

### **Jed Ashforth**





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"I've always thought learning to use VR can be likened to learning to scuba dive.

It needs familiarity with the equipment, a working understanding of how it functions and thus how to correct problems that arise in the moment, and the understanding that it will take a number of sessions before you become fully acclimated to the physical experience and the psychological factors that accompany it."

- JED ASHFORTH



#### - INTRODUCTION



JED ASHFORTH Immersive Experience Specialist

### YOUR USER COMES FIRST.

Virtual Reality, Mixed Reality and Augmented Reality will be familiar names for many of you. For those of you that have stumbled into reading this by accident, they're a family of extended reality (XR) technologies which represent a bright and exciting set of new opportunities for lots of different use cases, scoping in entertainment, education, enterprise, marketing, industry, fashion, the arts, and many more besides.

XR gives us powerful abilities to augment our existing world with digital elements we can control and interact with, or to create and experience entirely new worlds and realities where we, as creators, get to set all of the rules. But of course that power is inherently coupled to the responsibilities we bear towards anyone and everyone who visits these virtual worlds.

Creating entirely synthetic realities is a new skillset for us to learn, but we have strong foundations to build on. Humans have had more than fifty thousand years of experiencing reality as users, interacting with the world and the landscape around us, so we have a pretty good understanding of the way things work.

So, when we're building a **virtual** world, it's tempting to assume that we just need to simulate the **real** world as far as we can go, and then make our edits. Bingo! Slide a few sliders, change a few numbers. Add a few new rules to reality, and maybe tweak some existing ones that may not be convenient for our game or app.

What could go wrong?



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If you've worked in VR previously, then you probably already know that the answer is that **a lot can go wrong**!

Those six million years of experience have made each of us an absolute expert at spotting when things feel unreal or incorrect, down to the tiniest detail - and it's very hard to fool an expert. And just as importantly, the way our human biology functions has evolved to deal with the very specific rules of the reality we've always lived in. Suddenly presented with a different reality and different rules, those systems often won't function properly, and can give unexpected outputs.

Anyone creating a new reality for a human user has a lot to think about, and a lot of responsibility towards how that world will affect them. Either your user has to adapt and evolve to the reality you create, or the reality you create has to be built around the needs and expectations of your user.

Understanding all the challenges and differences your user will face both inside and outside the software experience - is essential to either route. So we've created this breakdown of the most common comfort considerations that any VR designer or creator might face.

This knowledge is an essential first step in creating experiences that always prioritise the user, and the user's needs, before all else. And if you want to dig further, and get an even deeper understanding to elevate your user's experience in VR, just get in touch. We're here to help.

Keep safe and well, and make sure you do the same for your users.



Jed Ashforth Founder / Immersive Experience Specialist





6 unique things vr designers aluays need to be thinking about







– 6 UNIQUE THINGS VR DESIGNERS ALWAYS NEED TO BE THINKING ABOUT

# **VR IS AN ESPECIALLY** USER-FOCUSED MEDIUM

Underneath everything we're doing through our software, we have to remember that above all else, we're designing new places and experiences for human beings to inhabit.

The user has to come first in your thinking at all times. This, of course, is a truism of design in every industry and medium. But in immersive design, this importance ramps up significantly.

In VR, there are many unique and unusual considerations - and risks - that demand you put the user at the forefront of your thinking at every moment, with every creative and technical decision you make.

A good way to think about the difference is that users **interact** with screen-based apps from the outside, whereas they **inhabit** immersive apps and experiences.



- 6 UNIQUE THINGS VR DESIGNERS ALWAYS NEED TO BE THINKING ABOUT

# **2 VR DOESN'T WORK WITHOUT TRUST**

### More than any other medium, we rely on a rapport of total trust with our users.

We ask users to blindfold themselves, shut themselves away from the world they are familiar with, and then place their trust in our software to lead them safely through a new, unfamiliar world whose properties, rules and experiences are entirely at the creator's whim!

This creates a new and entirely unique relationship between the content and the audience, requiring an unusually responsible and understanding approach from creators. Beuond just providing entertainment or utility, your experience has to act as **host, guide, teacher** and **carer** for your users.

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vr discomfort

6 UNIQUE THINGS VR DESIGNERS ALWAYS NEED TO BE THINKING ABOUT

# **B** WE HAVE TO PRACTICE CORPOREALLY-CONSCIOUS DESIGN

VR is fairly unique in needing content which functions differently but works equally well if users experience it seated, or standing, or walking around.

VR Content also has to dynamically adapt to all sorts of physical aspects; the size and shape of each user's physical play space, the user's height, their handedness, their visual acuity, their reach distance, their mobility, the shape of their face, and sometimes even the type of chair they're sitting on! And we want it to function the same, and emulate the same input sensations, whether our user is holding a controller and pressing buttons, or just using their fingertracked hands and tapping the air.

**Every user is different**, with different needs, different abilities, and different wants. And because VR encourages more physicality and spatial interaction than just pressing buttons on a controller or tapping a screen, we always need to offer our users **choice**, regardless of their constraints, abilities, play space, play style, and personal preference.

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- 6 UNIQUE THINGS VR DESIGNERS ALWAYS NEED TO BE THINKING ABOUT

# **4** THE SECURITY OF THE SCREEN FRAME IS GONE

Taking away the borders around the image and filling your vision is one of the ways VR seeks to trick player's brains into believing the experience is real.

But that means you're also taking away the security and separation from reality that the screen gives, the safety fencing that the screen's borders have always provided for audiences. Viewers peer at horror movies through one-way safety glass. Gamers have used abstracted and complex remote controls to operate their avatars on the other side of the screen.

This has always been the foundation of how we create and experience screen media. But with VR, we're putting them **in** that world - no seperation, no safety barrier, nothing to keep it caged and contained. All while aiming to make it immersive and believable.

#### As such, the ways the user engages with this fiction are very different than in other mediums, and doesn't always

synchronize with many of the tools and techniques that creators and audiences have become familiar with. This isn't just a twist on the existing creator-audience relationship; it's a complete redefinition with acutely different stakes.

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**6 UNIQUE THINGS VR DESIGNERS ALWAYS NEED TO BE THINKING ABOUT** 

# **5 FIGHT, FLIGHT, FREEZE 0R EMERGENCY-EJECT**

VR is essentially a very clever magical trick; an illusion that aims to trick the user's senses into believing that what they're experiencing is real and tangible.

When done correctly, it can be amazing and powerful. But it can also be a somewhat new and downright weird experience for users.

Consciously they know they're wearing a headset, and that it's all make-believe, but at the same time their subconscious responses can react as if they're facing real threats and challenges. We see the same responses time and again.

Some may freeze in terror and be unable to respond. Some may take flight from our virtual terror, causing them to career blindfolded into a real-world obstacle. Others will react with a fight response and lash out aggressively, which is the cause of many a smashed lamp or broken TV screen. And others will just nope out by tearing off the headset and flinging it across the room, vowing 'never again' to VR.

All this is on us. As the magicians performing the trick, **we're the ones responsible for however they might react**.





- 6 UNIQUE THINGS VR DESIGNERS ALWAYS NEED TO BE THINKING ABOUT



# **6 HEALTH AND SAFETY CONSIDERATIONS**

Our bodies are amazing. Over millions of years of evolution, our physiology has adapted and fine-tuned itself to deal very specifically with all the ways we interact with the real world around us in our day-to-day lives.

But now, for the first time in history, we are at a point where XR technologies present us with endless opportunities to bend, break or abandon the laws of nature in an entirely simulated world, all while working to convince the user that what they're experiencing is real.

And guess what? Our finely-tuned instincts for dealing with the real world don't always adapt easily to the differences in the simulation. For some users, VR presents an experience that's hostile to their physical and mental wellbeing. It's hard to think of many other entertainment mediums where even trying it once can be a roll-of-the-dice moment for a user, and a first impression that may stay with them forever.

**Understanding the causes and triggers of VR discomfort is essential** for designing safe, enjoyable experiences which a wide range of people will be able to enjoy with confidence.



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# so ... just what is vr comfort anyway?





- SO WHAT IS VR COMFORT ANYWAY?

# VR Comfort? VR Discomfort? VR Sickness? Huh? Wha? IDGI - Explain..?

Sure thing!

And don't worry, you're not alone if you're confused with some of this terminology.

A decade ago we really only thought in terms of motion sickness - a well-known VR phenomenon which had always proven a barrier to entry for the technology since Ivan Sutherland first created it in 1968. But with the explosion of commercial VR development in the last 10 years, our understanding of the user's needs within an immersive environment have blossomed into a more precise - and PR-friendly - lexicon of terms.

**VR Comfort** is the collective term we use to refer to any aspect of the Virtual Reality User Experience (VRUX) that will impact the player's physical or mental wellbeing, in either a **positive** or **negative** way.

As such, the term encompasses the whole spectrum of good and bad impacts, and has become the umberella term that describes this whole sector of VR design and implementation. That's because it sounds much better for the industry to be talking about comfort with respect to this technology (and giving off a nicely positive shine) than it does to talk about Sickness or





#### - SO WHAT IS VR COMFORT ANYWAY?

Discomfort, which are inherently negative words, and ones that could easily become the biggest talking points about the technology if industry representatives and tastemakers adopted them into their day-to-day vocabulary.

We used this approach at PlayStation when first defining our internal terminology during the early development of PlayStation® VR, and made sure to use it at a lot of talks at internal conferences on the subject, and encouraged it as the standard. I like to think it let our PR teams skip a few moments of discomfort themselves when we later had to address the very real issues of user comfort in VR at developer conferences and when talking to the press. Other manufacturers took the same approach. As a positive moniker for a sensitive discussion point it became common industry parlance, and most games and apps we see today feature 'comfort settings' - a definite improvement on terms like 'anti-sickness options' that we saw some early developers submitting in their builds!

But it is also, of course, used in it's normal day-to-day capacity to describe the aspects with a **positive** impact on wellbeing specifically. It goes without saying that when we're talking about the wide overall scope that 'VR Comfort' refers to, as developers we should always be seeking to move towards the comfort end of the spectrum.

**VR** <u>Discomfort</u>, by contrast, focuses on those aspects of the VRUX that induce any kind of negative reaction on the user's well-being. It goes without saying that these are elements that anyone crafting a virtual reality experience will always be looking to avoid, since their effects on the user will be unpredictable and may be severe. While patterns might be emerging as to who might be affected, **it is impossible to predict the reaction of any given user**.

Different aspects of the VRUX can trigger different responses in different users. Some lucky users appear to be immune to any ill-effects and are able to play, work and exist in VR for long periods. Many users can tell stories of how they developed their 'VR legs' over time. Other users will find they have a specific achilles heel or two which can trigger the onset of symptoms - such as travelling up virtual stairs, or being in a world that's slightly off-scale. Plenty of users bring their existing fears and phobias into VR experiences with them, or sometimes discover new ones. And some unfortunate users will experience the onset of severe discomfort within moments of first donning the headset and may never want to try again.

And these reactions are not limited to dropping someone straight into an intense VR experience, as you might expect. In some cases, users experience the onset of discomfort when they're simply looking around a menu screen or waiting during a boot-up sequence.

We'll look at some of the aspects that can trigger those responses later in this book, and discuss strategies to design VR experiences that avoid or mitigate these triggers.

For those VR users who do start to experience discomfort, there are several typical onset indicators that can emerge, all of which are symptoms of what is, nowadays, called **VR Sickness syndrome**.

We're going to throw up (!) some details around that in the next chapter.



vr discomfort

- SO WHAT IS VR COMFORT ANYWAY?

# **REMEMBER** The User Always Come First!



Every VR User responds uniquely to different discomfort triggers.

Comfort needs are not predictable. Triggers can vary with each game or application.

So we must never make assumptions about a 'typical' or 'average' VR user.

While in your world, you must be their **Host, Guide, Teacher** and **Carer** 

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vr discomfort



# telling you all you need to know about vr sickness







- ALL YOU NEED TO KNOW ABOUT VR SICKNESS

## What is VR Sickness?

VR Sickness is a syndrome which is also commonly known as Cyber Sickness. It's also sometimes referred to as Simulator Sickness, Motion Sickness, or even Sea Sickness.

Technically, these are all different things, even if they share many of the same symptoms, they all arise from distinctly different causes. And despite the name, it doesn't **only** occur while the user is in VR, although this is the most common form.

Sometimes, a user can enjoy a comfortable VR session, then suffer from post-immersion Reality Sickness, also known as Exit Sickness, which is triggered by your return to the real world.

While it manifests itself as some combination of onset symptoms in response to various triggers caused by the experience, the exact combinations will vary from user to user and will vary between different content types.

vr discomfort

Whatever people call it doesn't really matter though. When a user evokes these names or describes their symptoms in relation to VR, we can all understand what they're referring to.

Understanding how to even combat the symptoms can be surprisingly challenging for users, with a lack of 'official' focus on the issues from the hardware manufacturers, and little guidance beyond 'take a break or consult your doctor'. This often drives them to seek out info for themselves on Reddit forums and Discord groups. Apps and platforms are understandably prone to shying away from actually giving users any remedial advice in this area due to various liability risks this would expose them to.

This all means that over time there's been some mystique and misunderstanding built up around the subject of discomfort in the public sphere, and over time it has become inextricably linked to the technology in the wider public consciousness. It remains one of the big barriers seperating VR from wider adoption (but not the only one!) and is a definite offputting factor for many people who are worried about even trying the technology. "Not until there's no risk of me vomiting" is a reasonable low bar that any technology or form of entertainment should expect to be able to pass. Currently, it's proving hard to predict

### **COMMON SYMPTOMS CAN INCLUDE –**

Headaches
Disorientation
Vertigo
Sweating

- O Eyestrain
- Loss of Balance
- O Loss of colour to skin
- O Nausea / Vomiting

who will be affected and to what degree. The only reliable way for a user to determine how they personally will be affected is to try the technology out.

**VR Sickness** isn't an inevitable outcome of experiencing discomfort, but it is an outcome that has affected over 60% of VR users at one time or another. From a designer's point-of-view, the most responsible approach is to regard it as a constant, ever-present danger that's guaranteed to affect at least **some** of our users.

The symptoms can be mild or severe; it depends on the individual user and the individual triggers inherent in the software that they're experiencing. While you can't reliably account for what will trigger any specific individual user, we do have a good general understanding of the types of triggers in VR that will probably affect **some** of your users.

But as we've said, every user is different. That's just like considering every person in our real world. They have different expectations about how the world works based on their own history, culture and life experiences. Creating a synthetic reality that feels real to all people is a target designers shouldn't be expecting to aim for. In VR, there are a myriad of triggers that affect the believability of the world in different ways for different users. Anytime expectations fail to be adequately met can conceivably add to the user's discomfort, and discomfort can stack to induce sickness symptoms in the user. It's impossible to find a one-size solution that keeps all your users at the highest possible comfort levels throughout.



This means that a strategy of allowing the user to **understand the triggers** that might be affecting them, and allowing them to **tailor their experience to avoid these triggering effects**, is the safest route, and has become the de-facto best practice approach to ensuring your VR experience is comfortable for the widest possible audience, thereby maximising your potential audience, user base, and revenue capabilities.

Some lucky users prove completely immune from first contact. (Some lucky developers are immune too, and if that's you let me take a moment to envy you - but please remember that doesn't mean your users are immune. Remember, there's no such thing as a typical comfort response, and any developer working with the tech should recognise their use cases and exposure patterns are certainly non-typical. Make sure you design for all your users, not just yourself!)

The majority of long-term users will have undergone a period of conditioning and adaptation as they retrain their brain to deal with the aberrations and anomolies that VR can present, either organically, or through purposely following an acclimatisation regime. There are endless social media threads with recommended acclimatisation plans, progressing through different apps of escalating intensity, and such recommendations can be useful tools for those earning their 'VR Legs'.

And some unfortunate souls are simply very sensitive to the trigger causes, and have a bad reaction within seconds. Sometimes this might be becuase of content choice, but sometimes it can happen within seconds of them landing on the welcome screen. This might be down to particular sensitivity towards frame rates (in much the same way migraine sufferers can be triggered by flickering screens and overhead lights) or it might be that they just have a really strong reaction to the uncanniness of the simulation. Every user is different.

"Zero risk of it making me vomit" seems like an implicit user expectation that most technology would be measured against

#### So what causes it?

Yeah, this whole area is still a bit of a confusing mess. There are multiple popular theories, but there's currently no universally agreed explanation as to the exact biological cause, and why different users are affected to different degrees.

The leading theory, **Cue Conflict** theory, offers perhaps the most practical and useful insight for designers, but none of these theories actually prove 100% reliable for predictive purposes. That might be because we need more data from a wider sample pool, which is a common problem for this sensitive area and a nascent technology, or it might be that the theories are plain wrong. I suspect it's a little bit of both, but time will tell.

That might sound like this whole area really is just a complete unknowable mystery, and therefore a big development risk, but have faith, there's good news waiting in the next chapter!

vr discomfort

### **CUE CONFLICT THEORY**

Cue Conflict Theory proposes that discomfort is caused by a mismatch between what we EXPECT to see & feel, compared to what we ACTUALLY see & feel in VR.

It supposes our bodies are tuned to expectations of specific sensory input based on past experiences and biology.

This means that familiarity raises expectations, and therefore extended exposure / acclimatisation can reduce symptoms.

It's generally regarded as a good working hypothesis, and accords with much of the data we see. However, as a theory is has low predictive value – these results consistently occur ... but only sometimes. The symptoms are also not useful biological reactions, so it doesn't make much sense as an evolutionary development.

### FURTHER THEORIES

There are several other outlying theories that have been proposed as well. Here's brief summaries of 3 of them -

#### Eye Movement theory

Unusual tensions in eye muscles (which occur using most VR systems) agitate the cranial vagus nerve, which is responsible for several important survival functions like breathing heart rate. This leads to dizziness and sickness.

### Subjective Vertical Mismatch Theory

This is basically a refinement of conflict theory with; it considers the important factor to be the mismatch between our 'sense' of verticality, which gets confused even slight mismatches with our sense of verticality derived from our visual input.

### **Negative Reinforcement Model**

Your body detects that VR is the cause of the mismatches it's getting, which it regards as both a potential harm, and is leaving you vulnerable. So it induces sickness/ nausea to make you stop.

### POISON THEORY

Poison Theory suggests that sensory mismatches and the associated dizziness are interpreted as signs of poisoning – and so, as with excess alcohol or spoiled food, our body acts to evacuate the stomach.

Arising to explain the shortcomings of the Cue Conflict and Postural Instability theories, on the surface it makes sense. People do get sick and fall over when they're too drunk, and it fits that the body is assuming the sensory mismatches inherent in VR mean that we're drunk or ill. It makes more evolutionary sense than the other theories.

But yet again, it's a theory that unfortunately has low predictive value. Children generally seem more resistant to simulation sickness, but are biologically more vulnerable to toxins. Deeper data is needed to confirm this, but with most VR equipment only rated for 12yrs +, studies in this area are likely to remain few in number, and small in sample size.

# **URAL INSTABILITY**

**Postural Instability Theory** is a proposal based around our brain's ability to continually monitor a diverse group of sensory inputs to continually make tiny corrections to our posture in order to maintain balance.

The theory is that when there's missing or unexpected sensory inputs, as happens in VR, it hampers our balance systems' ability

This makes some sense - balance issues and dizziness often manifest as the first signs of VR discomfort. It also explains why we can acclimatise - the constant compensation and retuning means we adapt over time, and familiar activities are more ingrained and harder to 'retune'.

There are holes in this theory, though - loss of balance and dizziness don't consistently manifest first. That means it has low predictive value to us. And again, the onset of naușea serves no evolutionary purpose in



#### vr discomfort



# The Bucket of Strange

It's not usually a single trigger that causes discomfort, it's far more likely to result from the aggregation of all the strange sensations and mismatches the user has encountered thus far.

Here's a practical way to think about it. Anything the user's brain can't immediately reconcile goes into a bucket of strange, unfamiliar and unexpected experiences. It's like a bucket of failed expectations.

As mismatches and aberrations stack up, at some point that bucket can get too full, and the user feels too bad to continue.

It's possible to manage discomfort by emptying that bucket over time. More gentle pacing and lower intensity experiences gives the user breathing space and time for the bucket to settle.

Even one or two strong mismatches can be enough to fill an empty bucket in one go for some users, especially with new users (sometimes affectionately known as 'VR Virgins'). It's important to allow opportunities for 'downtime' between intensive moments so that the contents of the bucket can settle and dissipate - something I like to call 'making time to touch the virtual grass'. Characters, narrative, distractions and interactions can give your user to reason to slow down for a few moments and allow themselves to be re-grounded in your world.





# so...how do we combat vr discomfort?







- HOW DO WE COMBAT VR DISCOMFORT?

# If all that theory makes you weary - Good News!

As we've seen, the exact physiological processes that cause VR Sickness are complex, and very much still under investigation.

These competing theories can't completely explain the symptoms, and also can't provide much insight that can be used to predict **who will be affected**, or **when**.

There are many other factors involved which cloud the general understanding of discomfort even further.

We have military and academic research data into Simulator and VR sickness going back more than half a century, but the primitive frame rate, restrictive field-of-view and overall discomfort of the VR systems of the past offer very little useful insight into the problems with today's systems, where those technology constraints have been massively eased.

Many modern studies have questionable methodologies, with lots of anecdotal findings & assumptions, and often very small sample sizes. Statistics you'll see commonly cited are sometimes from informal studies and polls of under 50 people, using software with more primitive design and UX issues that are no longer prevalent. The rapid pace of advance in VR technology makes it a fast-moving target, and the potential variances from one VR system and piece of software to another can be huge and significant. It's hard for large scale academic studies to stay relevant.



It's also worth considering that manufacturers and developers aren't always keen to initiate or publish research efforts that shine a spotlight on VR sickness, for obvious reasons. Hilighting those potential problems is not great marketing. And once a business entity acknowledges their product contains an inherent risk of adverse effects on it's users, it also then also accepts the burden to act in its full capacity to address those issues. As such, openly discussing their findings might prove very expensive. It's not surprising that VR discomfort is an area that doesn't see as much research or focus as it deserves, even though it's a problem every VR experience must challenge itself with.

All of this means there is no workable baseline predictive model and that it's unlikely we'll see one of any authority and weight until the tech advances slow down, and the user base gets larger and more varied. **None of this helps when we need a solution to get over a development or business hurdle**.

#### Finally - here comes the good news!

Luckily, most of this is of very little use to developers anyway. It's not necessary to **solve** all of these problems before we can create an immersive VR experience that can appeal to the widest audience. So now you know about the theories, you can mostly forget them. Yay!

What's far more important is to recognise and understand the aspects in the software and hardware experience that might trigger feelings of discomfort for any given user (and every user is different, remember!) to determine whether the best route will be to **mitigate against** the possibility, **avoid** the trigger entirely, **acclimatise** the user to the trigger, or **equip** the user with the tools and training to decide for themselves. Let's take a look.

MITIGATE

**Mitigation** is always the first strategy to consider when trying to solve a VR discomfort issue. Many common discomfort triggers can be 'tuned down' through the use of mitigation techniques, and thus have less of an intense effect on users.

**Best practice** is to make sure these options are elective and always immediately accessible, to take care to offer the most widely-comfortable options by default, and teach the user about changing them during onboarding.

One **common example** of this is reducing **Vection** effects. Vection is the illusion of movement through visual cues, and is a common challenge in VR and can be a strong discomfort trigger for many users.

One solution might be to mitigate the effect through the use of **VR blinkers**, also commonly known as **Vignetting**. Like blinkers on a horse, this strategy reduces the user's view of visual cues in their peripheral vision when they move, and can scale dynamically to cater to more intense triggers from faster virtual movement.

Sector Sector



Vignetting in

Google Earth VR

#### HOW DO WE COMBAT VR DISCOMFORT?

AVOID

There are some discomfort triggers where there simply isn't a viable mitigation solution, or where the mitigation solution takes too much away from the user experience you're trying to create by newtering it too much or by destroying the user's immersion. Sometimes it's better to just **avoid** the trigger conditions entirely, and thereby remove the problem from your list of things-tosolve!

That doesn't need to be a cause for excising a whole sequence or removing an important moment. In my experience, such drastic redesign is rarely necessary. There are always **alternative ways** to communicate a narrative, portray an interaction, or evoke a real-life activity which don't include the trigger effects and can be comfortable for users.

A **good example** of the Avoid strategy is the common practice of allowing **Teleport** movement in a VR experience. By not showing any visual movement and instead warping straight to a new position, we can avoid any of the potential vection triggers altogether.

### ACCLIMATISE

Learning to use VR can be likened to learning to scuba dive; it needs familiarity with the equipment, and the understanding that it will take a number of sessions before you become fully acclimated to the physical experience and the psychological factors that accompany it.

There's plenty of anecdotal evidence to suggest that, for a significant number of users, VR activities that initially cause discomfort may be **acclimated to over time** as users gain familiarity with the trigger experiences. Rather than re-programming their expectations about what it should look and feel like to walk or drive a car, users over time can build up a new set of expectations for experiencing those activities in VR. Like learning to breathe from a scuba tank, it can soon become normal and comfortable, while still being a distinct experience from breathing out of the water.

Smart design and onboarding can set the user's expectations in advance and begin the acclimatisation process before the users ever reach the trigger point.

There's an extra parallel with the Scuba analogy that belongs here - VR, like scuba diving, is a complex and potentially dangerous pursuit for the user. It's important that, when an issue arises, the user encountering it has a working understanding of how the VR experience functions, and thus can **build an understanding of how to correct problems that might arise in the moment**.

Teleporting in Budget Cuts

There's a lot for users to learn about VR just in terms of using the hardware. Add in the complexity of using your app as well, and it's not unusual for new users to feel out of their depth, and immersed in an unfamiliar and potentially hostile world they don't know the rules to.

In contrast to the understated, familiar minimism of many of today's user interfaces, your VR design needs to **equip the user with options and tools to tailor their experience** to their unique needs, and the knowledge of **how, when, where and why to apply them**. In a discomfort situation, users need the shortest path to a solution. The longer they suffer discomfort, the more chance they'll emergency eject, and perhaps never want to try it again.

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# vr comfort isn't just about vr sickness







# It's not? So, what else do we have to consider then?

#### There's a lot of other factors to consider in terms of VR comfort - it's not just about avoiding discomfort triggers and stopping the user from experiencing sickness symptoms.

The moment-to-moment experience of VR is seeking to pull off an incredible illusion, convincing the user that they are present in the virtual world, and making them forget about the real world. But when real world considerations such as **fatigue**, **mobility** and **visual acuity\*** start coming into play, they're a constant reminder that this isn't real, that it isn't quite right, and that these activities seem harder or more awkward in VR than they do in real life. That makes it hard to keep the player immersed, and harder to keep the magic trick going. Every time the user surfaces from the virtual world to consider the real world, we have to find a way to re-engage and re-immerse them.

And there are lots of real-world factors that can affect the user in the virtual world, and lots of virtual-world factors that simply don't equate to the real world we're still feeling outside of VR. While today's VR hardware takes care of all the technical requirements to connect players to a VR world safely, we still have to remember that our content can introduce comfort issues inside the headset, and that the real world outside the headset is also likely to affect the user while they're in the experience.

There's a lot of factors, then, that VR developers have to keep in mind at all times. Some of these we have control over (the intrinsic aspects of our content) and some of them we have to accept that we can't change (the extrinsic real world factors) but we can predict, design around, and hopefully accomodate.

#### While this isn't even approaching being an exhaustive list, these are some of the most common elements of VR comfort that aren't necessarily sickness triggers, but that still affect the user's comfort.

As such, we often work with clients to help them consider and address the many different comfort requirements that can affect their users, outside of straightforward VR Sickness considerations. If you'd like to see if we can help you the same way, please reach out to us - our details at the end of the book.

\*visual acuity - a measure of the ability of the eye to distinguish shapes and the details of objects at a given distance









#### VR COMFORT ISN'T JUST ABOUT VR SICKNESS

### **ROOMSCALE - STANDING - SITTING**

XR offers a unique challenge - we need to design for 3 very different ways users can interact with your world.

Where possible, allow seated users to play your game. Do this for both mobility-affected users and for tired users who just want to chill on their couch

For seated play, every interaction needs to be within reach for these users. As such, it can be most efficient to design for seated play first, and then transpose this into standing play.

The standard 2m x 2m space requirement for Room Scale is available to around 75% of US users, but roomscale is much less viable for UK, European and Japanese home audiences.

Room-scale-specific experiences represent a small minority of home VR use overall. Only a handful of commercial games commit to a room-scale only approach in their design, but for location-based VR and Immersive events, this approach is more common.

### NON-ELECTIVE MOVEMENTS

Nothing snaps us out of the VR illusion quicker than seeing our bodies behave in unexpected ways.

Movements that the user hasn't initiated - like animated hand gestures, visible arms moving in ways our real arms aren't, legs out of synch with our own, or our bodies moving through the world unexpectedly - not only break the sense of immersion, they can also contribute significantly to the 'Bucket of Strange'.

This is why we often only see our hands in VR, and not our full simulated avatar bodies. There's a lot of guess-work depending on the tracking solution that your target VR system is using, and usually there's lots of parts of your body that aren't tracked, or can only be partially tracked.

Guessing the limb positions wrong is more likely to cause a break in immersion and/or add to discomfort than if we just don't see them at all.

### **FUNDAMENTAL TRUTHS**

There are a lot of constants that are enduringly solid and dependable in our reality, and form the foundations of our experiences and expectations about how the world will behave.

Examples include the direction and strength of gravity, the position and orientation of the horizon, our speed of movement, field of view, our height, and many more. Changing these constants is usually a fast-track to causing discomfort symptoms in a large number of users.

Remember, expectations are everything in VR. If something delivers an innacurate or unexpected experience, our brains will have trouble accepting it as real, and it goes into the Bucket of Strange.

> **Remember the Bucket of Strange**

# **REMEMBER - EVERY USER IS UNIQUE!**

Different aspects of the VRUX can provide usability challenges for different users. Think about how well your interactions will work for your whole target audience. Here's a **starting checklist** of things you should be thinking about.

- Can your experience be enjoyed by someone with **limited mobility**? • How well can it support **deaf** users?
- Can it be used with one controller, **does it require 2 hands**?
- Does it offer support for different **colour blindness** types? • Does it require **physical crouching**?
- Is it dependent on **arm reach?**
- Are you reflecting the **hand size** and **skin colour** of the user? • Are you portraying the **user's viewpoint** accurately and as expected?



#### VR COMFORT ISN'T JUST ABOUT VR SICKNESS

## THINK ABOUT COGNITIVE LOAD

The more a VR experience deviates from expectations, the more we have to process, and the more mentally tiring it can be for players just to be in that experience.

The real world is jam-packed with details and sensory information. To lighten the processing load, our brains use a kind of short-cut 'tagging' system to allow us to process trivial information in the background to avoid constant brain strain.

We don't need to examine a tree in detail to recognise it as a tree; as long as it fits our expectations of what a tree looks like, we assume that's what it is. Think of this **autopilot** as '**Brain 1**' mode.

This leaves space for the other cognitive reasoning we have to perform moment to moment. We can ignore the trivial and focus our attention on the interesting and unusual. Think of this **active processing** as '**Brain 2'** mode.

Any time something we're presented with doesn't fit our expectations, **Brain 2** has to dedicate processing to figuring out what it actually is. This takes time and mental effort and hinders our ability to process other elements.

Combining this with other cognitively challenging content (such as complex puzzles or sophisticated enemy patterns) means VR experiences can become mentally overwhelming for **Brain 2** if too much is happening at once, or if the user is constantly bombarded with inputs that don't match existing expectation models.

### BRAIN 1 DOESN'T Know It's not real!

Immersed users will often forget that the virtual world and physical world don't always intersect as expected.

Leaning on a virtual wall for support, or dropping the controllers onto a virtual table before taking off the headset are common experiences when new users are learning how to interact with XR.

Successfully immersing your user means **Brain 1** is not questioning the reality presented to it; sometimes testing will show times when it's better to **purposely pull back or break the immersion** to remind users of the illusion, and do our part to keep them and their XR equipment, safe!

### **USERS BRING BAGGAGE!**

### Users each bring their own unique mix of fears, phobias and hangups with them into VR.

We all know someone who won't do the Haunted House at the themepark, or who can't watch scary movies, or who steers clear of videogames featuring spiders. Many people have anxiey around the ocean, or of the dark, or of deep, endless voids. Similarly common are phobias around claustrophobia, heights, being alone, or being in crowded spaces. Any of these can be evoked in VR, often unintentionally, and can have powerful effects on susceptible users.

When the VR illusion is working successfully, the power of immersion can often trigger our instincts to kick in when confronted with scares, fears and phobias we rarely have to confront in real life.

Most new VR users underestimate the strong emotions that can be evoked the first time a threatening creature or character steps into their personal space.

And just because users would love the idea of being Indiana Jones in VR, they may encounter things that the Jones character is fine with, and that they as a user might be fine with in a traditional screen-based 2D scenario, but which can trigger anxieties, fears and phobias when they're experienced at life-scale in virtual reality.

Every user brings their personal baggage into VR with them, but once they're guests in the world we've created for them, we must be considerate and responsible for the content we present them with. If you're working in this area and need advice on how to best fulfill those responsibilities, we can help.

> Confronted with a primal fear in PSVR Worlds



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#### - VR COMFORT ISN'T JUST ABOUT VR SICKNESS

### **GIVE USERS AN EASY WAY OUT**

Often, the level of discomfort builds over time, so users can be a fair way into a game or experience before they reach a point where they want to stop due to discomfort.

**Don't expect your users to keep playing** until they reach a graceful exit point such as a save point, the end of a section, or completing a game level. When they gotta go, they gotta go.

**Don't make them choose** between relieving their discomfort or losing progress. Support short play sessions. Ensure your experience can be quit and resumed without the user missing or repeating content wherever possible. Make sure it's clear to the user if their progress has been saved, and don't be afraid to use plain, clear language to spell it out rather than relying on symbology or a 'saving' message they might miss.

When and if things get too much for your users, it's good practice to offer instant relief. Chill-out vibes and sense of safety in your pause screen can offer a respite from intense content. Better that than face them whipping off the headset to emergency eject - a bad result for your App and for general XR acceptance.

### **ED&I CONSIDERATIONS**

Equality, Diversity and Inclusion are important facets of making your user feel comfortable in VR.

In many ways, virtual reality opens new opportunities for inclusivity and representation for users. Because we have agency and embodiment in the virtual world through our avatar, VR can be a great tool for users to explore, recognise and understand the perspectives and experiences of others first-hand.

Embodiment tends to place significant user focus on the character they inhabit. If the avatar is supposed to explicitly or incidentally represent the user, as is the case in the majority of experiences (when users are not told whose shoes they are walking in, it is natural for them to assume they represent themselves, transported into this new world), then most users will hope that avatar customization will allow them to represent themselves through their choices. Being able to reflect gender, skin tone, height, hand size, and clothing can be vital for moment-to-moment belief. Facial representation and hair style may be important for the moments when they see themselves in a shared social setting.



### **HELP USERS SOLVE THEIR ISSUES**

#### If something feels wrong, you can expect that users will want to try and fix it. But the tech brings bespoke issues they won't know how to resolve yet.

So we can provide user-elective **comfort choices**, and make the default settings comfortable for as many users as possible, make sure the settings are **easy to access and change at any time** and with minimal disruption.

Most importantly for making your users feel comfortable using the tech, we can make sure users know what each of the settings do, and what VRUX problem(s) each of them might help the user address. That means telling them where to go to fix problems as soon as possible during onboarding, and walking them through the settings with tutorials and tooltips, text and videos. Crucially, they should understand the likely effects on comfort before they try it out. Experimenting with options is likely to lead to the user experiencing many varied onset triggers in a short amount of time, increasing the chances of causing discomfort. And at the point where your user probably just wants to get on with the immersive experience, how you handle these onboarding responsibilities can be crucial.

I've always thought learning to use VR can be likened to learning to scuba dive; it needs familiarity with the equipment, a working understanding of how it functions and thus how to correct problems that arise in the moment, and the understanding that it will take a number of sessions before you become fully acclimated to the physical experience and the psychological factors that accompany it.

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# evoiding vrdiscomfort issues through smert plenning end design







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• AVOIDING VR DISCOMFORT ISSUES THROUGH SMART DESIGN & PLANNING

# Great! We've learned lots! So what's next?

Hopefully in these pages you've gained some valuable new insights into the issues and challenges around VR comfort.

The advice in these pages has general application across all virtual reality experiences, and is relevant for all the current and upcoming headset technologies. After all, this is a human issue at it's core, not a hardware issue. The way our bodies react to an artificial world is something that tech might not be able to resolve for a long time (if ever) so the responsibility for keeping the user comfortable falls to those creating the content that mediates between them.

Comfort issues can be entirely unexpected and potentially disasterous for developers when they emerge during production or user testing. If fewer users are going to be able to play your game comfortably, that's going to affect your reviews, your sales, or your client's satisfaction.

If you're already facing specific comfort issues with your current project, we hope you might now be a few steps closer to forming a strategy to address them. And if you need more help, please reach out to us and we'll be happy to advise you on the best way forward for you and your project.

But you don't have to wait for comfort issues to surface before you can tackle them. You can, and should, start thinking about comfort challenges from day one.

When you're starting out on a new immersive project and find yourself at the planning and ideation phase, spitballing ideas with friends or colleagues, you have a bunch of innovative ideas for immersive content bouncing around in the tumble-dryer of your creative processes. But often you won't be confident that they'll be comfortable for your users. In VR development, creative innovation often feels easily within reach, but the question of whether it might unexpectedly trigger user discomfort can easily dampen your enthusiasm.

**From a business point of view, design ambition will always carry unexpected risks, and so it's understood that pioneering steps need to be taken carefully.** Pre-production is the key time to analyse your design and de-risk it before you commit to production and start spending your time, money and resources building it.

Many of our clients find high value in approaching their designs from the very start with user comfort as an ever-prevalent and significant shaping factor. Being able to show a 'comfort-first' approach can be a huge boon of course. Investors and publishers in the immersive VR space will be keen to understand the comfort risks of your title as early as possible in their assessments. Comfort challenges can be a major sales barrier - on storefronts the comfort level is key data foregrounded to purchasers, and from reviews to forum discussions and product comparisons, comfort is always a key point of assessment and commentary.

Here are three of the most important decisions you can make in the early stages of your project to guide you out of the cave of infinite possibilities that is ideation and pre-production, and give you clarity and confidence for your production journey.

Choosing the right path from the start and plotting the shortest route to your goal will make every part of the production process go more smoothly, and ensure a user-first approach in your creation.

If you want an experienced guide to help you make the right choices for your project and ensure you're avoiding unexpected discomfort triggers in your design and implementation, we're happy to offer our help, whatever the size and scope of your ideas. Give us a call. Our contact details can be found at the end of the book.



vr discomfort

- AVOIDING VR DISCOMFORT ISSUES THROUGH SMART DESIGN & PLANNING

# **SEATED, STANDING, MOVING COULD 1 DESIGN SUPPORT ALL 3?**

Seated play is surprisingly common as a standard in VR - you just don't always notice.

Plenty of experiences are designed around seated users first, but also work perfectly, with a few tweaks, for users planning to move around the space more. Seated is the most restrictive use case to design for, but it's the only option your whole potential audience will be able to use in comfort, and can often translate easily for standing play.

Full movement VR can be more immersive for those users with the space and mobility to enjoy it, and the 1:1 spatial movement avoids the discomfort triggers of artificial locomotion and interaction. For some projects, full room scale may be your only practical option. But don't always assume that's the case; most games and apps can be operated perfectly within a smaller playspace through smart design.

So think about your users and their likely use cases. **Supporting the smallest minumum play space you can and designing for seated users will also mean you're supporting the widest range of users and accessiblity needs**.

And whatever sizes you go for, you'll need to regularly test in appropriatelysized environments during development - if you're going room-scale, make sure you plan for enough available testing space.



AVOIDING VR DISCOMFORT ISSUES THROUGH SMART DESIGN & PLANNING

# **2 COULD YOU AVOID ARTIFICIAL LOCOMOTION?**

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vr discomfort

AVOIDING VR DISCOMFORT ISSUES THROUGH SMART DESIGN & PLANNING

# **3** TAKE THE SENSIBLE PATH TO YOUR GOAL

#### Hacking blindly through the wilderness isn't the only way to get there.

The number of innovative VR interactions we continue to see is fascinating and ever-expanding. It's always exciting to see developers exploring new techniques, solving problems and making clever use of the many ways the user can interact with VR's ever-evolving immersive interfaces to emulate real-world world (and fantasy) experiences and wow their users. The unique opportunities that the medium offers can open up a wide new frontier of possibilities for designers and creators who are excited to experiment and innovate. And from a business perspective, those innovations can represent appealing business opportunities.

But exploring those new frontiers can be challenging. Forging straight ahead through the unknown without an understanding of how to mitigate or avoid the comfort risks ahead can put the whole venture at risk. In VR, it's not usunusal for developers to base key pillars of their immersive experience around existing real-world interactions or gameplay mechanics which turn out to be the most challenging to recreate in VR.

Don't look at the map and follow a straight line to your destination. **Unless** you're keen to be a risk-taking pioneer, it's usually better to follow the more well-travelled roads.

See what other apps do. Design as much of your experience using established VR mechanics, comfort practices and techniques as you can. And don't be afraid to enlist an experienced guide (like us!) to help you.





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# about Goorealised Coorealised







#### **Realised Realities is a Specialist XR Consultancy based in Manchester, UK.**

Realised Realities offer deep expertise and experience in all aspects of Immersive Design, Interactive and Immersive Narratives, Immersive UX, XR Project Planning, and much more. We provide world-class guidance and support to clients of all sizes, from major creative forces to small business enterprises, enabling them to succeed in the XR space, and supporting them to realise the true potential of their immersive realities.

Realised Realities was founded in 2017 by industry luminaries from Sony Interactive Entertainment, and is headed by Jed Ashforth, former Immersive Experience Specialist at Sony PlayStation, and one of the creators of PlayStation®VR. Jed has helped more than 120 VR Projects since 2010, assisting the guiding hands behind major IP and brands including...

Star Wars	<b>Breaking Bad</b>	WipEout
Batman	How to Train Your Dragon	Gran Turismo
Jurassic Park	Tomb Raider	Playstation VR worlds
Kung Fu Panda	Angry Birds	David Attenborough
Fast & The Furious	<b>Resident Evil</b>	SKY Sports

...and many more to successfully bring their story worlds and experiences into the immersive realm, through single and multi-user experiences, across gaming, enterprise and entertainent sectors, at-home and location -based.

Jed has deep expertise and experience in the many ways you can elevate your user experience design, with strong focus on immersive gameplay and interactions, interactive narratives, understanding user behaviour, and ensuring experiential comfort and delight for the widest number of users.

Realised Realities work with clients to provide wisdom and insight, highlight their operational and creative opportunities, lead them in user-first immersive experience design, and help them to steer their projects away from unseen pitfalls and costly challenges. Our expertise can guide you through the most effective paths, and show you all the most efficient shortcuts, to help you create best-in-class immersive experiences.



immersive <mark>experience</mark> specialists

For more information please visit us at **realisedrealities.com** or contact us at **info@realisedrealities.com** 

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