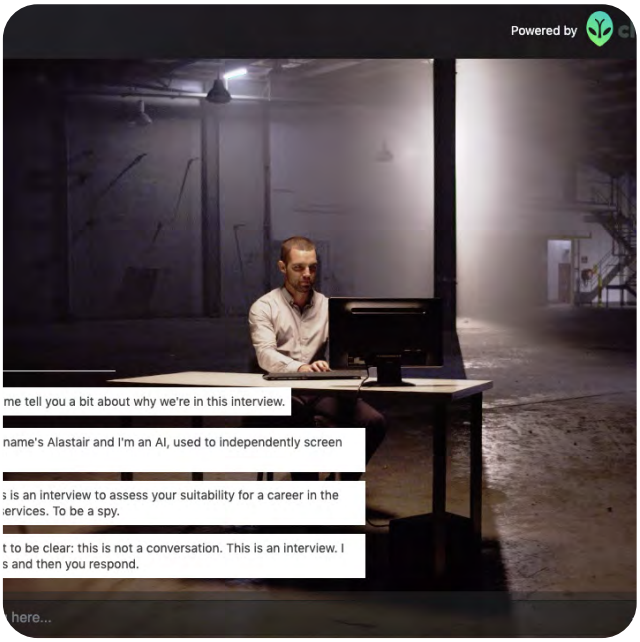
2. What value does VR offer to audiences in terms of engagement and enjoyment, compared with a 2D PC?

Personalisation of experience using AI can add value to immersive experiences

Over half of the participants noticed the emotion-based tailoring, and half noticed the age-specific tailoring. Almost all the users who noticed the personalisation felt that this tailoring added value to the experience.

Demand for more experiences like AI-Spy

The survey findings revealed significant demand for this kind of experience, with users reporting a high degree of enjoyment and repeatability. The large majority of users wanted more experiences like this at Broadgate and said that they would tell their friends about this, taking away a positive view of Broadgate as a result of the experience.



Case Study: RetroHunters

Discovery
Storythings

Funded as part of the Global Partners Initiative supported by UKRI and the Department of International Trade.

'RetroHunters' was a combined pilot show and augmented reality app experience, which explored the role of immersive storytelling in Discovery's emerging 'View and Do' strategy: to bolster Discovery Content consumption whilst also encouraging viewers' to go and try out the outlined activities.

The show stars Reginald D. Hunter, who interviews avid collectors of items from the 1980s and explores these collectibles first-hand. These collectibles included *StarWars* memorabilia, trainers and arcade games. The accompanying AR app lets viewers explore and interact with audiovisual representations of the collectibles presented in the show in their own homes. For example, a walking *Star Wars* figure of the AT-AT was shown in the app, and viewers could open and close its doors, and select other 'zones' of interaction to learn more about the object.

The project focused on whether both show and app were enjoyable, and whether they could trigger nostalgia and promote 'view and do' activities. The analysis also considered whether a key demographic (men aged 30-54, the core 'Discovery Demographic') responded differently compared to others.

Overall enjoyment

Both elements of the experience were well-received: the show was given a 4-star rating on average, whilst the app was given 3.8 stars.

Encouraging 'View and Do' activities

The more nostalgia people felt when exploring the app, the higher their reported likelihood of taking part in related activities in future.

The contribution of AR to the overall experience

The combination of the app and the show together (as compared to either element alone) led to higher levels of agreement with some key outcome measures. For example, 53% of individuals belonging to the Discovery demographic wanted to talk to friends and family about antiques and collectables after experiencing the show and the app, as compared with only 26% of those who had only seen the show (and 40% of those who only explored the app). Thus the show and app combined had a greater impact in terms of this measure than just the show or app alone.

Similarly, for individuals outside of the Discovery demographic, just over 50% of those who had seen the show and app reported wanting to watch more TV shows about antiques and collectables, compared to 30% of individuals who had only seen the show (and 32% who had only tried the app).

Augmented reality facilitated 'Nostalgic layering'

In-depth interviews with nine users showed that the objects presented were often experienced as a springboard or portal that transported them to their youth and evoked associated memories. Multiple elements of the experience (for example, the 'behind the scenes' political history of the MOCKBA trainer, the 1980 Moscow Olympics theme song, news clips from the era, the design of the trainers themselves) came together with users' own personal memories and knowledge, creating a much richer experience by provoking reflection. One user found the app highly effective for this, as it facilitated an exploration of objects beyond simply viewing a photo that 'doesn't do justice' to the object, and the modes of interaction evoked a feeling of childlike imagination and play that also aligned with their experiences of the objects. Vivid, highly social, contextualised personal stories were evoked, and users found this nostalgia pleasurable, wanting to discuss their memories of the objects with family members or friends with similar interests. The ability of the show and app together to provide additional context and history also connected users' adult interests with their childhood experiences, allowing them to reevaluate and understand elements of their experience in new ways.

Concluding Proposition: Audience Toolkit

Our audience toolkit, presented below, is an analytical tool which emerges from two years of research with immersive audiences on multiple StoryFutures and StoryFutures Academy projects. At its basis is a system of coordinates formed by two axes: one stretched between place and time and the other between platform and genre.

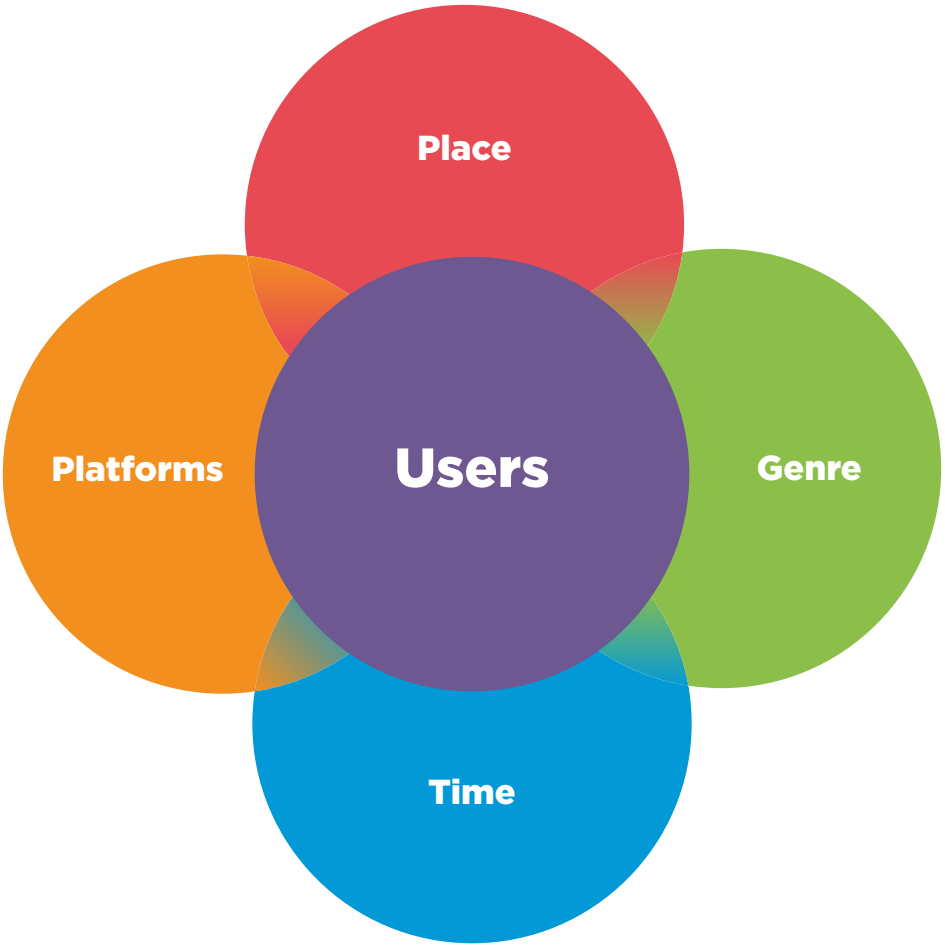
The framework is designed to be used before embarking upon the process of designing an immersive experience, at the brainstorming stage. It should also be consulted iteratively throughout the development process. It serves to ground any experience in a wider consideration of the affordances of the technology being used and the audience it is speaking to. This, however, does not need to be prescriptive. Finally, the framework is also of use in analysing audience responses to the completed experience.

Considering the *place* and *time* of the experience helps us position and understand the immersive experience within the flow of everyday life, in relation to significant locations and events, relationships and experiences, in a multitude of ways. It also helps us to think about the duration of the experience itself.

Thinking about *platform* and *genre* helps us understand and select the platform/device to be used (which will have implications in terms of who the audience will be and the size of that audience). It also allows us to analyse the intrinsic connection of the platform/device to the kind of experience being produced in its genre-based, style and aesthetic qualities. This axis therefore emphasises the connections between hardware, software, interaction design and the kinds of experiences these connections afford us.

At the heart of the framework is the user whose experience is shaped by all four elements.

Framework



Expanded Framework

Platforms

- What will be primary/secondary devices? What are the particular affordances of immersion these devices offer?
- Is reach or engagement more important?
- What physical and/or technological constraints do the devices bring?
- How/where will platforms interact?

Place

- Where are its primary & secondary home(s)?
- List the physical, health & safety, technological constraints and affordances of these places.
- How will users feel most comfortable/confident to try the experience?

Users

- **Who are primary/secondary users?**
- **How, and to what extent, will the user feel immersed? (e.g. presence, flow)**
- **What emotions do you want them to experience?**
- **What impact will it have on them: short term / long term?**
- **How will you know if it's successful?**
- **How important is a feeling of 'presence' for the user?**
- **When/where will you test with/involve the user?**

Time

- How long will the experience last?
- What time(s) of day will it be experienced?
- What barriers and/or opportunities do these times offer for users engaging?

Genre

- What type of immersive experience is it?
- What level of interactivity and what is the primary interaction or game mechanic?
- How will UX Design enable the kinds of immersion you are aiming at?

Defining our Terms

Place

In our framework, ‘place’ encompasses location (e.g. the National Gallery), space (e.g. amusement parks, cinemas) and place (e.g. bedrooms, dorms). Location usually means a specific point on the map. Space refers to an abstract space - an arrangement of elements that comprise, for instance, an amusement park without being any specific amusement park.

Place is a location created through human experience; it has specific objectives and emotional meanings. Our ‘place’ works across all three meanings: for instance, the National Gallery is an abstract space of the museum, a specific building at a known location, and a place with rich histories of meanings that extend from personal memories of visiting the gallery to the history of art and its values. People make places out of spaces and locations as they organise the world around themselves.

Time

We also explore the relationship between the factor of ‘time’ and the immersive experience. One element of this is the time of day or the day of the week when the immersive experience takes place - for example, whether there are any habitual correlations or preferred use cases related to particular times of day.

Another element is the duration of immersive activity, whether that be the length of time the user spends in a headset or on a device on any given day or occasion, or the length of time they spend engaged in a specific immersive activity.

This includes both the objective, measurable duration of activity and the subjective experience of time: losing track of time, for instance, can be an indicator of engagement and immersion. Detailed consideration of the factor of time in our research has revealed clear user preferences, desired physical and emotional states, and tolerance levels for a number of experiential frictions.

Platform

By the term 'platform' we refer to the generic socio-technical complexes upon which specific proprietary devices sit. In this delineation, platforms can be understood as encompassing the political, regulatory, social and technical parameters that frame the way specific devices function. In turn, devices exploit different potentials of these parameters and we need to also consider the overall ecosystem of devices that sit upon the platform.

Such an approach avoids a false hardware/ software dichotomy.

For example, whilst Virtual Reality is the platform, HTC Vive is one of the major VR devices on the market. Other devices, such as Valkyrie's haptic gloves, sit within the VR platform but are part of a specific device ecosystem aligned to HTC Vive.

Relevant platform/device configurations are outlined in Figure 5.1. Note that proprietary devices and systems intermix in different configurations.

Finally, as we are focused on users, our approach to platforms and devices is focused primarily on distribution rather than capture and creation.

Platform	Device
Virtual Reality	HTC Vive, Oculus Quest, Valkyrie Gloves, Sony PS4/PS5
Augmented Reality	iPhone, Google Pixel Phone, Samsung Galaxy, iPad, Tablet
Mixed Reality	Magic Leap
Web AR	Safari, Mozilla, Internet Explorer
Games Consoles	PS4, Microsoft Xbox

Figure 5.1

Genre

'Genre' refers to the type of experience (e.g. sci-fi, horror, nature documentary) and how it warrants specific kinds of interaction and experience design. User experience (UX)/design is significant here in creating and maximising a desired impact. For example, in a story-driven dialogue, where presence is key, UX must be designed so as not to disrupt this sense of presence.

UX design can also be thought of both in terms of the way users interact with the XR environment via software, and in terms of the way this interaction is restricted, or enhanced, by the software/hardware design of the XR device itself. It is worth noting, for example, that the same interaction mechanisms can deliver different actions depending on genre, e.g. the trigger interaction mechanic in a sci-fi game will often mean shooting a gun, whereas the same mechanic in a museum experience might be used to explore an object.

Given that immersive media are not yet fully developed as media in their own right, the genres associated with them are also continually being re-defined and therefore are not always precisely definable. The use of genre as a tool must therefore be able to adapt to changing meanings. It is worth remembering, however, that genre considerations are one of the most important factors in determining whether a user will be interested in an experience. The classification properties of genre can attract or repel potential users depending on the individual's understanding of a genre.

Users

The term ‘user’ refers to the person (or people/ audiences) engaging in the experience and is at the heart of our framework. Users can differ between each other both in characteristics that are more fixed (e.g. age, ethnicity and ongoing interests) and in states that can vary even over short periods of time (e.g. current goals, moods or cognitive capacities).

These differing user characteristics will impact on people’s responses to immersive experiences in ways that may be systematic and somewhat predictable. For example, women may be more likely than men to experience cybersickness, and a person’s current goals will determine the way in which their attention is allocated.

However, they can also impact in less obvious ways, for example, young users using VR to unwind as a respite from multiple other screens/ digital devices that demand their attention.

Ultimately, the user has the final say in the meaning and value of any experience - and is therefore central to our framework.

Using the Framework

The Audience Framework has emerged out of StoryFutures audience insight research, foregrounding points of inquiry, impact and meaning in user experiences of immersive technology. There are two noteworthy affordances of this framework.

First, the framework facilitates an iterative development process, as it is equally useful in initial conceptualisation and scoping as it is in developing user testing plans. Over recent months, StoryFutures has tested the audience framework in its StoryLabs, using it to centre the development of immersive solutions to the challenges our institutional and corporate partners raise on the users themselves. By starting with audiences rather than technology, the audience framework has the potential to give rise to even greater innovation, ensuring that projects fit the users and the experiential goals of the project. It has helped us and our stakeholders to develop a design process that consults users at key points of development, and that keeps the affordances of place, platform, time and genre, as experienced by the user, at the heart of the process. We suggest that it is a tool that can be incorporated by any stakeholder in the development of immersive content, to ensure that a detailed picture of end users is generated, and that the content is checked against this regularly to ensure it meets the goals of the experience.

Second, it accommodates an interdisciplinary approach to understanding immersive audiences. This is a critical development for the field as immersive research to date has been reliant on the quantitative approaches of human computer interaction and psychology, which, although enormously valuable, tell us only part of the story. Our research brings the cultural dimension of the immersive experience into contact with its quantitative expressions, putting the user at the heart of immersive design. This begins to address a recent call for interdisciplinarity in audience research generally, although rich insights from even more disciplines are needed:

> **"...[I]nterdisciplinarity is essential for audience research, which can never prosper without the art form specialisms offered by performance theorists, museologists, musicologists and media studies scholars; it will never truly flourish without the insights of psychologists, sociologists, psychotherapists and phenomenologists, alongside academics drawn from the all too disparate fields of cultural policy, arts marketing, cultural studies and biological sciences. Once we add into the mix the requisite methods and methodologies that range from ethnography to biometrics via big data analysis, we have a truly hybrid discipline that rightly reflects the complexity of capturing and attempting to make sense of audiences' diverse experiences of arts and culture."**
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> **— Hadley et al., 2019, p. 81**

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