

# Disability in the Metaverse



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SYDNEY

# Acknowledgements

We acknowledge the Wurundjeri, Gadigal, and Nuyngar peoples, who are the Traditional Custodians of the lands on which we all live and work. We pay our respects to their Elders past and present. We also acknowledge that sovereignty of these lands has never been ceded. They always were, and always will be, Aboriginal lands.

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We are incredibly grateful for the insightfulness, honesty and generosity of our interview and survey participants.

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## About the Research

This report is based on findings from a research project led by Professor Marcus Carter and Dr Ben Egliston. The research team comprised of 8 researchers from The University of Sydney, Western Sydney University, Nanyang Technological University, Curtin University, and the Australian Communications Consumer Action Network (ACCAN).

In consultation with people with disabilities and developers, the project aimed to identify and address accessibility challenges for disabled Virtual Reality (VR) users. This report represents preliminary findings with more detailed findings forthcoming in our academic publications.

The research informing this report was conducted from June 2023–June 2024. Our study principally draws on data from 102 survey respondents and 21 interviews with people with disabilities who use VR. With these

participants we explored how people with disabilities use VR, what challenges and opportunities they face, and what changes they would like to see to improve accessibility in VR. To supplement this participant research, we also reviewed 57 Reddit threads about VR and accessibility dated between 2019–2022 to document how accessibility barriers have changed over time.

To encompass a wide spectrum of people with disabilities, we also conducted a complex care study, where we spent time with 7 residents in disability care centers in Sydney (and 4 staff in these centers). We engaged with this cohort as they have not been previously consulted in research on VR, accessibility, and face unique accessibility challenges.

In addition, we also conducted interviews with 20 VR industry experts, including developers, designers, and accessibility experts, speaking to them about how they incorporate accessibility into their work, the obstacles they face when designing with accessibility in mind, and what tools they need to design more accessible experiences.

All user interview participants and Reddit posters in these cohorts have been given pseudonyms to protect their privacy. VR industry experts have given consent to not be anonymized.

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# Background

People with disabilities are often depicted as beneficiaries of Virtual Reality (VR) technology. Promotional material about VR and disability often positions the technology as a means through which to 'overcome' or 'fix' disability.

However, this assumes that people with disabilities need to be 'fixed' so that they resemble non-disabled individuals. This medical model of disability aims to correct or manage disability through clinical intervention.<sup>2</sup>

What is missing from such perspectives is acknowledgment of how technologies, such as VR, might disable users. As an alternative to the medical model of disability, the social model of disability uses the term disability to refer to impairments that are created by physical environments, social exclusion, and inequality. For example, if a disabled person is unable to use stairs, the medical model would focus on changing the individual so that they can climb the stairs, while the social model of disability would focus on how we could engage the environment (such as adding a ramp) so that their impairment is no longer important in that context.

In line with the social model of disability,

disability media studies scholar Elizabeth Ellcessor highlights how media technologies create new types of impairments.<sup>3</sup>

For all its claims of benefiting people with disabilities, VR often creates new impairments for its users. For example, in some users, VR can cause motion sickness. Instead of looking at how individual users can overcome their motion sickness (by acclimating themselves to VR), we should be exploring how we can design VR differently so that it does not induce motion sickness.<sup>4</sup>

Our findings suggest that VR is a *disabling technology*. Current VR systems make rigid assumptions about the body and what it can do, creating accessibility barriers for people with disabilities. In this report we analyze four common ways of interacting with VR (what we call affordances) that create accessibility barriers for people with disabilities: movement; vision; sensory immersion; and independent play. Our research has found that the focus on these sensory affordances creates exclusions for people with disabilities. VR, in this way, produces a form of what we term exclusionary sensemaking – the way that VR makes sense of our bodies and how they move

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1 See: AR Post. "7 Benefits Of AR and VR for People with Disability" published 2022, <https://arpost.co/2022/02/09/7-benefits-ar-vr-for-people-with-disability/>; and Virtual Reality Society. "Virtual Reality for the disabled", no date, <https://www.vrs.org.uk/virtual-reality-healthcare/disabled.html> for examples of these narratives

2 Pamela Fisher and Dan Goodley, "The linear medical model of disability: mothers of disabled babies resist with counter-narratives," *Sociology of Health and Illness* 29, no.1 (2007). <https://onlinelibrary.wiley.com/doi/10.1111/j.1467-9566.2007.00518.x>

3 Elizabeth Ellcessor, *Restricted Access: Media, Disability, and the Politics of Participation* (NYU Press, 2016)

4 Marcus Carter and Ben Egliston, *Fantasies of Virtual Reality: Untangling Fiction, Fact, and Threat* (MIT Press, 2024)

excludes the bodies of people with disabilities.

Our research also highlights the importance of accounting for the immense diversity of disabilities, working with people with physical, visual, psychological, and cognitive impairments.

In what little prior research exists on disability and VR accessibility, there is a strong focus on common physical disabilities, such as those who use wheelchairs. While this is a positive first step, it often means that people who fall outside this narrow understanding of disability feel left behind as VR develops in ways that exclude them. This was something that many of our study participants articulated, with one participant noting “accessibility options are always limited and targeted at only a few mainstream ailments”. Another participant highlighted how this exclusion made them feel as though the VR industry did not care about them, suggesting that their “disability [is] just too rare to care about”.

The way that people with disabilities engage with VR challenges common assumptions about the medium and its potential. Making VR more accessible invites us to question VR design, opening new possibilities for what VR can do. Our research suggests that disability (and

consultation with the disabled community) can provoke new directions in design. Disabled people have lived experience and knowledge about accessibility that could materially improve VR design both for people with disabilities and non-disabled people.

Based on this research, we identify 6 recommendations that should be brought into VR design to improve VR accessibility. We believe that these will be of benefit not just to disabled users but will also expand the wider potential of VR’s adoption in society. ■■

# The physical body

Most modern VR systems use a variety of sensors and computer vision techniques to track how the user's body moves in the physical world such that they can be represented in digital environments. To do this, most VR headsets only need to track the position of the user's hands and their head, and not the whole body. These two body parts are considered the most important for a VR user when interacting with the digital environment, as they capture how a non-disabled person would typically move in an environment.

However, the assumption that the user's body will move in particular ways does not always represent how people with disabilities move their bodies. We suggest that the design of VR technologies often reflects what disability scholar Rosemarie Garland-Thomson calls the 'normate body'.<sup>5</sup> This refers to the socially constructed, ideal image of the body. The typical VR user is seen as white, non-disabled, heterosexual, and male.<sup>6</sup> This excludes the diversity of human bodies, particularly those with disabilities.

For example, VR generally assumes that people will interact with the digital environment with their hands, and often do not track the rest of the user's body. This may be the case

## Bodies move in different ways

In many popular social VR games, (e.g. *VRChat*<sup>7</sup> and *RecRoom*<sup>8</sup>), players often use voice chat to socialize with each other. The use of voice chat excludes Deaf and hard of hearing users who use sign language to communicate. Hands in many social VR experiences only allow the player to create a small number of hand shapes (for example, a flat hand, fist, pointed index finger, and a thumbs up). The small number of hand gestures mean that Deaf and hard of hearing players find it difficult to communicate using sign language in social VR experiences. Signers (people who use sign language) communicate tone through facial expressions and gestures that are also often not represented by VR avatars.

One Deaf study participant highlighted how these features are not available, that this is "limiting" for Deaf and hard of hearing people, and that they must "work around" these limitations. The way that VR represents the physical body in the digital world excludes how Deaf and hard of hearing users use their physical bodies to communicate.

for non-disabled people, but those with conditions such as arthritis or cerebral palsy, or those missing a hand, or fingers, might use different parts of their body to interact with objects. A person who has arthritis in their hands may use their hips or shoulders to help open doors instead of relying on strength from their hands. People with disabilities move their bodies in different ways that are often not accounted for by the sensors of the VR

5 Rosemarie Garland-Thomson, *Extraordinary bodies: Figuring physical disability in American culture and literature*, (Columbia University Press, 1997).

6 Marcus Carter and Ben Egliston, *Fantasies of Virtual Reality: Untangling Fiction, Fact, and Threat* (MIT Press, 2024): pp. 5-29.

7 VRChat Inc, *VRChat*, (2014), VR application.

8 Rec Room Inc, *Rec Room*, (2016), VR game.

system, which can lead to accessibility barriers. The breadth of how people with disabilities move is vast, and VR experiences cannot always account for all the different variations in how people move. We need to think carefully about who we might be accidentally excluding when we only consider the physical bodies of non-disabled people and design VR interactions in prescriptive ways.

When we consider how VR tracks the disabled body, we also must consider how assistive devices are a part of the body for many disabled people. Many people with disabilities require assistive devices, such as canes and wheelchairs. However, assistive devices are not considered when representing disabled bodies in VR. One study participant, Sara, who uses a wheelchair, found that because her chair was not recognized by the VR system, and thus not represented in the virtual environment, she was often in danger of hitting the sides of her chair and hurting herself when she moved her arms. The fact that the VR system did not recognize Sara's wheelchair meant that, for her, VR was dangerous to use. Sara suggested there should be an option to register the physical location of her chair, so she could be notified when her hands were getting close to it, through mechanisms like Meta Quest's

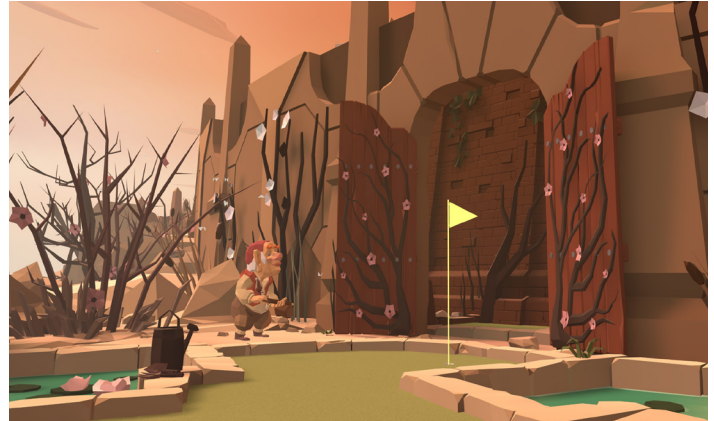


Fig. 1: Walkabout Mini Golf

### Designing for different bodies

Mighty Coconut's *Walkabout Mini Golf*<sup>9</sup> uses simple, accessible controls that take into consideration the physical bodies of people with disabilities. Instead of assuming that the player can walk to their ball to putt it, they created the 'lock ball position' option. When the player uses the 'lock ball position' feature, they are automatically positioned in front of the ball in the exact same position each time. This means that the player does not have to walk to the ball and position themselves so that they can putt the ball.

Further, the length of the putter automatically adjusts to the player's height. The strength of the putter can also be adjusted, allowing players with different physical strengths to play. These features mean that players who are in wheelchairs, players of various heights, players with limited mobility, and players with limited physical strength can adjust the game's settings to suit how they move their bodies. The way that the putting motion is designed in *Walkabout Mini Golf* does not assume that the player's body will move in a 'typical' way and gives the players options to choose how they want to interact with the mini golf courses.

<sup>9</sup> Mighty Coconut, *Walkabout Mini Golf*, (2021), VR game.

'Guardian' for setting out a user's space.

The lack of consideration given to assistive devices does not just occur at a software level, as the example above demonstrates, but also at a hardware level. For instance, study participants found that this led to issues such as the VR headstrap causing pressure on cochlear implants and headsets being knocked out of place by wheelchair headrests.

The disabled body is different from (and engages with the world differently) to the non-disabled body and a failure to acknowledge this diversity is where VR acts as a disabling technology.

Many people with disabilities use assistive devices when using VR, however, these are rarely considered when designing VR experiences. ■

# Vision

Given VR's celebrated visual affordances, it is often presumed that blind and low vision users would be uninterested or unable to use VR. This is informed by assumptions that people make about blindness. When most people imagine blindness, they imagine someone who cannot see anything at all and only experiences blackness.

However, total blindness only accounts for approximately 15% of blind and low vision people.<sup>10</sup> Most blind and low vision people do see some light, shapes, and colors. Our research found that many blind and low vision study participants were interested in using VR but were rarely considered to be people who would want to use VR. One blind study partic-



Fig. 2: Cosmonious High

ipant suggested that this lack of consideration felt like developers “gave me a new car, but they didn’t give me the keys”. Another, with astigmatism, suggested “the very medium of VR is contradictory to wearing glasses”.

## Privileging visual affordances

Arthur, a blind study participant, encounters a wide array of accessibility barriers when using VR. He related to us a conversation he had with a VR designer about accessible VR that highlights the barrier an ocular centric understanding creates. Arthur had suggested the Meta Quest app – currently used for casting and buying apps – could be expanded so he could use his phone to navigate menus within the headset. Using a device, such as a phone, that is familiar to him and that he knows will work for him, would reduce the accessibility barriers normally presented by VR. The developer replied to Arthur, but “you can’t look at your phone with the headset on”.

The developer’s response reflects a lack of understanding about the way visually impaired users use devices like mobile phones and other digital technologies, the barriers they face using spatial interfaces today, and the importance that sighted people place on visual interaction, at the exclusion of other ways to interact with technology.

Because visuals are seen as a key affordance of VR, developers tend to pay less attention to other affordances that might benefit blind and low vision users, such as spatialized audio and haptic feedback. Haptics refer to the use of touch and force feedback technologies to simulate touch in virtual environments. Spatial audio simulates the way that sound behaves in the physical world in a VR environment, producing sound that comes from a particular point in space. This allows users to pinpoint the location of the source of the sound. The goal of haptics and spatialized audio in VR is to enhance the immersive experience and provide realistic sensations. While they provide greater levels of immersion for sighted users, they are vital for blind and low vision users.

<sup>10</sup> American Foundation for the Blind, “Low vision and Legal Blindness Terms and Descriptions,” no date, <https://www.afb.org/blindness-and-low-vision/eye-conditions/low-vision-and-legal-blindness-terms-and-descriptions>.

One blind study participant stressed that both haptics and audio are essential to their VR experience: “[i]f the experience is completely visual and there are no haptics or sounds I’m not going to enjoy it”. Focusing on vision as the most important sensory affordance of VR fails to account for the wide range of ways people want to engage with VR experiences.

Vision accessibility issues do not only occur with blind and low vision users; they are also encountered by those who wear glasses. Glasses are the most common form of accessibility aid. However, they have long been incompatible with VR headsets. The fact that VR is unable to accommodate such a common accessibility aid signals to users that accessibility is not widely considered when it comes to other disabilities.

Headset design places the VR lenses very close to the user’s face. While this allows for a fully immersive visual experience, it creates ergonomic challenges for those who require glasses that are not easily overcome through attachments like glasses spacers.

Due to the lack of visual clarity in displays and insufficient text size options, people who need glasses cannot simply take them off when using VR. This is an issue affecting many users, as the World Health Organization has estimated that at least 2.2 billion people globally have a near or distance vision impairment.<sup>11</sup> ■

## Designing beyond vision

Many VR games can provide features that increase accessibility for blind and low vision players. For example, Owlchemy Lab’s game, *Cosmonious High*,<sup>12</sup> has released an extensive vision update, with several key features that provide greater access to blind and low vision players. Features like high contrast object highlighting, audio description of objects and environments, and teleportation description help the player orient themselves in the digital environment without relying solely on visual cues.

*Cosmonious High* also added audio and haptic feedback to actions such as grabbing and releasing objects. These features place less emphasis on visual cues, helping blind and low vision players interact with the game world on their own terms, rather than assuming the only way that players can navigate and interact with the virtual environment is through sight.

11 World Health Organization, “Blindness and Vision Impairment,” published 2023, <https://www.who.int/news-room/fact-sheets/detail/blindness-and-visual-impairment>.

12 Owlchemy Labs, *Cosmonious High*, (2022), VR game.

# Neurodivergence

Often when we think about how to make VR more accessible, we think about physical disabilities. Yet neurodiverse individuals and people with neurological conditions also experience barriers to VR – so much that we found that 32.7% of our study participants identified as being neurodivergent or having a neurological condition. However, they are rarely considered as needing accessibility considerations in VR. Neurodiversity encompasses atypical neurological development (such as autism, ADHD, and dyslexia), which may impact learning, attention, and other cognitive functions.

On the other hand, neurological conditions refer more specifically to medical conditions, such as epilepsy and Parkinsons. Both neurodiversity and neurological conditions are more difficult to identify and may not always have one-size-fits-all accessibility features in VR. Our research has found that just as VR is designed for the normate body, it is also de-

## Unpleasant sensory experiences

One study participant, Tobias, spoke of the friction between his schizophrenia and the auditory sensations of VR. He found that audio cues like whispering have a “habit of increasing after-play psychosis” because they sound similar to auditory hallucinations that he experiences as a symptom of schizophrenia. Tobias found that games that had options for subtitles were particularly useful, as they helped him distinguish between the game content and hallucinations. Tobias also suggests that there needs to be clearer details about user experiences before starting an app, so that they can be prepared for what will occur in the experience, rather than starting an experience and being unsure about “what you’re getting into”.

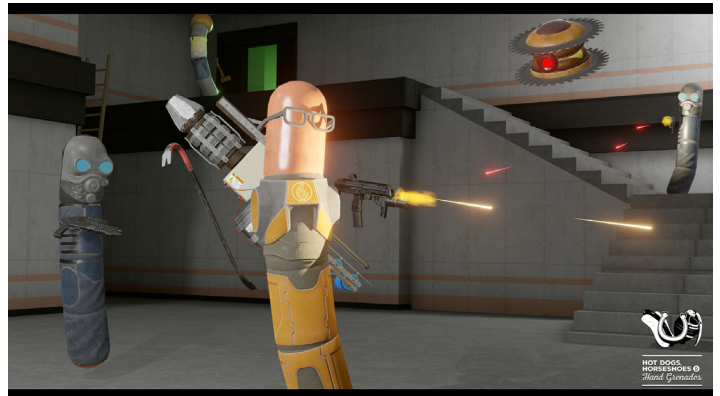


Fig. 3: Hotdogs, Horseshoes & Hand Grenades

signed for the neurotypical user.

VR’s goal of total sensory immersion often creates accessibility barriers for neurodivergent users and those with neurological conditions. There is considerable variance in people’s ability to process sensory stimuli, manage its intensity, and organize bodily sensations. Sensory experiences can be not only unpleasant, but overwhelming and distressing. There was a variety of ways our participants found sensory overstimulation in software, with one participant who experiences seizures finding that even opening a VR app led to overstimulation “before you even found the settings”, while another participant said that they found that UX design of most apps “confronting”.

Sensory overstimulation can come not only from the software (in the form of things like content, brightness, and flashing lights) but also the hardware (in terms of the material that the headset is made from and how

it sits on the face). One study participant, Avery, who is autistic, found the materials of commercial headsets, and the way headsets create a seal around their eyes, is so overwhelming that they "can't keep the headset on for more than a few minutes". Avery found that the design of the Quest Pro (with the front of the headset only resting on the forehead and leaving space between the headset and the face below the eyes that allows the user to see the physical floor) to be a much more comfortable experience, as they headset allowed them to adjust their sensory immersion according to their own preferences.

We also found that VR tended to reinforce neurotypical forms of social interaction. For example, the 'personal boundary' feature in social VR experiences creates an invisible boundary around the user so that they can avoid unwanted interactions. This can be turned on for everyone, just people the user does not know, or off for everyone. While personal boundaries provide much needed safety and comfort to users, neurodivergent people can have significantly larger interpersonal distance preferences.<sup>13</sup> The design of fixed interpersonal distances is an accessibility issue. Giving users control over their personal boundary size would not only make VR more accessible to neurodivergent users who prefer larger interpersonal space, but also provide options for a range of people who may have different personal boundary preferences due to gender and cultural norms. ■

## Designing for neurodiversity

To avoid triggering user sensory issues, when implementing a new, more visceral explosion in Rust Ltd's game *Hotdogs, Horseshoes, and Hand Grenades*<sup>14</sup>, developer Anton spoke about how he broke up the explosion mechanic into its separate parts (the tinnitus sound, audio ducking, and visual shockwave). Each of these features could be independently turned on or off and were all set off as a default. This is a key example of considering the sensory affordances of VR and giving granular control of the sensory experience to players. If the explosion effects are overwhelming altogether, players could choose one or two elements that they were comfortable with, so that they could still experience the immersion of the new effects, without them being overwhelming and triggering sensory overload.

13 David Jones, Shiva Ghasemi, Denis Gračanin, Mohamed Azab, "Privacy, safety, and security in extended reality: User experience challenges for neurodiverse users," *HCI for Cybersecurity, Privacy and Trust, HCII '23, Springer Cham*, 2023, 10.1007/978-3-031-35822-7\_33.

14 Rust Ltd., *Hotdogs, Horseshoes, & Hand Grenades*, (2016), VR game.

# Higher Levels of Care

People with disabilities who require full-time care are often both physically and socially isolated, which can make it difficult for this cohort to find engaging and meaningful leisure activities. They are also not present in prior research into XR and disability. In our study, we sought out people with disabilities who require full-time care through a partnership with a care facility in Sydney. This helped us understand and document the experiences of people with complex disabilities using VR, and the unique accessibility barriers that they faced when using VR. This is critical because, while VR is often advertised as helping people with disabilities live rich and full lives<sup>15</sup>, people with disabilities who require full-time care are rarely considered as people who might want to use VR for entertainment purposes (in these contexts VR is often only considered as a tool for health and rehabilitation, rather than for leisure and enjoyment).

While VR is often said to provide opportunities for people with disabilities to experience leisure activities that would otherwise be inaccessible to them, the design of the VR headset assumes that a user will be able to set up and use the technology on their own. However, many people with disabilities, including those who require full-time care, require assistance

## Onboarding complexity

During our research, we were approached by a care center who were excited about the potential benefits of using VR with their residents. Our research team went to the center with several different types of headsets and games for residents to try. One study participant, Gabrielle, enjoyed her experience using VR, although it was not without technical issues. Most of the accessibility barriers came with the onboarding experience: opening applications, ensuring the headset was fitted correctly, and teaching her how to use the controls. During her playthrough of the Quest *First Steps* tutorial game, there were moments when Gabrielle was unsure of what objects she needed to interact with to progress the tutorial, and we were unable to assist her as we could not see what objects there were, as Gabrielle was not directly looking at them. Allowing the onboarding processes to be completed externally to the headset and allowing onlookers to assist in directing the user's gaze (for example, on a phone app such as the Meta Quest app) would have alleviated many accessibility barriers for Gabrielle.

not only to set up the headset, but to operate it as well. We believe that the assumption that a VR headset will be operated by one person excludes people with complex disabilities who need assistance operating VR. Many residents of the care facility we visited, for instance, had complex needs and were often non-verbal. These users were unable to follow directions to make menu selections or press certain buttons. However, as noted above, they could

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<sup>15</sup> For example, see, Vanja Garaj, John Dudley, and Per Ola Kristensson, "Five ways the metaverse could be revolutionary for people with disabilities," *The Conversation*, published 2022, <https://theconversation.com/five-ways-the-metaverse-could-be-revolutionary-for-people-with-disabilities-183057>.

potentially benefit much more than others from VR, and we found that our study participants were excited and interested in the possibilities of using VR.

We need to reconsider the design of VR as centered around solo, self-directed play, by doing things such as expanding already-existing features, such as casting in the Meta Quest mobile app, and standardizing the adoption of tools, such as *WalkinVR*<sup>16</sup>. Currently the Quest app allows an onlooker to see a live feed of what is happening inside the headset. However, they are unable to provide further support to the VR user. Allowing the operator of the phone app to help in tasks, such as launching applications in the headset, directing the user's gaze to an object, and helping the user with inputs, would provide greater accessibility to those who need assistance operating VR headsets. There are some apps on the market that provide these options. For example, *WalkinVR* allows an onlooker to use a second controller to help the user move and interact with the digital space.

While *Walkin VR* has exciting potential for people with complex disabilities, it can only be used in headsets that are connected to powerful computers and is incompatible with most popular VR headsets. Our research suggests that we cannot assume that people who want to use VR will also be able to engage with VR independently, and that this needs to be considered in VR design. ■

## Designing co-play

Riccardo, a young man with a spinal cord injury, who has experience in gaming, tested out a VR headset in his care facility. Riccardo was excited that VR “just feels so real” and provided him with a “sense of freedom”. While he enjoyed playing, he was often faced with barriers to access because games assumed that the player would be non-disabled and capable of independent play. Riccardo enjoyed encountering puzzles and activities that were challenging for him and wanted to try them out. However, sometimes after trying a puzzle, he decided that he needed to skip it. To assist Riccardo, we needed to take the headset off him to complete certain tasks before he could progress in the game, reminding him of what he cannot do and resulting in a frustrating and unfulfilling experience with VR. Riccardo mentioned that he would like to see a ‘skip’ button, so that he can challenge himself with puzzles in VR, but also decide to skip a puzzle or area if it becomes a barrier to accessibility, rather than handing off the headset for someone else to complete the task for him to progress.

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16 Frankly Dog, *WalkinVR*, (2020), VR application.

# Accessibility is not just about design: Communication is key

“Accessibility options are not super accessible”, one of our study participants, Kyle, who has a form of dwarfism, summarized, after detailing the long journey of trawling through different forums, blogs, and YouTube videos to figure out the right adaptations and settings adjustments he needed just to be able to play a VR game. This was after he resorted to standing on a stool the first time that he used VR because the accessibility options for height adjustment were not clear to him as a new VR user. While developers put a lot of work into accessibility features, without an avenue to clearly communicate what accessibility features are available, people with disabilities are left unsure about whether VR will be accessible for them. This not only creates an accessibility barrier for users, but also makes users with disabilities reluctant to purchase games and headsets.

Lack of accessibility communication does not only make users hesitant to purchase games – increasing communication about accessibility leads to better, more accessible games. Each developer we have highlighted in this report understood potential accessibility barriers in their games and how they could overcome them by communicating and beta testing with people with disabilities.

For example, Owlchemy Labs has made the vision update of *Cosmonious High* a prominent element of their storefront pages. Mighty Coconut employs people with disabilities

## Lack of communication creates barriers

One study participant, Martin, who has hand tremors, spoke to us about wanting to buy a Meta Quest headset during the pandemic. He almost did not purchase one, as he was unsure whether it would work given his disability. He was unable to find any information about whether it would work through official channels, such as press releases or hardware specifications from Meta. Instead, Martin posted on the Oculus subreddit asking other users whether the headset would create barriers for his disability. While Martin did end up trying out the Quest, he highlights the difficult position that this puts disabled users in. As Martin notes, “it’s quite a lot of money to spend if when you get it then you use it, you think actually this just doesn’t work with my condition”.

throughout their team. Rust Ltd has active Reddit and Discord communities where players can request the accessibility features that they require.

There is an incredibly diverse range of experiences in the disabled community. Not only is it impossible to design for everyone’s needs all the time, but a feature that might increase accessibility for one person might represent an accessibility barrier for another person. For example, providing settings and options for people to configure an experience to their own accessibility needs increases accessibility for many users. However, this may mean that menus are more complex to navigate, which can provide barriers to access for people with cognitive disabilities, who require simplified menus. Communicating with users

with disabilities allows developers to understand what features will be the most valuable to users and provides accessibility solutions that work for their user communities. Engaging with the expertise of people with disabilities not only signals to them that they are valued members of the VR user base, but also provides valuable insight into VR design that benefits all users. ■■

### Accessibility communication drives sales

During the promotion of *Half Life: Alyx*, there was considerable discussion about accessibility features in gaming media outlets.<sup>17</sup> Detailed discussion of accessibility features and how they work in public spaces may seem inconsequential, but they signal meaningful inclusion to players with disabilities. One Reddit user posted thanking Valve for making *Half Life: Alyx* accessible. When they found out, through the promotion of the game, that it was accessible to them, they said that they could not “even describe how happy that made me”. This accessibility communication is not only a positive experience for this Redditor, but it was also the reason they purchased a VR headset.

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<sup>17</sup> Fraser Brown, “Half Life: Alyx’s movement system was changed because tall testers kept getting stuck,” *PC Gamer*, published 2020, <https://www.pcgamer.com/half-life-alyxs-movement-system-was-changed-because-tall-testers-kept-getting-stuck/>;

# Recommendations

The following 6 recommendations for accessibility frameworks and design approaches derive from our study's findings.

## 1. Foster opportunities for people with disabilities to communicate, and be a part of, accessible design

People with disabilities are experts in disability and accessible design. Many study participants we spoke to not only spoke about the barriers to access in VR, but articulated solutions as well. We suggest engaging this expertise by providing options for people with disabilities to give feedback on VR games, hardware, platforms, and storefronts particularly early in the development process. Further, we highlight the need to employ people with disabilities as play testers, consultants, and as a part of development teams, as many of the positive examples of accessibility in existing VR experiences came from teams that employed or consulted people with disabilities.

Greater accessibility features will also have a flow on effect for all users, as many features commonly used by people today were initially designed as accessibility features. For example, while subtitles provide greater accessibility for Deaf and hard of hearing people, they are now commonly used by those

without hearing loss.<sup>18</sup> As other accessibility guides have highlighted, paying attention to how people with disabilities adapt to different situations can provide insight into design principles that not only provide access to people with disability, but provide greater flexibility to non-disabled individuals as well.<sup>19</sup>

## 2. Provide flexibility in interactions

Prior work on disability and VR has focused on a small number of disabilities and accessibility concerns. However, as we have highlighted, disability is diverse. Small development teams cannot design for every potential accessibility need. Instead of creating a set of expectations about how people should engage with a VR experience, we suggest that VR hardware and software developers should prioritize sliding scales and customizability, exemplified by the successful accessibility examples we have discussed in this report.

## 3. Give users more control over sensory stimuli

Relying on one sense to alert the user to objects, confirm interactions, or provide inputs (such as locomotion) will exclude people with

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<sup>18</sup> Hannah J Davies, "Lights, Camera, caption! Why subtitles are no longer just for the hard of hearing," *The Guardian*, published 2019, <https://www.theguardian.com/tv-and-radio/2019/jul/21/subtitles-tv-hearing-no-context-twitter-captions>

<sup>19</sup> Microsoft, "Microsoft Inclusive Design," published in 2016, <https://inclusive.microsoft.design/tools-and-activities/Inclusive-101Guidebook.pdf>

certain disabilities. For example, while an audio cue might assist a low vision user, it will create an accessibility barrier for users who are Deaf or hard of hearing. Providing audio, visual, and haptic cues offers opportunities for people with disabilities to interact with a VR experience in a way that suits them. Further, giving users control over sensory stimuli in software (for example, turning off flashing lights or sound effects) and hardware (by providing modular headsets) creates greater accessibility for neurodivergent users and users with neurological conditions.

#### **4. Enable VR to be controlled outside of VR**

Providing greater functionality of casting app services will not only allow people with disabilities to integrate assistive technology (such as mobile phones) into their VR use, but also provide opportunities for people with disabilities who require assistance to use VR. This provides a richer experience for people with disabilities, while also increasing enjoyment for new players, the elderly, and children, as evidenced by study participant, Michael who is a freelance developer for a VR experience in a shopping center (that had a lot of inexperienced VR users). The app allowed a VR technician to reduce the mental load of onboarding, by doing things like adjusting the height of the avatar, volume, and restarting the experience.

#### **5. Communicate existing accessibility options more clearly**

As we have highlighted in this report, accessibility is rarely foregrounded in product launches and storefronts. We suggest that tech companies make accessibility features a prominent part of product launches, promotional material, and keynotes. Further, we recommend the implementation of accessibility tags on storefronts so that users can identify and search for games that meet their accessibility needs.

#### **6. Provide developers with tools to assist in accessible design**

Our research found that many smaller development teams must balance accessibility features with limited budgets and timelines. While the developers we spoke to prioritized accessibility in development, they wanted to implement many more accessibility features than they reasonably had the time and money for. Therefore, we suggest that platform and development tool companies should provide developers with tools that help make accessible design more time and cost effective to help provide inclusion to a greater range of people with disabilities.