Understanding How We Make Accessible Games: Perspectives from The Games Industry and Players with Disabilities

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Abstract

Accessibility in mainstream digital games is becoming an increasingly prominent concern, yet accessibility considerations inside of games are still inconsistent, with some developers delivering more accessible games. Very little research has sought to explore the underpinnings of this disparity from the perspective of game developers and game development studios. This thesis seeks to better understand the challenge of making accessible games, primarily from the perspective of game developers with the vision that this understanding can help us develop strategies to ensure accessible and inclusive games are made available, the industry wide.

The thesis begins with an interview-based exploration of the experience of making accessible games, from the perspective of professional game developers, helping us to understand how the personal motivations of developers, organisational support and external resources are all important to creating accessible experiences. This is followed by an exploration of the experiences from a specific studio, first from the perspective of players playing a game output by the studio, and then from the perspective of developers working at the studio that made the game. Combined, this data illuminates several key challenges associated with making accessible games, as well as opportunities that a studio could leverage to enhance their ability to deliver accessible player experiences.

The insight from these studies is then combined into a checklist-style tool that targets game development studios, designed to be used by others to illuminate their challenges, as well as educate organisations on the personal, organisational, and external factors contributing to their ability to succeed in making accessible player experiences. The thesis contributes significantly to a body of literature that has sought to explore the experiences of game developers around game accessibility by providing in-depth insight into the challenges that developers encounter in their efforts to make accessible games. We also provide actionable suggestions and strategies that development studios can use to reflect on their processes and more effectively pursue the creation of increasingly accessible games.

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Declaration

I declare that this thesis is a presentation of original work, of which I am the sole author. This work has not previously been presented for an award at this, or any other University. I conform that all sources are acknowledged as references.

Some of the material in this thesis has been published and this is declared here:

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1. Thesis Introduction

Today there is a vast array of different video games released, and many of these are inaccessible to players with disabilities. This thesis is centred on investigating this problem, particularly from the perspective of the game developers that produce these games. This chapter begins with a detailed introduction to this problem, which includes an outline of the thesis structure and our research approach.

1.1 Background Information

As the most popular form of commercial entertainment, video games have incredible cultural significance. Video games are played by 3.1 billion people worldwide (Statista Market Forecast, 2022) and individual games often have massive worldwide popularity. To provide an example of one such impact; in 2016 Pokémon Go had 226 million players, changing the behaviour of these people as the game encouraged them to search through various real-world places in order to find Pokémon that they could capture on their phones (Iqbal, 2023). This is one example from one game that had the capacity to change the behaviour of hundreds of millions of players. This illustrates how the video game industry has the capacity to influence over 3.1 billion people that engage with digital games. Relatedly and importantly, video games have also been demonstrated to have value in various applied settings such as serious games in education (Karsenti & Parent, 2020) and therapy (Gallou-Guyot et al., 2022). Together, these factors highlight the significance that games have within our society.

The forms that these video games take is highly varied, and each video game tends to place different demands on the player's ability. Whether it is a shooting style of game that expects fast reactions, hand eye coordination and motor dexterity, or a strategy game that expects careful decision-making and planning. Equally, the range of inputs and devices used to play games is highly varied, with people using mobile devices, mice and keyboards, controllers or technology that tracks features such as bodily movements. Each game makes its own demands on the player's ability in order to interface with the game. The range of experiences that games can offer are vast, and therefore it is understandable that demands on the player are equally so. While this variety can lead to exciting avenues for the design of diverse and challenging games (such as in the example of Pokémon Go, which is unusually demanding on gross motor ability by asking players to walk to discover Pokémon), this range of demands also poses a challenge to inclusivity.

Within our population, of the World Health Organisation (2023) recognises 17.8% of the population as disabled. When this data is considered in relation to the broad popularity of video game play (and the 3.1 billion players worldwide) it is logical to conclude that many people who play or would be interested in playing video games identify as having some form of disability that can cause them to encounter accessibility barriers when not accommodated. In spite of this, only a relatively small proportion of the literature has focused on understanding the play experiences of people with disabilities. While the body of literature is relatively nascent, some illuminating investigations have helped us understand the range of difficulties and frustrations (Beeston, 2020) that people with disabilities experience while playing games, as well as the accessibility features they rely on (Beeston et al., 2018).

As the population does not possess a single, uniform set of abilities (and some identify as experiencing disability), we inevitably see many people who play games are encountering disability barriers and needing support from accessibility features as a result (Beeston et al., 2018). This then poses an obvious need for games to be designed in such a way that enables them to be engaged with by people with the diverse array of abilities and capacity that are represented across our population.

In an effort to help accommodate this, many games today seek to offer different accessibility options which enable players to adjust the experience to their needs. For instance, games like *The Last of Us: Part 2*, (2020) and *Marvel's Spider-Man* (2018) feature a wealth of accessibility options, including features such as high contrast modes which are aimed at helping people with low-vision to perceive visual information from the game more clearly. Companies like Microsoft have also made considerable efforts with their hardware in this area, with Microsoft's accessibility controller offering an avenue with which players can adjust the type of input they use to interface with the game (Microsoft, 2020). Between software and hardware, a common theme can be seen as flexibility of the games demands, whether this is through software level adjustment or providing options to change how the player interfaces with the game.

Despite improvements from certain games and studios, there are still many games released today which are inaccessible. For instance, the game *Marvel's Midnight Suns* (2022), developed by *Firaxis* in collaboration with *Disney* lists just two accessibility options in its menu and omits important options such as the ability to pause the game during cutscenes (moments where the player passively views cinematic sequences), or remappable controls for players that might need more flexibility to how they interface with the game. In the past, games like the *Spyro Reignited Trilogy*, (2018) have shipped without critical features like subtitles for its cutscenes. Based on the existing literature, we know that these are features that people with disabilities rely on in order to play (Beeston et al.,

2018). Reinforcing this, we also have accessibility reviews from people with disabilities, reporting the barriers that occur in many games. For instance, the recently released *Tiny Tina's Wonderlands*, (2022) in the acclaimed *Borderlands* series was reviewed as being highly inaccessible (Bayliss, 2022). Many other games sit between the two extremes of highly accessible or highly inaccessible and still present a wide array of accessibility barriers for players.

We have a clear need from the disability community, where there is a clear audience of people who want to play games. However, evidence from both the literature and industry suggests that while there are good examples of inclusive design, these are occurring inconsistently with many examples of poor and mixed accessibility provisions. This highlights a problem where people with disabilities are frequently being indirectly excluded from a culturally significant facet of our society and only able to selectively engage with the medium. This is clearly an area worthy of research attention, there are a variety of different approaches that we might take to exploring or intervening in this issue.

1.2 Summary of Existing Approaches

A large proportion of the game accessibility literature has focused on exploring design solutions to accessibility problems. For instance, exploring means by which games such as chess might be made universally accessible (Grammenos et al., 2005) or investigating specific solutions for a type of disability, such as how a game might be designed to be inclusive for people who are blind (Yuan & Folmer, 2008). There is a large amount of this type of literature, and in-turn a large number of different solutions that can be considered well-understood and documented. It is conceivable that this approach might be helpful for designers who have decided they want to make an increasingly accessible game, but are uncertain how that might be achieved, and in that sense this avenue of research provides a lot of value in potentially moving inclusive design implementations in games forward. However, this literature does little to help us understand why these various design recommendations and solutions are not consistently making their way into games.

Equally, there are a variety of different guidelines available that prescribe different design solutions to different types of disability. The Game Accessibility Guidelines (2012) describe many different design solutions that could help game developers make more inclusive games, categorising these on the basis of expected implementation difficulty and disability domain. However, despite the availability of these guidelines many games are released today that do not provide remedies to their accessibility concerns, and do not follow the guidance provided by the guidelines. Therefore, it is reasonable to assert that while these guidelines might help those that search for them, the problems

that developers encounter in making accessible games will often be beyond the specifics of the implementation, involving organisational and psychological components of the developers, and development environment. Therefore, in order to understand the inconsistent accessibility of video games, we need to understand the experiences and motivations of developers making them.

The current state of research on the experiences of game developers with accessibility work is limited. Porter & Kientz (2013) investigated the experiences of both players with disabilities and game developers in playing and making accessible games, respectively. However, the reporting of qualitative interviews from game developers is brief and offers no insight into factors that might be attributed to the organisation of accessibility work within a studio, and its associated challenges. Other research in this area suffers from methodological limitations, Levy & Gandy, (2019) conducted a study testing the effectiveness of an accessibility knowledge intervention with students who were enrolled in a game design course. While this avenue may generate valuable insight, it has limited validity as the motivations and constraints surrounding research with student participants are likely to be very different to that of a game developer working in the industry. Although this small body of research offers some interesting insight into the experiences and challenges of game developers in making accessible games, a more comprehensive understanding of their motivations and the barriers they face is needed.

In summary, there is a problem in the industry where video games are still inconsistently accessible for people with disabilities. While game accessibility does appear to be improving, the information required in order to improve accessibility within games is available both inside of academic literature and industry guidelines, and yet this is being inconsistently applied. This strongly suggests that developers and development studios are facing additional challenges that are not well clarified or understood. The quantity of research into the experiences of game developers engaging with accessibility work is especially small considering the size and popularity of the video game industry and the number of people with disabilities who would benefit from improved inclusivity within this medium. Consequently, this thesis proposes that a deeper investigation into the working experiences of game developers within the industry is required.

1.3 Research Questions

With the paucity of knowledge about the experiences of game developers making accessible games established as a sizable and important gap in the literature, this thesis sets out to investigate this problem with three primary research questions:

Research Question 1: What are the challenges, motivations, personal and environmental factors that contribute to the accessibility output of any particular development environment? This question has various additional sub-questions which are important to illuminate a complete picture on the experience of accessible game development.

A. What challenges and facilitators towards making accessible games are rooted in the environment of the development studio?

B. What personal knowledge and motivations do game developers hold on accessible game development, and how does this contribute to accessibility output?

Research Question 2: What strategies might be effective in helping to address some of these accessibility challenges? This research question highlights how the thesis aims to leverage insight into the game developers' experiences in order to action strategies and interventions that might assist developers towards making increasingly accessible games. As such, the research hopes to identify strategic opportunities and investigate an accessibility intervention strategy which might improve accessibility within large scale commercial video game studios. Following our first study, a subordinate question also emerged, focused on how player experiences might be leveraged to make games more accessible.

A. What are the experiences of people with disabilities in playing games, and how can these impact the accessible game development practices of a studio?

Together, the research questions outline how this thesis has sought to better understand the issues surrounding the work that occurs towards making accessible games, and with this knowledge, investigate the value of strategies that might be effective in reducing these challenges.

1.4 Approach

In order to appropriately contextualise the research, it is critical that we discuss the prior concepts, understandings and personal characteristics that have contributed to this research and its direction. This section of the thesis is dedicated to this.

1.4.1 Concepts

Social Model of Disability. Models of disability are frameworks of understanding that shape how we define and discuss disability. Before discussing disability, it is important to identify the model of disability that we will consider when approaching this research, as this frames how disability is

defined, the research approach, and in turn makes sense of our discussion of it within the context of games.

The social model of disability has its origins in the United Kingdom from the 1970s and describes disability as a socially constructed phenomenon where disability is the result of a mismatch between the demands of the designed environment and the ability of the person (Shakespeare, 2013). Under this model, disability is not caused by the impairment held by the individual but is a result of how our society itself is organised, designed and the expectations that it creates. For instance, interacting with a computer's mouse and keyboard might be difficult or impossible for someone with a motor disability. Under the social model, the mismatch between the expectation of the system (moving the mouse with precise control and being able to press down on the keys) and the ability of the person (who in this example experiences a motor disability) leads the system to create an accessibility barrier. Through the lens of this social model, disability is a type of experience that people can encounter, as opposed to something that the user themselves possess.

This lens is especially instrumental in encouraging meaningful social transformation towards improving inclusive design, as in this example the social model also helps us understand the direction that we might take as designers to improve the user experience and in this case, remove the accessibility barrier. The user who struggled to interact with the mouse may not be disabled if provided the option to use an alternative style of input such as a trackball or eye tracking. This contrasts with the medical model, which would view disability as a problem rooted in the individual, requiring medical intervention (Shakespeare, 2013). By rooting the disability in the individual, it primes us to seek solutions on that individual level, and within this example that might lead us to miss design considerations that could foster more inclusive design.

From the perspective of a video game developer, the social model is especially pertinent because it centres the challenge around the artefact within our society that they are responsible for. Similar to the example provided above, a game can be designed in such a way that it demands more than the players ability, and in these instances the design accessibility barriers. The social model is especially helpful in helping us identify issues like this, which can then be resolved through design consideration that can accommodate a wider range of player ability. Within accessible game development this model appears widely accepted, with many games such as *The Last of Us* (Sony, 2020), *Spiderman* (2019), or *Forza* (Microsoft, 2020) seeking to make changes to the game itself in order to better accommodate a wider array of player ability.

Another key aspect of the social model of disability is the fact that it also recognises the diversity of experiences that people have. By highlighting that disability arises as a result of

interaction between a person's ability, and the expectation of the artefact, we can see that there is an incredibly large number of different experiences that are likely to arise from a single game. By both emphasising disability as a societal barrier and the variety of experiences that people have with the same game or digital artefact, the social model appropriately positions us to best investigate the challenges associated with accessibility efforts within game development. As such, this model frames our research and its direction as we have sought to better understand the experiences of game developers with the hope that through this understanding, we might be able to develop strategies and inform development practices towards making increasingly accessible games.

Two additional concepts that are that is important for us to define is our understanding of accessibility and inclusion. It is our view that Accessibility in video games refers to design features that remove or avoid barriers for players with disabilities, such as remappable controls, subtitles, colourblind modes, adjustable difficulty settings or design features that avoid barriers altogether. Inclusion, on the other hand is more broad focuses on representing and welcoming diverse player identities, ensuring that games both reflect and support players of different cultures, genders, abilities, and experiences. While accessibility ensures that more people with disabilities can play, it sits alongside the wider concept of inclusion which encourages designers to make for wider audiences of players.

Accessible Player Experiences. Within the scope of the social model of disability as it is applied to games, Power, Cairns & Barlet (2018) describe the issues surrounding inclusive game development in an Access Player Experiences (APX) frame of understanding. While this APX approach was not used to design our research approach, it was a valuable lens on the issues that arose in our research findings and understanding and contextualising some of our research and its findings. As such, we refer to terms used in the APX approach to understanding inclusion, and this segment of the thesis is dedicated to explaining this approach so as to help the reader understand how it applies to our work.

Figure 1

The three layers of inclusion as illustrated in Power, Cairns & Barlet (2018).

The APX approach to understanding the challenges related to inclusion describes inclusion as occurring in three waves, access, enablement, and experience which inside of the context of games translates to three layers, presentation and controls, challenge, and player experience. This model of understanding describes how all three are essential for the development of inclusive games. Access describes how the first stage of inclusion usually relates to surface level accessibility, and in the context of games this regards the presentation and controls. Specifically, ensuring that the player is able to perceive, and interface with the game. In order to operate a game, the user needs to be able to control the game with whatever means afforded by the developers, operate a controller, move a mouse, or touch a screen. Additionally, the user needs to be able to perceive information output by the game in order to understand what is happening, such as the visual display, haptics, and any audio that the game outputs. If the player is able to perceive information output by the game, and control the game, then they are able to access it. Examples of implementations that tackle this access approach inside of games might be features like high contrast modes that help people with low vision perceive the scenes in the game, or custom button remapping, which allows players to adjust how they interface with the controller and operate the game.

Figure 2

An example of the high contrast mode offered in Ratchet and Clank (2018) is shown above. This setting increases the contrast between specific elements of the game and the background to help players with low vision perceive key elements of the game.

The second wave described in Power, Cairns and Barlet (2018) is enablement, which in the context of games relates to the challenge posed by the game. Specifically, this regards how a game's presentation of difficulty and how inclusive experiences need to be able to accommodate the range of ability of players so that they are not excessively or unintentionally difficult. For instance, a player with disabilities might use custom button remapping or a custom controller to create an alternative control scheme which allows them to play the game one-handed. This might make it possible for this player to play the game, but they might still experience additional difficulty performing actions in the game as efficiently as the game expects. This player then struggles to progress in the game because, despite making some access considerations, the game is excessively difficult. Features such as adjustable difficulty and more fine-grained options to adjust the level of challenge in the game can allow players to re-align the difficulty with their ability and, in turn avoid barriers and create a more inclusive experience.

Figure 3

Sniper Elite 5 allows players to customise the difficulty of the overall game, and also individual components including combat, sniping and tactical aspects of the game.

Finally, the third layer is player experience, which relates to a more holistic understanding of the experience that manifests from the various different components of the game. For instance, a player might be able to access the game through access level accommodations, presented with an appropriate level of challenge with adjustments to the difficulty, but are they comfortable, enjoying the experience, or immersed as intended? Player experience requires going beyond check-list driven approaches to accessible design (Power, Cairns & Barlet, 2018) to understand whether the game and its various inclusive design features manifest in positive player experiences. This aspect of the approach is best understood through ongoing investigations of the player experience within the context of the specific game.

1.4.2 Positionality

Reflexivity is a crucial component of both reflexive and constructive approaches to qualitative data analysis (Charmaz, 2006; Clarke & Braun, 2014). Charmaz (2006) describes the research process as a co-construction of meaning between the participant and the researcher, and therefore it is important to understand the priors and background of the researcher engaging in the analysis in order to appropriately contextualise the research. This reflective self-awareness also allows the researcher to understand their own biases and reflect critically on their analysis to help ensure rigour. With this in

mind, the background and relevant beliefs of the researcher that may have influenced the analysis are detailed in this section of the thesis. These are expressed from the first-person perspective.

Background. Note that throughout this thesis, I refer to myself (the researcher and author of this thesis) with the plural form, using 'we' and 'our'. Within this section and any section that is deliberately reflexive, this tense shifts to the singular 'I'.

Before beginning the PhD, I occupied a role in the games' industry with the job title, Games User Researcher. This is a role in the video game industry that is focused on understanding the player experience and advocating for player centred design. In this role I have contributed to the user experience on many video game titles and in this role, I have had many conversations with game developers and designers on topics related to user experience and game design. As such, I share some understanding of the game development processes that contribute to the construction of a game, and some of the challenges that might be associated with successfully delivering a game and its individual features. Additionally, and equally significantly, this role also provided an opportunity to engage in many observational research projects where I have directly observed player behaviour of many hundreds of players, ranging from young children to adults across a variety of different genres. In rare instances, this also included small samples of players with disabilities who were recruited incidentally, this lack of focus on accessibility in my professional work also served to spur my academic research interest in why game developers were not making accessible games on a consistent basis – something I did have the scope or freedom to investigate thoroughly when working in industry.

It is also noteworthy that I also have an understanding of psychological concepts related to human behaviour, and motivation, with a background in psychology. I hold a MSc in Clinical Neuropsychology and a BSc in Psychology, which paired with a passionate enthusiasm for games lead to my role in the industry as a Games User Researcher.

Furthermore, I have my own lived experience of disability, as someone that is neurodiverse, with dyslexia, dyspraxia and disrupted attention. Alongside which I also have moderate-severe scoliosis, with associated mobility issues and chronic pain.

Beliefs. As well as the attributes of my background that may have affected the research, I also hold key beliefs that may have affected their analysis. Specifically, I believe that video games have cultural significance in society, and that they hold importance in social discourse. Video games have been important in my life as both a hobby and career trajectory, and this contributes to a belief that they should be inclusive. I was first introduced to video games while briefly hospitalised and temporarily

disabled as a child with an acute appendicitis, and this early experience likely affects my perception on the value of play.

I also believe inclusivity is important and that the current state of video game accessibility and inclusivity is insufficient, with many games remaining inaccessible to people with disabilities. I believe that this is an instance of social inequality and that as academics and games industry practitioners, we should seek to rectify this by better understanding their experiences, the issues surrounding accessible game development within the industry, and then seeking to challenge these barriers.

While these biases are inseparable from the research, steps were taken to help minimise the effect that these biases would have on the analysis. Specifically, the researcher engaged with detailed memo writing with the intent to self-reflect on their own beliefs while analysing the data. For instance, the memo below was written within the context of a thematic analysis where developers appeared to express difficulty prioritising accessibility work.

> *I believe I've heard developers from the games' industry say the same thing about challenging prioritisation against other features before. But am I sure I'm seeing the same thing in my interviews here? Investigate further within the data in further interviews.*

> *I'm aware that I'm personally unhappy with the state of the games' industry regarding accessibility. These developers appear to feel the same way. I need to be cautious to ensure that my questions and analysis do not lead to developers. I cautiously present neutrally on this issue and ask open, non-leading questions while being open to alternative viewpoints.*

In general, the purpose of this memo writing was to write transparently and reflect on my existing biases and to help ensure that the observations and analysis were centred around the interviews and data derived from the participants in the studies documented in this thesis, rather than unconsciously extended from prior experience, and held beliefs.

Despite this effort to limit the extent that the researchers' priors may have influenced the analysis, the researcher also believes that this past experience was a significant strength of this research. The past experience in game development helped in developing relationships with developers, which led to both research opportunities and successful rapport building with participants featured in the research. Familiarity with common practices in the games' industry such as the use of non-disclosure agreements and secrecy associated with confidential projects helped build trust with developers and studios, which most likely lead to easier access to participants and better disclosure from participants who were interviewed.

1.4.3 Industry Partnership

The PhD work spurred a relationship with a large-scale game developer named Splash Damage. It is important to provide detail on this industry partner and our relationship, because this relationship was either integral or shaped all the studies presented in this thesis.

Company Details. Splash Damage is a video game development studio founded in 2001 in the United Kingdom. The company is headquartered in Bromley, UK and owned by Tencent. Splash Damage employs more than 400 employees and is known for developing shooting, and strategy games among others. Some of the games developed by Splash Damage include *Enemy Territory: Quake Wars*, (2007), *Brink*, (2011) and *Dirty Bomb* (2013). The company has also worked on several high-profile projects with other companies, including *Halo: The Master Chief Collection* (2020) and *Gears Tactics* (2020).

Splash Damage has most prominently been involved in the making of competitive, first-person shooters but has delivered games in other genres, such as Gears Tactics which is a strategic game. Their studio houses some knowledge about accessibility, and they have made efforts to improve accessibility with recent releases. Both Gears Tactics and The Master Chief Collection featured accessibility improvements (such as text-to-speech) and colour adjustment modes, that their other games had not. Speaking to our contacts from the studio, this is an area that they hope to continue to improve in as they move forward.

Relationship. The relationship with Splash Damage began organically as the researcher and the Accessibility and UI Lead at the company began to chat together on the International Game Developers Association (IGDA) Accessibility discord group. Through this conversation the researcher and Accessibility Lead at Splash Damage established a potentially mutual benefit for research collaboration, where the company would appreciate more insight into the experiences of people with disabilities playing their games, and the researcher benefited from access to a large-scale commercial studio through which to study accessibility work.

The researcher had many regular conversations with Splash Damage's Game Accessibility and UI Lead throughout the programme of research. While potential research projects were discussed with Splash Damage, the company was very helpful and flexible allowing us to conduct our own research without intervention. The research questions and approach to investigation was not dictated by Splash Damage, but the research simply had natural value to the company by virtue of seeking to investigate a phenomenon that was intertwined with practice within industry.

As with our research questions and approach to investigation, the approach to our analysis was not dictated by Splash Damage. However, the researcher did step outside the academic research practice to provide various reports, conversations, talks and workshops at the studio. These methods sought to disseminate our research findings in a way that was practical and actionable within the context of a fast-moving game development studio where the employees would not naturally read academic reports. The researcher had familiarity in delivering reports and disseminating information to games companies as a result of prior experience as a Games User Researcher, and as such let that prior experience lead the approach when disseminating research to the company and towards wider industry.

Through our relationship with *Splash Damage,* we were also placed into contact with staff from *Microsoft Games Studios* who provided a number of keys to Gears of War Tactics which were given to participants in order to provide them with access to the game. It is important to note that as the game is publicly available, *Splash Damage* had no oversight on the research design or analysis, such as the questions that were used during the interview, or approach to the analysis that was used.

1.4.4 Action Research

The research objectives of this thesis seek to enact change on an applied scenario within the games' industry. Action research is described as a process of studying the 'real environment' with the aim of improving practices (Henson, 1996) and provides a systematic approach to investigating the impact of changes within a real-world context. Action research is often applied within education settings but can be leveraged in any scenario where the researchers play both an active and passive role in the process of initiating and measuring change (Craig, 2009). As such, action research provides a valuable set of guidelines for our research which aims to understand a problem, enact a strategy intended to promote change, and observe said changes. In turn, it is important to clarify what we mean by action research and how this approach to research design has been applied to our research around game accessibility. Craig (2009) describes Action Research as a process that includes several key stages, these are outlined below.

1. Determining Overarching Questions

These have been determined through both the researcher's prior experience working in the games industry and making personal observations, which then directed my literature search towards understanding this issue. The first study also helped shape these research questions, by interviewing game developers on their experience making games and tackling accessibility challenges.

2. Structure and approach

The structure and approach stage of action research requires careful consideration of the best data sources and methods with which to examine in order to provide insight on the overarching research questions. In this work, because there is very little data from either game developers and their experiences of accessibility challenges, or players with disabilities, this was determined primarily driven by qualitative data sources directly with participants from these groups.

3. Multiple forms of data

A key component of action research is the use of multiple forms and sources of data. This body of research has been extracted through interviews from a range of sources, including game developers and players with disabilities. In addition to this, notes on the accessibility of the game developed by our industry partner are also used as a means of understanding the state of accessible game development from the studio.

Table 1

The research questions and how each data set corresponding to each study helps us yield answers to each question.

Overarching Questions	Data Set 1	Data Set 2	Data Set 3	Data Set 4
What is the experience of making accessible games?	Interviews with game developers (Study 1)	Interviews with game developers at Splash Damage (Study 3)	Identification of accessibility features and issues in Gears of War Tactics (Study 2)	
What strategies might be effective in helping to address some of these accessibility challenges?	Interviews with Developers in the industry to understand challenges to inclusive design (Study 1)	Interviews with game developers at Splash Damage (Study 2)	Interviews with players with disabilities (Study 2)	Identification of accessibility features and issues in Gears of War Tactics (Study 2)

4. Data Analysis

This step involves determining how the data will be stored, coded, and analysed. In essence, this step determines how meaning will be made from the data, and different types of data used in the study.

5. Planning and action

A critical component of action research is the idea that the research insights are fed into the development of future plans and action to be taken. As such, a component of this process involves creating and enacting these plans. In my research this took the form of collaborative meetings with my industry partner and a material output in the form of an accessibility report which was delivered and presented to the development studio.

1.4.5 Qualitative Methods

Qualitative methods were used to investigate our research questions. Qualitative methods are considered to be especially useful when seeking to explore complex phenomena and to gain a deep understanding of the experiences of people (Maruster, 2013; Willig & Rogers, 2017). The way people feel, how they think and process information, and understanding their motivations are good examples of complex human phenomena where qualitative investigation has the capacity to provide deep insight. This depth of understanding is especially critical when seeking to investigate an area that is less-well understood. While quantitative methods might employ pre-existing scales and measures, a qualitative approach allows the research to be led by the experiences of the participants in the phenomena itself. Given our aims to investigate an area of the game development experience that is not well established in the academic literature, a qualitative approach seems most appropriate. A qualitative method allows us to investigate the complexities associated with the motivations, understanding and processes of accessible video game development in great detail, which is critical in understanding this experience and precisely where the challenges associated with accessible game development might lie.

It might also be argued that qualitative approaches are the most natural means in which to investigate a phenomenon from the perspective of the game developer. Game development itself is full of meetings and conversations, design problems to solve and constraints to negotiate. These challenges are typically resolved through dialogue between developers, between teams, producers, managers, and other key stakeholders at the studio. With this in mind, it is our belief that a qualitative interview-based approach that has a closer relationship to the format in which game developers often work and are therefore familiar with, has a powerful ability to unearth and understand the complexity of the experiences that developers are having around accessible game design.

Another feature of some approaches to qualitative research is the opportunity for reflexivity and the accommodation and mitigation of researcher bias in the research practice. As the author of this thesis has close proximity to game development, the use of reflexive methods which identify and seek to mitigate the impact of biases but does not claim they do not exist is particularly valuable. Qualitative research and interviews have the opportunity to leverage features such as the shared dialogue of game development between the researchers and participants in order to enhance the quality of the research through fostering trust and rapport with the developers. Despite this, the process of reflexivity also allows the researcher to consider their biases and help to ensure that as far as reasonably possible, they are restricted from affecting the analysis. More details on reflexivity and

precisely how this is incorporated into the research process is outlined in the positionality segment of this chapter.

In sum, qualitative methods provide the most appropriate route with which to analyse this particularly poorly understood aspect of the game development process. This is due to the depth of understanding on complex topics that they can provide, and the potential for reflexivity to enable the researcher's prior experience to enhance the research quality while also providing practical approaches to reduce the influence of biases on the analysis through the form of reflexivity. As a consequence, the methods used in this thesis were interviews and diaries coupled with Constructivist Grounded Theory (Bryant & Charmaz, 2011) and Reflexive Thematic Analysis (Clarke & Braun, 2014). The specific details on how these methods were applied is described in the method segments of each study-focused thesis chapter (chapters 3, 4, and 5).

1.4.6 Ethics

All three studies for my thesis were reviewed and approved by the Physical Sciences ethics committee at the University of York. As part of this process, significant considerations were made to ensure that the research was in-line with the university's ethical guidelines, which included:

- Participants were required to provide informed consent (through detailed information sheets and opportunity to ask questions) before participating in each study, and made aware that they were able to withdraw from the study at any time.
- Anonymisation of recorded data through transcription, pseudonyms and the omission of any information that could enable a reader to identify any participants.
- Consideration of the risk of exposing players to digital games with violent content and measures taken to minimise this risk (e.g. players were recruited for study #2 based on prior interest in playing the game)
- Personal data such as names and email addresses are not tied with the recorded data and only used for correspondence between the principal researcher and participants.

1.4.7 Data Management

The researcher has ensured that they have read and understand the Universities' data management policy. Detailed plans on how data is recorded have been submitted with each ethics application and approved by the Physical Sciences ethics committee. These are also explained in more detail within the respective project chapters in this thesis.

Specifically, data is stored on a single password-protected area on the university managed computer of the principal researcher and backed up into the University Google Drive file system.

1.5 Structure and Contributions

This segment of the introduction is dedicated to outlining the structure of the thesis and the contributions to the literature that are made by each chapter, beginning with chapter two.

The second chapter of the thesis seeks to establish an understanding of the current literature and a basis for the work detailed in this thesis. This literature review outlines the accessibility work that has been completed thus far, looking at different approaches that academics have taken to understanding the challenges associated with making accessible games. This includes research that has sought to tackle accessible design problems, to better understand the experiences of people with disabilities, and to understand the challenges associated with accessible game development. The literature review appropriately contextualises and motivates the thesis by establishing three beliefs.

1. There is a large body of literature available on design approaches and guidelines towards making accessible games.
2. There have been some valuable investigations of the player experience with people with disabilities, but this area is limited in its quantity of research.
3. There are very few investigations of the experiences of game developers and the challenges associated with making accessible games, and this is an area in need of further investigation.

On this basis, the third chapter details our study, outlining a grounded theory of the experiences of developers making accessible games. This research is motivated by the lack of research in this area found in the literature, with existing research being either limited and outdated or using unrepresentative samples (such as students rather than game developers). As this is an area with a paucity of existing research, we took a grounded theory approach to investigating the phenomena of making increasingly accessible games. Using this methodology, we found that successful accessible game development was dependent on collaboration between three key areas: personal factors towards making accessible games, organisational accessibility, and external resources. The primary contribution of this research was in establishing this need for a coordinated effort between organisational investment, external resources, and the developer's personal attributes. The theory hypothesises that without the coordination of these factors, efforts to make accessible games are likely to be unsuccessful or encounter a number of different barriers. The theory supposes that organisational buy in is one of the most essential components as it is only with this, that developer

knowledge can benefit from the critical external resources that developers need to build knowledge towards making accessible games (such as experiences from people with disabilities via playtesting).

Following this research, chapter four outlines our collaboration with our industry partner. Specifically, this chapter focuses on detailing the relationship with the industry partner and the details of the game that would be used as an artefact of study for our diary study (detailed in chapter 4). This and the status of their game with players with disabilities. This also includes a list of accessibility features present in the game (*Gears Tactics*) as well as a list of usability issues that were identified when the diary study was conducted. It is thought to be important to contextualise this relationship and the accessible state of the game, as this context is valuable to understanding the player experiences reported in our diary study (chapter 4) and the developer experiences of working at the studio while seeking to make increasingly accessible games (chapter 5).

Chapter five introduces our diary study methodology and reports the findings from this work. The diary study approach was taken with the view to preserve the highest ecological validity possible, something that is missing from the research on the experiences of people with disabilities. As such, we allowed players to play the game (*Gears Tactics*) in their home environment for 30 days, having them report on their experiences with diary entries, and interviewed participants three times throughout this study period. This approach provided us with valuable insight on the experiences of people with disabilities who play games, what motivates them to play, how they experience accessibility issues and the different strategies they might use to overcome these when possible. Our findings contributed to our understanding of the play experiences of people with disabilities, and perhaps most fundamentally supported a body of research that indicates that these players are motivated and experiencing play in a manner that is similar to the rest of the population. The primary observation being that these players encounter a great number of usability issues that result from excessive demands of the game. These issues were often severe in their effect, and our research illustrates that this was despite various efforts to adapt or tolerate these mismatched experiences. Further implications are discussed in chapter 5.

The following chapter introduces our approach to interview study with game developers at a specific studio. This research had two primary purposes, first two to help us understand the value of the diary study insight and how it might be applied within a real-world game development environment, and to generally gain a better understanding of the experiences, challenges and barriers relating to accessible game development within a large-scale commercial studio. The focus on a single large scale development studio allowed us to gain far deeper insight into the types of organisational challenges that a studio might face when seeking to make increasingly accessible

games. Using reflexive thematic analysis, many areas of the organisational process were identified as contributing to their ability to make accessible games, such as having a clear designation of responsibility for accessibility work, having regular opportunities for feedback from people with disabilities, and having clear accessibility goals for their projects. All of which were thought to help enable them to better prioritise accessibility work, which was currently seen as sometimes challenging against other types of features and existing responsibilities. This makes a significant contribution to the literature, as no previous research has analysed the experiences of making accessible games within their organisational context in a similar level of detail.

Chapter six then sought to understand how these findings from game developers, from both our first study (chapter 3) and our third study (chapter 6) might be translated into something actionable for game developers seeking to understand the organisational challenges that might be occurring within their studio surrounding video game accessibility. With this view, we document the development of a reflexive checklist, which is based on the qualitative findings from both studies with game developers. The purpose of this checklist is to ask questions about organisational facets surrounding accessible design and encourage developers to identify and reflect on these potential areas of challenge. Additional developers were interviewed as part of the process in constructing this tool, to help us understand how it might be used within a real-world context and whether they were areas that they thought were more or less valuable in capturing potential challenges at their studio. This makes its contribution through providing a lens with which developers can hold up to their own organisations and identify factors that are likely posing barriers to their efforts to make accessible games. This is an applied contribution that sits in line with our intentions with this thesis as an instance of action research.

The thesis then summarises its findings and discusses our conclusions with reflection upon the existing literature with chapter seven. The thesis makes a significant contribution to the literature, particularly to the area of understanding the experiences of developing increasingly inclusive games, from the perspective of game developers. Based on these findings, the thesis makes various recommendations and offers various opportunities to help game developers to potentially improve their processes surrounding the organisation of game accessibility work. These recommendations are discussed in this final chapter, and in detail in chapter six alongside the reflexive checklist which is available for any studio that may wish to use it to reflect on their organisational accessible processes.

2. Literature Review

Video games are commonly inaccessible and, as outlined in the introduction, this thesis is focused on investigating that problem further. In order to contextualise our approach, there are several important areas of the literature that we must first review. These both help to motivate the research and position our contribution within the wider literature. To this aim we have identified five key areas, each of these are briefly outlined below and then reviewed in turn throughout this chapter of the thesis.

1. **The Value of Play and Entertainment**. This is a brief discussion that helps motivate the research by highlighting that video game accessibility is not only important for the sake of equal access to leisure, but because video games have the capacity to benefit players in a variety of different areas, including education and mental health. This reinforces why it is vital that we understand both the difficulties and processes behind making accessible video games.

2. **How Mismatched Demands Can Affect the Play Experience**. This briefly discusses the demands of games and how differences in ability can create accessibility barriers and adversely alter the player experience when not accommodated by the game design. This is important to discuss as it highlights why it is critical that we think about accessibility when making games if we wish to realise equality between the experiences of different players. This is important to establish early, as it helps us understand the scope of disability that is being discussed in this thesis.

3. **The State of Our Understanding Around the Challenge of Designing Accessible Games.** This is followed by a review of the literature that has sought to understand the experiences of developers seeking to improve the accessibility of their games. This is critical for us to understand how to better support developers to make accessible games more effectively, and to identify areas that require further exploration. This segment includes some discussion of change management and the experiences of web developers seeking to improve web accessibility, as these areas may be relevant to us understanding how game developers might seek to improve their accessibility work.

4. **Understanding how Change Occurs.** Moving from the challenges faced by game developers working in large scale organisations that make games, we consider how change tends to occur in these types of organisations. This is an important area of consideration as if we want to leverage insight from these game developers into changes that make it easier to make accessible games, we must take time to consider the mechanisms of change within an

organisation and use relevant theories when planning any strategy designed to create an organisational change.

5. **Guidance Available on Making Accessible Games**. This segment entails a review of the literature that provides various forms of guidance on how game developers might improve the accessibility of games. This includes games research that has sought to provide specific solutions to accessibility problems, and game accessibility guidelines that provide a range of suggestions to improve game accessibility. This area is important to review, as it helps us understand what gaps might exist in the knowledge space for game accessibility that developers are able to draw upon.

6. **The Player Experience of people with Disabilities**. This segment of the review discusses the literature that has sought to investigate how people with disabilities are experiencing play. This incorporates literature providing insight on the experiences of people with a variety of different types of disability and also highlights the different methods that can be used to evaluate the experience of these groups of players. Furthermore, this section discusses some alternative methods that have not been applied to the study of people with disabilities playing games, including diary studies and game analytics.

This is followed by a final segment which summarises the state of the literature across these areas and highlights what we see as major gaps in our knowledge around how increasingly accessible games are made.

2.1 The Value of Play and Entertainment

The single strongest argument that motivates our research is the simple fact that video games are a massive facet of popular culture, entertaining millions of players worldwide, with organisations like the ESA which reports statistics on video game consumption in America, indicating a majority of people play games. (*ESA Essential Facts*, 2023). Therefore it is a simple matter of inclusion that people with disabilities are provided with equal access to the experiences that they offer. Gee, (2005) argues that through mechanisms of control, meaningfulness, and expertise in the face of complexity, video games offer the capacity to provide pleasurable and desirable experiences. Video games have the capacity to provide a form of leisure activity, a creative outlet, or merely a meaningful form of entertainment for the user to experience and interpret on their own terms. Consequently, it is necessary that we see video game accessibility as important so that these games that millions of people like to play, can be made accessible to as many people as possible.

We also acknowledge that with the incredibly diverse range of experiences that video games are able to offer, it is inevitable that video games also possess the capacity to cause harm. For instance, there is some evidence that links video game play to addiction (Esposito et al., 2020) and aggression (Burkhardt & Lenhard, 2022). Each of these concerns represent potentially significant societal consequences that are beyond the scope of this thesis to review but do serve to highlight the likely case that video game play is not a universal positive in society. This is instead drawn out to highlight that we believe video game accessibility is important, in spite of these concerns. While video games may have the capacity to cause harm, we believe that video game accessibility is important so that people with disabilities have equal opportunity of access to the rest of our society. Gee, (2005) contends that next to nothing is exclusively good or bad for you, that video games are not distinct from that, and that it is how people choose to interact with an artefact that often determines its benefit. It is with this in mind that we believe it is important to invest in understanding how we can make accessible games, so that people are not deprived of that possibility to choose which games they wish to interact with and experience.

2.2.1 Play Beyond Leisure

While there is a strong argument for inclusion for the sake of equal access to leisure activities, it is also important to highlight the body of research that suggests that video game play can have a positive impact on health and education. This argument is significant as it emphasises the broader societal benefits of understanding and resolving the challenges surrounding the development of accessible games. Specifically, although it is inherently important that commercial games are accessible for the sake of inclusion and access to entertainment, serious games (games with an applied educational or health benefit) also have the capacity to benefit our society, and therefore this helps contribute to motivating research in this area.

Studies have suggested that video games might have a beneficial effect on emotional and cognitive training (Bediou et al., 2018; Raouafi & Sosso, 2017; Pallavicini et al., 2018; Powers et al., 2013). A recent systematic review of the impact that video games can have on cognitive and emotional training found that a large body of studies demonstrated that commercial video game titles may benefit the training of cognitive and emotional skills (Pallavicini et al., 2018). Furthermore, there is a body of evidence which suggests that video games may have a benefit in rehabilitation and health settings (Danilina et al., 2017; Tresser, 2012). In a review of 38 articles (Primack et al., 2012), the researchers suggest that serious games have the capacity to improve both physical and psychological health.

However, the authors of this review also described the quality of the research in this area as poor, citing a lack of longitudinal studies and methodological flaws such as the absence of blind researchers (where the researchers are unaware of the condition group to avoid biasing the data). Despite this, more recent reviews have made similar observations, with video games assisted therapies showing promise in mental health settings (Danilina et al., 2017). As such, while video games are still not usually primary provisions when it comes to physical and psychological treatments, they do demonstrate considerable promise as a potential method that people can benefit from. This potential for benefit emphasises the need to invest in understanding how we can make digital games accessible.

In educational settings, video game research has painted a similar picture, suggesting that video games have the potential to improve educational outcomes (Aldrich, 2009; Gee, 2006; Squire, 2008). A recent review of the literature suggests that games and simulations help students engage and encourage students to achieve their learning goals by enabling them to practise and interact within a virtual space (Vlachopoulos & Makri, 2017). There has also been exploration of commercial games like Media Molecule's Dreams PlayStation Lifestyle, 2020), and *Assassins Creed Origins* (2018) having value as educational tools in classroom settings (Karsenti & Parent, 2020). In spite of this, both research and application in this area remains fairly limited. Very few commercial videogame titles have obvious educational benefits that align with subject matters taught in schools, and those that do (such as *Assassin's Creed*) tend to only exist for very specific subjects such as Egyptian history. Therefore, while video games may be a promising educational tool, in practice their application in this area may still be in its infancy. Nevertheless, accessibility of these games is imperative in situations where these games are applied, and this contributes to the importance of developing our understanding of how to build accessible games.

In conclusion, a brief look at the literature surrounding the application of video games in health and educational settings suggests that video games have the capacity to be powerful tools with benefits across a vast array of domains dependent on the content of the game. While it is likely that factors such as higher cost of video game development and limited benefits compared to traditional provisions slow adoption of these methods, the evidence base across a wide array of domains appears promising. There is increasing focus on using games in educational and healthcare settings, and development of games with health or educational benefits is ongoing. This therefore provides an additional argument to the importance of video game accessibility, not only is it important that commercial titles can be made accessible for the sake of inclusion and entertainment, it is also important that we possess the knowledge to make accessible games so that if video games

are or become prominent in educational or therapeutic settings, people with disabilities are not left behind by these technological and societal advancements.

2.3 How Mismatched Demands Can Affect the Play Experience

Before moving to discuss the key various key areas of the literature on game accessibility, it is first important to establish how games manifest these inaccessible experiences to players. This is important to understand as it contextualises both some of our research approaches, and our research findings, especially within our diary study research where we explore the experiences of people with disabilities.

Much of the research with players with disabilities focuses its investigation around a specific category of player impairment. For instance, a study might focus on people with motor, cognitive or sensory disabilities. However, in this case we have chosen to frame our research around the social model of disability, and within which disability is caused by the environment's demands failing to accommodate the ability of the user. Therefore, it is important to apply this approach when we describe how accessibility barriers occur within games. This section will describe many of the accessibility challenges that occur within games, framed around the demands of the game. Specifically, we will discuss how excessive sensory, cognitive, motor and mental health demands can create experiences that are inaccessible to players.

There are many ways in which disabilities are often categorised or grouped together, we have chosen to use the taxonomy proposed by Aguado-Delgado et al. (2020) which features cognitive, motor and sensory disabilities. However, in line with the social model of disability we describe these in relation to the demands of the game, and how disability can occur when these demands do not match the ability of the player ability. This is in contrast to a description that would be centred around the impairment as the source of the disability. In order to cover aspects of a games demands in relation that relate to industry guidelines for accessibility features such as phobia warnings (Game Accessibility Guidelines, 2012) and protection options, we have also added a section for 'emotional' demands.

2.3.1 Sensory Demands of Video Games

Sensory demands of games relate to the requirement that the player is able to process stimuli from the game, such as visual and auditory information. Players with sensory impairments will often experience additional difficulty, or a barrier to play when the sensory demands are too high relative to their ability. Sensory demands without alternative supplementation tend to create accessibility issues when the game is experienced by players with conditions such as sight loss or deafness.

For example, it is common in shooting games that the player is required to visually identify enemies before they are able to respond appropriately to them. For a player with sight loss, this demand may be excessive making it difficult to identify enemies, leading to either increased difficulty, or a barrier to play. These demands do not need to stem from an intentional source of challenge either, a player with hearing loss may find the demand associated with following the game's narrative to be incompatible with their ability if narrative elements are only presented via audio. In order for games to be made accessible to these groups of players, they need to offer means in which the demands are supplemented or can be adjusted so that players can still perceive this key information. For narrative information, this often means providing features like subtitles or closed captioning. However, more complex solutions may be required to reduce the demand of certain features, such as audio-based way finding for players who find the visual demands of the game to be too great to find their way.

2.3.2 Cognitive Demands of Video Games

Cognitive demands of a game relate to facets of the game that require the engagement of cognitive functions such as memory, attention, and executive functioning. If not designed to be accessible to all players, considerate to the range of ability that people might have in cognitive domains, games can be impossible or excessively difficult to play. Without additional support or supplementation, these mismatched demands create accessibility issues, and these mismatches are more likely for players with explicit variation in cognitive ability, such as those with conditions such as dyslexia, attention deficit disorder or autism spectrum disorder.

For example, a game might provide the player with an instruction that it anticipates they will attend and remember - such as how to use a particular ability that the player might need to progress. For people who are neurodivergent or experience cognitive disability, this demand might be too great. Players with Attention Deficit Disorder are likely to have difficulty distributing their attention constantly to the game. In this example above, this could lead to the player missing the instruction, and then not knowing what to do when the game expects them to recall it. Without additional

support, these types of cognitive demands tend to cause players to experience accessibility barriers or additional difficulty. Options for supplementation are diverse but might come in the form of being able to review prior information or more broad features such as being able to slow the game down.

2.3.3 Motor Demands of Video Games

Motor demands typically relate to the means in which players interact with games. Modern video games require that players operate some kind of physical interface, a controller, keyboard or touch screen. This base requirement then interacts with the software itself which specifies the nature of that interaction as well as how fast, and precise the actions need to be performed in order to succeed in the game. For players with motor impairments, it may be difficult or impossible to operate the physical interface or meet the demands of the software in order to find success in the game. There exists a wide array of different conditions that are likely to make it difficult for players to meet the motor demands of a game, some examples include tremors, joint stiffness, missing limbs or muscular fatigue.

To illustrate an example of how this kind of accessibility barrier might manifest in a game, a first-person shooter might require that players precisely move an analogue stick in order to aim the camera at an enemy. More challenging yet, the game might expect the player to land occasional precision shots in order to progress efficiently. A player playing the game while experiencing tremors might find this level of precision difficult to achieve, therefore finding the game too difficult or, in some cases, impossible. Accommodations that seek to remove or avoid these barriers will consider means in which these demands can be reduced. Different types of aim assist (such as where the game helps move the player's camera towards the enemy targets) can help reduce demands associated with precision aiming. Features such as custom remapping and one-handed modes can help reshape the demands of the game so that they match the player's ability. As with other areas of accessibility the options and range of player experiences are incredibly diverse, resources such as guidelines *(e.g. Game Accessibility Guidelines*, 2012) aim to help make designers aware of the options available to reduce these demands and make increasingly accessible games.

2.3.4 Emotional Demands of Video Games

Demands of a game that pertain to mental health might involve processing various types of stimuli. These elements might be explicitly called out through the game's narrative, or less overt details that are still observable and experienced by the player, such as background audio or imagery. For players with mental health difficulties, it may be difficult and undesirable to experience certain types of content. There are a large number of different conditions which are individually very

complex, that may make it difficult for players to experience some of the emotional demands of a game. These include conditions such as phobias (e.g. arachnophobia), anxiety disorders or post-traumatic stress disorder.

For example, a game might feature content where it includes spiders as an enemy type. For people with arachnophobia, these might not be experienced as moderately aversive but trigger a phobic reaction to the game. Alternatively, a game might have social demands, such as communication channels that enable voice chat from other players. As these conditions are diverse, the means in which developers might make their games accessible are diverse too. These might include features which provide options to remove certain types of content from the game (such as spiders) or simply being more upfront about the types of content the player might encounter and providing options to skip.

It is also important to highlight that while it is useful for us to discuss these demands and their accommodations independently, these are often not experienced discretely by players. For example, as well as low-mood, mental health conditions like depression might have players experience various additional symptoms. Alongside low mood, depression is associated with various cognitive impairments including difficulty with executive functioning, memory and attention (Perini et al., 2019). Furthermore, a condition like depression might be experienced alongside other conditions that may not be mental health related. In fact, research indicates that physical disabilities are often associated with mental health conditions, meaning someone with a physical disability might be more likely to experience depression than the rest of the population. What this means for our research (and for developers seeking to design accessible games) is that the experiences players are likely to have with a game are likely to be diverse and interacting with a complex array of factors that might influence their abilities. This highlights the importance of investigating the play experience with a diverse array of players and player ability. This is important both in order to develop an understanding of the range of experiences and how the game might begin to remove barriers to accessibility.

2.4 The Challenge of Designing Accessible Games

Despite there being a clear benefit to video games being accessible to everyone, commercial video games still present a vast array of barriers that prevent all players from playing equally. Researchers have drawn attention to accessibility issues in video games (Bierre et al., 2005) and while there are no recent reviews of the state of video game accessibility across the breadth of the industry, we frequently see players with disabilities highlighting the challenges that they have

engaging with mainstream video game titles (Bayliss, 2022). It is not uncommon that popular video game titles omit basic accessibility considerations such as subtitles (Wolfe, 2018), which are known to be widely used by players broadly (Brenden, 2019), as well relied upon by players with disabilities (Beeston et al., 2018).

Power, Cairns and Barlet (2018) argue that approaches to designing accessible games must take into consideration the uniqueness of how each individual player experiences the game and how that is affected by their specific disability. The authors highlight that accessibility options that merely focus on enabling players to access the game are not enough if the player experience is still uncomfortable due to elements of the game placing demands that are too high, resulting in accessibility barriers and inequal experiences. As such, it stands to reason that at present, the vast majority of games are simply not adaptive enough to provide inclusive experiences for all players.

2.4.1 Challenges in Game Development

Video games can be considered the product of a game development studio, which is staffed by game developers. With this in mind, game developers and the organisations that they work within are the context in and how which games are produced. With this in mind, when a game has shortcomings, it is critical that we look to examine these developers and the situated context in which their work takes place in order to understand the underlying causes of those shortcomings. Simply put, in order to understand why games are inaccessible, it is critical that we investigate the game development studios, processes and developers that are involved in the production of them.

A small body of research has focused on understanding the challenges in game development, and the experiences of the game designers. Porter & Kientz, (2013) highlighted that there was a significant gap between the human computer interaction academic literature, and the game development industry. Specifically, the authors described how the experiences and difficulties experienced by game developers seeking to make more accessible games were not well understood. In order to help address this issue, the authors used semi-structured interviews to gain insight into the experiences of game developers making accessible games. This work identified a number of key issues affecting accessible game development. One such issue was that the game developers surveyed, often, only focused on the 'low-hanging fruit' of accessibility. These developers would describe scenarios where they would often only focus on the accessibility considerations that were more straightforward or easier to implement - features such as colour-blind options and subtitles.

The developers interviewed in the study (Porter & Keintz, 2013) also touched upon issues related to the internal processes at the game development studio they worked at, suggesting that

accessibility issues only get addressed if an individual is conscientious and makes it a priority. This may indicate that more structured internal processes that help to ensure that accessible considerations are always considered in the game development process could be valuable. The game interviewed developers spoke about leveraging in-house expertise, such as game developers who were colour-blind to address colour blindness issues in their games, and while this likely provides valuable insight for the studio, it also reinforces the idea that the studio only addresses the low-hanging fruit of game accessibility - prioritising the accessibility considerations where they already have access to expert insight. The developers also spoke about how technical issues often made it easier or harder to make their games accessible. Stating that they often relied upon the middleware developers (such as the developers of Unreal Engine or Unity) to include the features that would allow them to make accessible games more easily. The study further identified that developers experienced difficulties making games accessible on consoles due to proprietary systems, such as specific chipsets that allowed only certain devices to communicate with the system.

Despite providing insight into an area that is not often studied, the research provides minimal insight into the personal and organisational attributes that might contribute to the ease of accessible game development within the development environment. Specifically, the authors do not place emphasis on the process in which an accessibility issue is escalated through an organisation, and whether or not that accessible design thinking is supported by internal processes. This type of knowledge might help us understand how to approach problem-solving some of the challenges, such as how processes might be changed to help studios make accessible games. Therefore, while the study does offer some value as an initial exploration, a more thorough exploration could benefit both our knowledge and practice on making accessible games. This directly relates to the focus of our research that also interviews game developers (see chapters 3 and 5).

Another study sought to evaluate whether players with disabilities could act to provide valuable insight when designing a game for players with disabilities (Gerling et al., 2016). This is interesting, as strategies such as co-design may assist with many of the challenges that game developers report in understanding the experiences of players with disabilities from previous studies (Porter & Kientz, 2013). In order to achieve this, they asked both players with disabilities and game design students to design games that could use a wheelchair as an input device. By comparing the outputs of both groups, the study suggested that both game designers, and players with disabilities were able to generate valuable game design ideas, though game designers included a greater level of detail. This is interesting as it reflects the importance of incorporating people with disabilities into the research process when seeking to make increasingly accessible games. This is something that has been considered with our research as we use a diary study (see chapter 4) method to explore the

player experience and sought to evaluate how this type of information was being used by developers at the studio that produced the game (see chapter 5.3.7).

However, this research (Gerling et al., 2016) is not without limitation. Although the findings provide encouraging evidence that people without game design experience can provide valuable input into a game development role, there are caveats. First, as these game designs were not carried out to implementation, it is not clear whether the level of detail expressed in the game designers' designs would have led to significantly different quality of game outputs. This highlights a key challenge with examining this type of phenomena outside of its real-world context. Under full scale game development in a commercial environment, developers may have different constraints which may pose challenges beyond those observed in these more artificial environments. This might lead to differences in output between this type of research setting, and a real-world commercial development environment. Related to this, the study uses game design students as the experienced group of game designers, but these students will have been notably less experienced than commercial game developers.

Further, the format and context of assessment between the two groups were not matched. For the game designer student group, the game design process was integrated into their 12-week undergraduate course, whereas the players with disabilities were invited separately across a 16-week period. These distinct time scales and context may have led to differences in results, which were not attributed to their experience and ability. For instance, the game design students may have felt more detail was required as the study was integrated into their course framework, where they are often critiqued on detail. Finally, the study sought to separate and compare the two groups, whereas a realistic co-design effort in the games' industry would see players with disabilities working in collaboration with game developers. This final caveat is noteworthy because within industry, this type of co-design work acknowledges that an outsourced co-designer (in this case a player with disabilities) is not an expert game designer, and that their input is valued because of their insight into an area that the game designers are less equipped to understand. Therefore, if players with disabilities were leveraged in a game design role in industry, the lack of detailed output may not be a significant limitation as they would be directly assisted in this area by an experienced game designer.

Much of these constraints feel as though they were likely inevitable limitations of the research context (with student participants inside a university setting). There are various challenges that can make it difficult to engage with, and research within, the context of commercial game development studios. Not least potentially prohibitive non-disclosure agreements and often far-reaching desire for commercial secrecy. Despite the distance between their research setting and

commercial game development, the work still provides valuable insight that evidences the importance of incorporating people with disabilities into the design process. However, at the same time, the work also illustrates a key opportunity for further research that might seek to perform similar types of investigation within a more natural setting.

Another study (Westin, Brusk & Engström., 2019) sought to better understand how game developers could be supported to make accessible games. They used a workshop format which incorporated both game designers and players with disabilities into a participatory design process. The authors identified a few key areas that they thought may help game designers make inclusive games, the most essential appearing to be creating a connection between the game designers, and players with disabilities. The authors argued that it was also important to recruit players with specific disabilities and abilities so as to test specific areas of the game. The researchers' observations are valuable, emphasising that this new way of working, with a stronger connection between developer and players with disabilities could be valuable in designing accessible games. However, the manner in which this way of working is achieved in the research might also be a limitation, as the nature of their methods pull developers out of their work environment, it does little to help us understand the challenges developers face within the typical context of their work.

Other research has focused on the idea of an 'accessibility intervention', and whether developers with limited knowledge about game accessibility could be taught to better design accessible games. Although this study was able to demonstrate some success in that an accessibility lecture was able to help students better design a game for players with visual impairments, the methodology has significant limitations. Specifically, as the participants were video game design students and not game designers working within industry, it lacks an ability to assess the real-world impact of this style of intervention in industry. Like similar research (e.g. Gerling et al., 2016) that uses students rather than employed game developers, it is likely that students feel different motivations to attend and adhere to the content of their taught material, simply because they are students who are assessed on the basis of their ability to successfully engage with information taught in their lectures. This then makes it harder to understand how this style of intervention would be applied within its real-world context, as a professional game designer may not share the same motivations as a student. Additionally, the intervention point, and evaluation point were spaced closely together, and the students were specifically asked to make a game for visually impaired players. Therefore, it is altogether unclear how these students are likely to carry this information into designing future games over a longer period of time. This renders any potential implication for the games' industry less certain. While this type of research can be a valuable starting point, further

studies should seek to incorporate commercial game developers and their organisations to help assess the real-world transferability of the findings.

Another article that sought to understand experiences of people developing games found that participating in game jams where there was an inclusivity induction was helpful in getting developers to become aware of key issues surrounding game accessibility (Scott & Ghinea, 2013). In the paper the authors report the experiences of a single participant in the Global Game Jam following an inclusivity induction and among other observations, they found that this process helped them with their awareness of key issues around inclusivity in games and developing design and problem-solving skills in relation to these. This is interesting as it highlights that developers are likely to have knowledge gaps in these areas and that practice in an applied setting is likely to be helpful. Despite this, as the sample size for this study was only a single student participant, it is very difficult to know whether these observations might transfer to game developers working in professional settings. Additionally, the study does not report on the difficulties that the participant may have experienced prior to taking part in the inclusivity induction, and therefore it provides a very limited view on the types of challenges that game developers are likely to encounter when seeking to make accessible games.

Much more recently, the Royal National Institute of Blind People (RNIB) published a report detailing the state of accessibility in the gaming industry as experienced by blind people (RNIB Accessible Gaming Research Report, 2022). As part of this research process, they also consulted with developers working in the games industry and observed a number of key challenges to making increasingly accessible games. Specifically, they reported that developers had inconsistent knowledge of the needs of players with sight loss, with only 15% of developers fully understanding the needs of blind players. They also report three key barriers to making accessible games.

A. A lack of game engine support for accessibility features
B. Accessibility solutions might adversely affect gameplay
C. Complexity of accessibility features

The report also highlights the knowledge gap between developers with disabilities and blind players in relation to how to make accessible games, with only 15% of developers surveyed feeling as though they had a sufficient understanding of the needs of players with sight loss. This finding is interesting as it echoes some of the reporting from Porter & Keintz (2013), particularly in relation to a knowledge gap between developers and players with disabilities. In the RNIB report it is stated that developers prioritise the experience of partially sighted players, which is a similar observation to the prioritisation of 'low-hanging fruit' reported in Porter and Keintz (2013) and may reflect a concern

regarding the complexity of accessibility features and their prospective implementation. Despite providing a lot of value, the report focuses on the challenges associated with designing for sight loss, which still leaves us with a limited understanding of how the experiences developers have around accessibility work as a whole.

It is also worth highlighting there are some concerns that can bias this type of data reported by the RNIB. For instance, developers interested in accessibility might be more likely to participate (sampling bias) and developers might be more likely to respond positively about their knowledge on accessibility when it is not truly being tested (social desirability bias). These further highlights why deeper investigations are required in this area, examining a wider range of types of disability.

After reviewing this literature, there are several key issues that can be identified. Foremost, our understanding of games and the experiences of game developers seeking to make accessible games is very limited. At the time of writing, there is only one recent study which attempts to understand the experiences of game developers working within their natural organisational context (Porter & Keintz, 2013). Second, many of the studies that seek to assess the effectiveness of teaching interventions have methodological weaknesses. Such as using students and classroom environments to assess the effectiveness of teaching inventions. While these approaches can be informative, it is unclear how developers in real-world commercial development environments might operate differently to these classroom settings. This then highlights the importance of research that explores the experiences of developers inside of their real-world commercial context.

2.4.2 Parallels to Web Accessibility

It is likely that many of the challenges that game developers face is similar to those encountered in HCI broadly, and areas such as web accessibility. In their chapter, Power, Cairns & Barlet (2018) argue that there is usually a delay before new technologies are made broadly accessible to use by those with disabilities. This aligns with what we see in game development, with technologies like virtual reality facing increased accessibility challenges when compared to traditional games (Phillips, 2020).

In reviewing the literature seeking to understand the experiences of web developers making accessible websites, Swallow, (2017) observed an increasing number of web developers with an awareness of accessibility. The author suggests that awareness of guidelines surrounding web accessibility was thought to be helpful, but that developers felt that training was required in order to be more effective. Despite this, the author also noted that there appeared to be no overall improvements in adherence to web accessibility, despite increasing awareness of guidelines. This

may help explain some of the issues with game accessibility, as while relatively comprehensive game accessibility guidelines exist (e.g. (Game Accessibility Guidelines, 2012)), the presence or even awareness of this knowledge does not necessarily ensure the development of increasingly inclusive games. Swallow (2017) goes on to suggest that the biggest challenges are likely associated with the manner in which web developers have minimal theoretical knowledge of disability, the issues that users with disabilities face, and in turn how to most effectively provide accessibility support. It is very likely that this issue is similar to that which we see in game accessibility, which aligns with how we see value of connection to players with disabilities being highlighted in the small body of research that is available (Gerling et al., 2016; Levy & Gandy, 2019). This is also an area that (Beeston et al., 2018) assisted with by creating player panels in collaboration with the AbleGamers charity, and through working with the AbleGamers charity this work has enabled game development studios to more easily get feedback from players with disabilities.

However, it is also important to highlight that, while both manifest as accessibility problems in a technical field, web and game accessibility also have a large number of differences. Games today are often developed by large teams composed of many hundreds of developers working on a single project, they often work with 3D engines and have a wide array of different interaction design and control paradigms that place distinct demands on the player that often are not present on websites. Additionally, games often feature purposeful challenges as a key component of their design (Power, Cairns & Barlet., 2018), where specific mechanics of the game offer an intended source of friction and demand for the player to overcome. This contrasts web design where a key goal is often utilitarian, designed to enable the user to perform a particular function or to achieve a particular goal with as little friction as possible. These differences are sizable and provide a likely explanation as to why challenges in game accessibility work are likely to be distinct. Crucially, they highlight why video game accessibility presents challenges that require independent investigation from web accessibility, and also why many existing and future solutions for game accessibility are likely to be distinct from web. In the context of this thesis, this highlights the need for our investigations that are specifically focused on game developers and people who play games, as this has the capacity to unravel those challenges that are specific to games.

2.5 Understanding How Change Occurs

We have established that the challenges associated with the production of accessible games may be rooted inside of game development studios. While this is an area of developing research, the existing literature (Porter & Kientz, 2013) implies that organisational change might be an effective avenue to helping developers make increasingly accessible games. For instance, in their study, they

draw out two themes that appear interrelated. Specifically, that developers 'value in-house expertise', where they cite an example with colour blindness, and that developers tend to focus on the low-hanging fruit, where they again discuss colour blindness. If colour blindness is a 'low-hanging fruit' which is in part due to the availability of in-house expertise on this subject, then it seems likely that broader in-house expertise would also broaden the scope of 'low-hanging fruit'. It is inevitable that the investigation of the situated context that these accessibility barriers are produced within will reveal potential processes and facilitatory factors that can enhance an organisation's ability to make accessible games.

Although we can use the insights generated from this research to identify potential processes and practices that might assist in making accessible games, there remains a significant gap between research and practice. Generating insight aimed at enhancing a developer's ability to make accessible games, without consideration to how it might be applied, will limit the ability for our research to have an impact. This is particularly pertinent when considered in the framework of an action research project, which seeks to not only investigate a phenomenon but to initiate change. As such, this segment is dedicated to reviewing key literature surrounding the understanding of how change occurs within large scale organisations.

If we consider that some of the challenges associated with making increasingly accessible games are likely to be connected with the process and organisation of accessibility work among developers (Porter & Kientz, 2013), then it is important to consider different approaches that might help us understand how to support change for both individual developers, and organisations. Change management theory describes a set of processes and strategies that organisations can employ to understand how to facilitate change within an organisation (Lauer, 2021). In this section of the literature review we will consider a selection of perspectives on individual and organisational change as these may be pertinent to understanding some of the challenges associated with change, as well as opportunities to encourage successful change when looking to help game developers make increasingly accessible games.

2.5.1 Individual Change

Cameron & Green (2019) categorise strategies towards change management in terms of being applicable to individuals, teams and organisations. Perhaps most significantly, the author highlights that individual change is at the heart of everything achieved within organisations – the authors argue that change fundamentally requires individuals to have the motivation to change and that big changes often begin small. At this individual level there are a variety of different approaches

to understanding how change occurs within individuals, including cognitive, psychoanalytic, cognitive, and humanistic approaches. For example, (Satir, 1991) developed a psychodynamic model of change based on observing individuals and families experiencing a wide array of different changes. The model identifies six distinct stages of the change process, these are described alongside a hypothetical for how they might apply to game accessibility.

Table 2.

The stages of Satir (1991)'s model are described alongside hypothetical examples of how these might translate to a change management scenario within the context of game accessibility.

Stage	Stage Description	Example
Old Status Quo	The initial state before the change has occurred.	Accessibility is not widely considered in day-to-day work.
Foreign Element	Something new that enters the system and acts as a catalyst for change.	Accessible design tools are introduced and seek to change the mindset of designers working on features of upcoming games.
Chaos	This is where the individual can struggle to process the information received. Individuals sometimes resist the notion that things may redouble their efforts to continue the status quo.	Developers might be initially resistive of some of these changes, feeling as though they take more time, or are not necessary. Some developers seek to continue with the status quo.
Transforming Idea	The individual begins to come to terms with the reality of the change and they develop this transforming idea which helps them to understand a way forward through the change.	Continued exposure to the new design tools has developers considering what the game might look like if they tried using them. Maybe they figure they will 'try them out' for a day, and start to consider what their workflow might look like.
Integration	The individual is able to assimilate the new world into the individual's	Through some consideration, the individual is able to see how the change will fit with

	own world. The change is put into practice.	their current workflow. The change is put into practice, and they use the design tools regularly.
The new status quo	After the change is integrated into this individual's way of processing the world, this becomes the new status quo.	The new design tools become part of the status quo, the standard process in which the individual works when designing new aspects of the game.

This model is interesting as it helps us understand some aspects of the change process and particularly explains why there may be elements of resistance included in that individual process. The chaos stage helps us understand how some resistance can be a component of a natural process as individuals learn to transform a novel concept into their own working practice. This is valuable because it could help developers understand that transitions towards different processes are not necessarily linear and that the process between the introduction of novelty to integration can also lead to some initial turmoil as individuals process the new information designed to lead to change. Despite its strengths, a vulnerability of this particular style of psychodynamic model is that it does not effectively describe how change takes place or really identify aspects that might enable the change to be experienced more easily.

Another perspective on how individual change occurs looks at the individual's cognition and thought processes in relation to a change. Cameron & Green, (2019) describe how this can translate into a way of considering the individual's perspective within an organisation in relation to how change can be achieved, and they describe this across six stages; self-concept and values, beliefs and attitudes, feelings, behaviour and results. The authors advocate these as key areas in which results need to be achieved in order to see change within the individual, within an organisational context. The authors highlight that an important way that people differ is in how they talk to themselves about results, for instance, one person might think 'I knew I could succeed. I can do that again', whereas another might say 'That was a fluke, I doubt I could do that again'. Cognitive approaches advocate reflecting on these differences in individual thought patterns and challenging those beliefs when they are considered unhelpful. This adds context to other models, helping us understand how individuals might go through the cognitive processes required for change to be successful and it is likely that organisations could take valuable insight from not one, but multiple of these models as a result.

Cognitive approaches also provide a variety of techniques that people might use to help influence change positively, for instance rational analysis is a cognitive technique based on the fundamental idea that our beliefs are not always rational. The thought 'I would never be able to achieve that' might seem intuitive when thinking about a complex task a user has not engaged with before, but with rational analysis would ask the user to challenge this belief with evidence that this assumption might be incorrect. For instance, the individual may have completed many similar, related tasks before and when considered together this evidence might help them see the new and challenging task as something that is achievable (Cameron & Green, 2019). Despite this, a significant limitation of a purely cognitive approach is that it does not recognise the inner emotional workings of an individual and how simply reframing something as positive or considering the rational explanation may not affect how a person feels around that subject. With this in mind, it may be important for our research to utilise methods that allow developers to express these inner emotional factors that might be contributing to their work around game accessibility.

2.5.2 Organisational Change

While it is important to understand the mechanisms of individual change, it is critical to understand how change occurs over a wider organisation as well (Cameron & Green, 2019). Researchers have considered various models of organisational change that help underpin how the change occurs, and the challenges that can arise in relation to successful change management. In this segment we explore a selection of popular models and consider how they might be considered in relation to a game development setting.

Kotter (1995) provides an eight-step process for organisational change, this model was the result of analysis that derived from the authors consulting practice, which included more than 100 different organisations that were experiencing change. The research highlighted stages of change in an organisation when going through a successful change process and can help us understand how successful change might occur within a game's studio.

Table 3

The 8 stages of successful organisational change (source: Kotter 1995).

Stage	Description

Establish a sense of urgency	Discussing today's competitive realities, looking at potential future scenarios. Increasing the 'felt need' for change.
Form a powerful guiding coalition	Assembling a powerful group of people who can work well together.
Create a vision	Building a vision to guide the change effort together with strategies for achieving this.
Communicate the vision.	Kotter emphasises that the *need* to communicate is at least 10 times the amount you *expect* to have to communicate. The vision and accompanying strategies and new behaviours need to be communicated in a variety of different ways. The guiding coalition should be the first to role model new behaviours.
Empower others to act on the vision	This step includes getting rid of obstacles to change such as unhelpful structures or systems. Allow people to experiment.
Plan for and create short-term wins.	Look for and advertise short-term visible improvements. Plan these in and reward people publicly for improvements.
Consolidate improvements and produce still more change.	Promote and reward those able to promote and work towards the vision. Energise the process of change with new projects, resources, change agents.
Institutionalise new approaches.	Ensure that everyone understands that the new behaviours lead to corporate success.

In the context of game accessibility work, these stages might serve as helpful lenses of analysis as they provide an opportunity to identify reasons why change may not be occurring successfully in a studio. For instance, Kotter highlights that successful change requires that the

organisation empowers people to act upon the vision for change, based on this it is conceivable to suppose that a barrier for change is likely to be a lack of empowered individuals able to work towards making the changes required to make increasingly accessible games. Despite this Cameron and Green (2019) highlight that a weakness of this approach can be that the 8 steps do not emphasise that the various steps for change require similar attention and energy. In their experience, they find that managers often struggle to achieve change when the energy input into this process is disproportionately weighted to the early stages.

Senge et al. (1999) argue that many change initiatives fail because there are a vast array of balancing processes that act to preserve the status quo within any organisation. Unlike Kotter (1995), Senge does not provide discrete stages of change that should occur, instead they provide four guiding principles:

- Start small.
- Grow steadily.
- Don't plan the whole thing.
- Expect challenges - it will not go smoothly.

They also highlight challenges such as managers' commitment to change provided it does not affect them and how people have a habit of attacking symptoms while ignoring deeper systemic causes of issues. Furthermore, organisations are bound by often invisible relationships and interrelated actions that can often take years to have their full effect on one another (Senge, 1997). This suggests that people seeking to understand how change can occur would benefit from being cognizant of these less overt relationships within an organisation and also take a flexible approach to implementing change rather than a prescriptive 'how to'. When talking about balancing forces, (Senge et al., 1999) also discuss the key challenges to initiating change that arise in response to change initiatives within an organisation.

Table 4

Barriers to change s (source: Senge et al., 1999).

Challenge	Description
'We don't have enough time!''	People working on the change initiatives feel as if they do not have enough time to step out of their day-to-day routines to work on change related activities.

'We have no help!	People feel as though they are not being adequately supported to engage in the change related activities
'This stuff isn't relevant!'	Employees are not convinced of the organisational need for the investment in change
'They're not walking the talk'	Employees look for the new values or behaviours to be reinforced by behaviours from management and when this is not happening there is resistance
'This stuff is _____!'	Individuals feel discomfort when feeling exposed or fearful about changes, this gets expressed as resistance in different ways.
'This stuff isn't working!'	People can be impatient to receive positive results. Traditional means of measuring success may not translate well to the new initiatives and give a distorted view of change progress.

These perspectives are interesting and might help us understand the types of challenges that may be experienced when seeking to invoke accessibility related changes in game development studios. Despite this, Senge et al. (1999) does not help us understand the early stages of change initiatives, the challenges described assume the change initiative is already being initiated, usually at a managerial level. However, it is not clear how those changes come to be before the organisation begins to try to initiate a change. In these cases, referring back to change management perspectives for individuals appears valuable, as these organisational change initiatives cannot exist unless they are first spurred by someone inside an organisation. Collectively, these perspectives on individual and organisational change are valuable and might help organisations plan for change and avoid some of the more obvious barriers when seeking to change culture, process and output surrounding the organisation of game accessibility work.

In direct relation to our work, one of the common factors between these various change management theories is that they each require some kind of observation of desired output of change. With this in mind, if our work is seeking to spur some change within organisations that enables them to make increasingly accessible games, it will be important to consider how change around accessibility is monitored. While the thesis uses rich qualitative methods to examine the

experience of game developers, we also seek to provide a tool with which developers can monitor their own organisational change around accessibility.

2.6 Guidance Available for Making Accessible Games

Having reviewed the theories around how individual and organisational change occurs, it is important to consider the changes that people want to occur surrounding accessibility, in games. The research that aims to provide guidance for developers offers an avenue that we can view this desired change. Research aiming to improve the accessibility of games has sought to directly research the means in which a game might be made more accessible and often provides subsequent recommendations. This body of research often seeks to either develop or adapt a game which is inclusive to people with a particular category of impairment. In general, this research provides a mix of design prototypes and guidelines which seek to help game developers make accessible games. In this section we will discuss these various approaches with examples relating to perceptual (auditory and visual), cognitive motor impairments.

2.6.1 Perceptual Accessibility Research in Video Games

Much of the work focused on improving the accessibility of games has centred around improving accessibility for people with visual impairments (e.g. Dombrowski et al., 2019; Engström et al., 2015; Yuan & Folmer, 2008). When we consider this body of literature, there are two key approaches. The first seeks to design audio focused games for people with visual disabilities (e.g. Adamo-Villani & Wright, 2007). This approach seeks to design bespoke experiences for this group of people with visual disabilities. The alternative approach has sought to seek means in which existing, popular games (typically designed for players with sight) can be adapted or developers can be better supported to make these types of games in such a way that they are accessible for people with visual impairments (e.g. Atkinson et al., 2006; Engström et al., 2015). Both of these approaches have distinct strengths and weaknesses, as such it is valuable that we review both areas of literature.

In relation to the design of bespoke audio games, there have been a number of efforts to design specific experiences for people with visual impairments that are discussed within the literature. Friberg & Gärdenfors, (2004), discuss how videogames can be designed for people with disabilities. In the paper they emphasise issues around features such as audio clarity, continuous display, and musicality. These design discussions are interesting because they highlight distinct design considerations that need to be made for people with visual impairments, even outside of these bespoke audio game experiences. For instance, for a player without a visual impairment, an issue

with audio clarity is likely to cause a mild inconvenience if it is noticed at all. A weapon strike that is not presented as clearly as it should be is unlikely to leave the player stuck or experiencing additional difficulty, if the player can also visibly see the weapon attack. But if this weapon attack audio is instead the only output from the game that communicates how the game's state has changed, then audio clarity can become a major accessibility problem.

Other researchers have presented design prototypes for audio-focused games, too. In their paper Roden & Parberry (2005) documented a design prototype for an audio-only 3D game engine. This prototype provides a development environment that developers can use to make audio-only games that represent 3D spaces. In a practical capacity, using an engine like this provides developers with the tools to make audio games without requiring that they develop these bespoke pieces of software themselves, entirely from scratch. However, this approach comes with fairly significant limitations, specifically developers are often trained and experienced using specific game engines (such as Unreal Engine or Unity) and as such using an alternative game engine can require a lot of additional learning on the developers end. An arguably more valuable approach instead sees developers and researchers working towards the development of tools that integrate with the existing tools that are already being used by the games' industry (e.g. Smith & Nayar, 2018).

Another significant limitation to the design of these bespoke audio-only video games is that they fundamentally do not seek to provide players with equal experiences. The proposition that a user with a visual impairment cannot play the latest Spider-Man game but can instead play an entirely alternative audio-only game about a different superhero is unsatisfactory when we consider accessibility to be a matter of equal access to experiences (Power et al., 2018). While in this hypothetical example, the alternative audio-focused game might offer a good experience, it does not enable the players with impairments to experience the latest Spider-Man game alongside their peers with sight. This shuts them out of any social experiences that align with the new game, such as surrounding social discourse, or co-operative and competitive play, which all contribute to the experience. This is particularly pertinent when we consider that we already know that people with disabilities, including those with visual impairments, are seeking to play mainstream games (Beeston et al., 2018).

One study focused on accessible design in an adventure game, studying whether players with visual impairments could be equally immersed as players without visual impairments when playing a narrative game guided by natural audio (Engström et al., 2015). The study sought to create an accessible immersive experience without using traditional accessibility features such as text to speech, which the authors say may reduce the game's immersive qualities. This was accomplished by

having three groups of players, sighted, blindfolded and visually impaired, play through a graphic novel style game that was designed to accommodate both blind and sighted players, and then evaluate their level of immersion using an immersion questionnaire (adjusted Immersion Experience Questionnaire (Jennett et al., 2008). Significantly, the study observed no differences between the three groups of four of five measures of immersion. This provides evidence that the design was effective in enabling both sighted and visually impaired players to reach a similar level of immersion and demonstrates how accessible design considerations can help players experience games similarly to everyone else. More research like this is required to understand the impact that various accessible design attributes and specific disabilities have on the player experience.

Another study (Smith & Nayar, 2018) sought to develop an audio based user interface in order to enable players with visual impairments to play games without sight. Traditionally, players would perceive the edges of a track with visual perception and react to manoeuvre the vehicle safely (and optimally) around a track and its various turns. The racing auditory display (RAD) provides second-channel audio support to communicate track details to players, crucially this system goes beyond simply allowing players to steer to avoid the edges of the track but also communicating the turns ahead so that players are able to plan and optimise their driving line. In their evaluation, they found that players both preferred the RAD system but were also able to achieve lap times that were close to those of players with sight. In their evaluation, they found that players were more able to plan their racing line and take shortcuts than players using more traditional driving assistance systems that were more instructive. This approach appears especially valuable as it seeks to understand the experience of racing in a car. This design mindset feels in line with the thinking of Power et al., (2018) where the authors advocate going beyond access and considering means that inclusive design can preserve the intended experience of play for people playing with disabilities.

Another paper (Atkinson et al., 2006) discusses the design of AudioQuake, a modification of a game, designed to allow people without sight to play first-person shooter games. AudioQuake is modified with second channel audio support for information that was previously only communicated visually and aims to help players with disabilities perceive key information that is important to play. Although almost two decades old, AudioQuake provides valuable examples of how games without accessibility considerations can be made more accessible. Despite this, it is also unfortunate to observe that across this lengthy period of time, these types of second channel accessibility features are still very uncommon in modern day video games.

Quake itself is a series developed by Bethesda, whose most recent first-person shooter games have included Doom (2016) and Doom Eternal (2020). Unfortunately, neither of these popular

titles include second channel support comparable to options offered by AudioQuake. Several similar resources for improving audio accessibility were available during this period, highlighting an influx in interest in game accessibility and an influx in available knowledge on how games might be adapted for people with visual disabilities (Adamo-Villani & Wright, 2007; Glinert & Wyse, 2007; Oren, 2007). The presence of this early accessibility knowledge is juxtaposed with the accessibility offerings in popular titles over the following decade. The misalignment between availability of knowledge and implementation can be considered an example where the knowledge to make increasingly accessible games has been available for many years but does not appear to be adopted by game developers. There could be many distinct explanations for why this has occurred, which only serves to highlight the value of investigations in this area, particularly research that seeks to investigate the experiences of developers making commercial games.

Similar lack of translation of knowledge between the games industry and commercial game development can be seen in other areas related to video game accessibility (e.g. Pascale et al., 2008; Yuan & Folmer, 2008). For instance, Blind Hero (Yuan & Folmer, 2008) is a design prototype that illustrates how the popular rhythm game Guitar Hero can be made accessible for people without sight. In the prototype, they supplement the visual information with haptic feedback to enable people who are blind to play effectively. While it would be unusual for an individual developer to solve an accessibility problem with a hardware-based solution, as the Guitar Hero series has historically been associated with the sale of specific peripherals, a hardware-based accessibility solution for the game could be feasible. Slightly later, *Rock Vibe* (Allman et al., 2009) was developed by another research lead organisation with the intent to make *Rock Band* accessible. In both these cases, the burden of this accessibility work lies on these external organisations, and modern game development studios have not adopted these design innovations to make their games more accessible by default.

Similar disconnections between the academic literature and industry implementation exist in relation to accessibility for people with auditory impairments, too. While there have been various approaches to providing information for developers seeking to make games more accessible for people with auditory impairments there is still a visible disconnect between the literature and guidance available (e.g. (Adamo-Villani & Wright, 2007; Brook, 2017), and the support offered for this group of players inside popular video games. In their review of auditory accessibility in games, (Brown & Anderson, 2021) identify a number of issues with the auditory accessibility of popular mainstream games such as Resident Evil 2 (2019). In their review, they cite an example from a game where the player is pursued by a character called Mr X, who can be prematurely detected through the sound of his footsteps. Without the auditory feedback, players will be unable to detect the

enemy and suffer far greater difficulty as a consequence (Craven, 2019). The authors go on to cite a number of other examples from the industry where auditory features are critical to the player experience, and second channel support is not provided (Brown & Anderson, 2021). The presence of these disconnections help motivate our own research as it is unclear whether this information simply is not being received by game developers, or whether there are other barriers in play.

2.6.2 Cognitive Accessibility Research in Video Games

A limited body of the literature has focused on how games might be designed for people with cognitive disabilities. Outside of games I, there is recognition of the need to provide accommodations for people with cognitive disabilities (e.g. Lewis, 2006; Mobahi & Karahalios, 2005). While there is some research oriented towards designing serious and therapeutic games for people with cognitive disabilities such as stroke and dementia, there is very little that focuses on commercial titles. In areas such as motor and visual disabilities, it has been the case that researchers have been at the forefront of searching for techniques which might enable us to adapt these games so that they are accessible. However, this approach appears less common in relation to cognitive disabilities.

Instead, much of the work focused on designing games for people with disabilities has been focused on serious games - games focused on providing positive benefits such as health related interventions. For instance, a sizable body of literature has looked at how social multiplayer games can assist in the development of social abilities among children with autism (Mohamed et al., 2006; Ohring, 2008). In Sides, a tabletop computer game designed to assist with the development of social skills (Piper et al., 2006), where players interact with each other to achieve shared goals in a cooperative table-top game. The researchers found the game to be effective in helping motivate children with Asperger's to engage in a social activity. With this research, the authors also identified a variety of design considerations specific to making a game of this type for people with Asperger's. For instance, in this game one design change the researchers made saw them limit the potential to interact with the board during the turns of other players, as prior to this change they observed players would interfere with the turns of players who were taking too much time. This style of research has continued, with recently published papers demonstrating approaches to designing games for people with autism (Jaramillo-Alcázar et al., 2022; Whyte et al., 2015).

While we are not aware of work that has sought to understand how specific mainstream games can be adapted for people with cognitive disabilities, there is a body of work that provides guidelines for designing games around cognitive disability. One paper discusses how games might be designed to be accessible for people with cerebral palsy (Compañ-Rosique et al., 2019). In this paper

they discuss three game prototypes designed by consulting with therapists for people with cerebral palsy and provide a variety of design guidelines based on this experience. One such guideline suggests adjustable speed for action in the game, which would enable players with a disability who may take longer to respond to adjust the expected window to something that is accessible to them. Another suggestion to enable the game to be played by one-button is to use a 'sweeping' system where each of the game's options are presented one at a time. These types of guidelines can be invaluable and while in this case, they are applied within the context of these bespoke prototypes made specifically for people with cerebral palsy, these types of features could be used by mainstream game developers to accommodate people with cognitive disabilities.

Suggestions for how to accommodate people with disabilities are also included in the game accessibility guidelines and XBOX accessibility guidelines *(Game Accessibility Guidelines, 2012; Xbox Accessibility Guidelines*, 2021), as well as the AbleGamers design patterns (*AbleGamers Accessible Player Experience,* 2018). For instance, all three of these include a suggestion that the game has some kind of options for adjustable speed. Therefore, even if accessibility focused adaptations of existing games (e.g. Yuan & Folmer, 2008) are less common, they are still being considered in wider guidelines for accessibility. In some cases, these suggestions for improving cognitive accessibility appear to be making their way into the design of mainstream games, for instance (*The Last of Us: Part 2*, 2020) features an accessibility option that allows the player to slow down the speed of the entire game, enabling them to perform actions such as react to enemies, without time pressure. Despite this, this type of setting is uncommon and modern, popular games such as *Call of Duty Modern Warfare 2* (2022), or (*The Legend of Zelda: Tears of the Kingdom*, 2023) do not feature this type of option. As with other types of disability, this suggests that there are challenges that developers experience towards making accessible games that are beyond the mere availability of knowledge that require more thorough investigation.

2.6.3 Motor Accessibility Research in Video Games

Another area of research has been designing for people with motor disabilities. Similar to research in other areas of disability as pertaining to games, there are various approaches that research seeking to solve issues pertaining to motor accessibility have taken. One of these approaches is rooted in very early research that sought to provide alternative physical avenues for people with disabilities to interact with computers (Kilgallon, Roberts & Miller, 1987; Mutschler & Schöller, 1986). For instance, in their research Mutschler & Schöller (1986), sought to provide an avenue in which users could operate computer and telecommunications devices with speech as

opposed to physical input. This approach mirrors many of the approaches for motor accessibility that are seen in games today.

However, as researchers have pointed out (Power et al., 2018), designing inclusive games requires developers go beyond merely providing options for players to be able to access and interface with the game at all. Games are distinct from other forms of software in that they often provide intentional sources of friction and feature distinct experiential outcomes that they wish to evoke in the player experience. Consequently, an approach that looks to resolve issues of accessibility by only considering the input devices that players might use is often liable to be inadequate. If for instance, a player is enabled to interface with a game by operating it with verbal cues, but the game is operated at a much slower speed than it is by physical players, then the player's experience is still very distinct from others, and the player might not be able to reach desired outcomes such as being able to overcome the games level of difficulty while playing with the accessibility features. As such, researchers have considered various specific approaches to improving the motor accessibility of games.

One such approach has been to design bespoke experiences centred around simplifying the input style of a game. For instance, in their paper (López et al., 2017), describe the design and development of a collection of bespoke one-switch mini-games, designed for people with motor impairments. In this study, the games are designed from scratch to be adapted to these games that can be operated by a single binary interaction. In their evaluations of the playability of these games, they find that they can be played by the majority of players in the study, and that the majority of players participating report enjoying the games too. Therefore, in this instance, by designing a game around the one-switch interaction style it would appear that the developers were able to build a game that was both accessible and provide a positive experience for its target audience.

Despite this, this research (López et al., 2017) comes with limitations. One major criticism of this particular study was that the method that the researchers used to evaluate whether the players 'had fun' with the game was simply to ask them *'did you have fun?'*. However, this measure is inadequate for a number of reasons. First the question does not help to distinguish if the participant had fun with the game, or with the experience of participating in this novel study. A response bias effect is likely if the players expect that the researcher wanted them to have fun, which is likely given that this is the inevitable desirable outcome of most games. Third, the binary measure tells us nothing about the experience, or what they specifically enjoyed about it. Collectively, these issues make it very difficult to understand whether players enjoyed the experience of playing the one-button games, irrespective of what the study reports. Additionally, the sample size is very small (8

participants) to provide a valuable conclusion on something as subjective and complex as enjoyment. Furthermore, as bespoke video games played only by people with disabilities do not resolve the issues relating to social inclusion wherein players are unable to engage with existing, mainstream video games.

Despite this limitation, the research is still valuable as it provides various potential strategies for how games can be designed to support one-button play, even outside of the bespoke games built for the research. Additionally, the researchers provide evidence to suggest that the games they have built may have rehabilitative value and offer an evaluation of the game from a perspective of paediatric rehabilitation and found that the games had value in this area. This further reflects the significance of wide investigations in how to make accessible games, as there are potential applications for game accessibility beyond purely leisure and enjoyment.

One example of a developer that sought to solve the issue in relation to improving accessibility among mainstream titles. In *Gordon's Trigger Finger* (Hoang et al., 2008), the developers provided a design adaptation of *Half Life 2* that could be played with only one button. Unfortunately, this game is published only as a game jam entry and no data on the evaluation of the user experience is provided. This design adaptation serves to demonstrate how interaction simplification can help make games more accessible for people with limited motor abilities, such as quadriplegic players. This is particularly notable as *Half Life 2* represents a very complex and popular style of first-person shooter game that tends to be quite inaccessible, even today (e.g. Bayliss, 2022). Despite this, the lack of any evident form of player evaluation makes it unclear what the player experience is when reduced to one button and as such the value to game designers is likely to be quite limited. Specifically, it is unclear they consider making an adjustment that drastically changes the design of their game, if it is not evidenced to improve players' experiences.

Another adaptation is Sudoku Access (Norte & Lobo, 2008) which provides two options for players to interface with the game, either by voice or single switch. With this system players are able to interact and solve Sudoku puzzles. This is interesting but comes with some significant limitations when we consider the potential for wider application. Specifically, although Sudoku is an existing and popular game it is not representative of the typical complexity of many mainstream, popular video games that take place in complex 3D spaces where players often have a variety of different actions they can perform. As such the research findings are quite limited in their ability to be transferred to other popular mainstream video games that people play today.

Within the academic literature, researchers have often sought to provide their own approaches to alternative input (e.g. Liao, Fong-Gong & Shu-Hsuan, 2019; Taheri & Weissman, 2021).

One paper (Taheri & Weissman, 2021) documents the design and evaluation of a control system designed to enable quadriplegics to play first-person shooter style games. In this instance, they provide the players with gesture-based inputs using a camera system that recognises the players facial expressions. Different facial expressions (such as happiness, sadness, and disgust) are aligned with different in-game actions such as walking forward and shooting and enable players to interface with the game. The authors provide an evaluation of this style of input which demonstrates that players are able to achieve a high degree of efficacy with the control system.

Despite this, the evaluation is quite limited as the work centres around a bespoke video game designed for the evaluation of this input style, and it is not clear how this input style translates to play experiences in contemporary first-person shooters. One limitation appears to be the manner in which the input style only supports one action being performed at one time, which would restrict the player from being able to perform conjunctive actions such as moving, shooting and jumping at the same time. But this work is still valuable in demonstrating an approach that players might be able to use in more simplistic first-person style games, and the evaluation within the confines of the bespoke game illustrates the significance of collaboration between software and hardware, between the people involved in designing the alternative input scheme, and people involved in designing the hardware.

From the games industry, developers looking to solve motor accessibility issues have sought to provide a variety of different means in which to make the inputs flexible. Most common accessibility design recommendations (AbleGamers Accessible Player Experience, 2018) advocate for input flexibility. This typically manifests in the form of customisation of the button remapping options, and the opportunity to use alternative styles of controllers. On the hardware side, Microsoft and Sony have both developed their own accessibility orientated controller interfaces, designed to enable players to connect their own buttons, switches and other forms of input device to interface with the game (Microsoft, 2020, PlayStation, 2023). These approaches are valuable because they enable players to be accommodated and use many alternative input styles such as those designed by researchers, without playing alternative games or being restricted to hardware that supports their devices. So a player can use the XBOX Adaptive controller to interface with the latest *Call of Duty* or *Halo* title using alternative styles of button configuration. Unfortunately, the documentation development and evaluation of these devices is quite limited compared to what is typical of an academic publication, and therefore other manufacturers seeking to make similar controllers may struggle to understand the design and process underpinning the production and evaluation of these devices.

Additionally, the functionality of these devices is always constrained by software side support. The XBOX Adaptive controller allows for top-level remapping of the game's controls, but unless a game enables software-level remapping, the controller needs to be reconfigured for each individual game. Additionally, these controllers are limited in their ability to reduce the complexity of a game's input styles. For instance, if precision aiming is a severe difficulty experienced by players with a motor disability, then an alternative style of input will not automatically enable them to overcome this difficulty. In fact, the alternative style of input may simply be something that they are able to operate but actually increase the difficulty of precision aim when compared to traditional input (such as levers designed to be operated by a player's feet). Select games offer settings that mediate this issue by reducing the level of precision required to aim accurately in the game Gameindustry.biz, 2020). In *The Last of Us Part 2* (2020), the game offers various settings to reduce the demand on precision aim, which include options for aim assist (where the system makes it easier to stay on target), lock-on targeting (where the aim snaps to the target automatically when the player presses to aim) and automatic targeting (where the aim automatically switches between targets as required). Collectively these types of features can be used in conjunction with accessibility controllers to not only enable players to access and interface with the game but experience the games demand at a level of difficulty that is matched with the player ability.

The difficulty with this approach is that it requires a combined effort towards accessibility and inclusive design between both hardware manufacturers and software developers. In games like *The Last of Us Part 2* (2020) this is made more possible as the publisher of the game is also the producer of their PlayStation hardware. But in other instances, it requires collaboration from development between who are not part of the same organisation. Subsequently, there are many games that are mechanically similar to something like *The Last of Us Part 2* and yet do not feature the same level of design accommodations for accessibility. The consequence is that even if players have access to these accessibility controllers, they may still find them either difficult to configure inside of the game, or that the experience offered cannot accommodate differences in how they are able to interact.

2.6.4 Universal Accessibility Research in Video Games

A number of studies focused on designing video games that were universally accessible. These games would feature accommodations for players with visual, motor, and cognitive disabilities all within the same game. One such game titled *Access Invaders* was developed as part of a research project aiming to make a universally accessible game (Grammenos et al., 2006). In this paper the authors argue that mainstream games developed to be accessible are only capable of achieving very

limited accessibility, and despite the issues with segregation and cost, bespoke accessible games can achieve a far greater level of accessibility for players with disabilities.

Access Invaders achieves this by supporting alternative input devices, varied output modalities and interaction styles, and a flexible user interface. While the research successfully demonstrates how a game like Atari's Space Invaders can be converted into an almost universally accessible game, this comes with stark limitations that are only briefly considered by the authors. Namely, *Space Invaders* is a very simplistic game compared to modern titles that players are frequently playing, and therefore this enables the adaptation into an entirely accessible game to be much more cost effective as the games code and art is not that sophisticated compared to contemporary games developed by much larger teams. This might make it very difficult to transfer insights from this development prototype into contemporary video games with greater complexity.

A similar approach was taken by researchers with a tic-tac-toe style game (Ossmann et al., 2008). In their paper they document means in which they make adaptations to a traditional version of tic-tac-toe in order to make it accessible for people with perceptual, motor and cognitive disabilities. This involves features such as second channel support in the form of auditory output to communicate key game features to support people who are blind, and the opportunity to use alternative input styles to support people with motor disabilities. This approach demonstrates the importance of a variety of accessibility considerations in making these games accessible. However, this suffers from similar issues to access invaders and UA chess (Grammenos et al., 2005, 2006) where the games simplicity makes it possible to make these games highly accessible in a manner that may not translate as easily to mainstream games. Indeed, it is extremely uncommon that we see any mainstream video games managing to be as accessible as these research prototypes.

2.6.5 Guidelines for Designing Accessible Games

One approach that has been used in an effort to help game designers to make increasingly accessible games is the use of guidelines. Guidelines serve as lists of best practices that game designers should seek to adhere to if they wish to make accessible games. For game accessibility specifically, there are a variety of different guidelines and similar resources for developers to use. This section will examine these guidelines and critically review their approach to resolving accessibility issues in the games industry.

The Game Accessibility Guidelines (2012) are an online resource that provides game developers with information on a variety of features that can be incorporated to make a game more accessible. These are grouped into basic, intermediate, and advanced categories based on what the

accessibility guidelines identify as value, reach and impact. To provide an example, a basic guideline they provide is that games should have custom button remapping, enabling players to alter which in-game action is mapped to which button on their physical interface. Meanwhile, an advanced guideline suggests that developers should avoid making precise timing essential to gameplay. For a developer might mean providing an alternative style of interaction if the game features precise timing for things like quick time events. These type of design suggestions are provided to developers through more than 60 guidelines which are continuously updated and expanded, and cover motor, cognitive, vision, speech, hearing and general accessibility categories. This resource offers a wealth of valuable information on both what developers can do to make accessible games, as well as high-level instruction on how that might be achieved. However, these are not without limitation. The categorical grouping on the game accessibility guidelines is quite opaque, and it is not clear how many people with disabilities are reached by each feature. This is likely due to the challenge associated with gathering data from developers that would tell us how each feature is used by players. Instead, the documentation on the Game Accessibility Guidelines webpage suggests that developers should use player telemetry to determine this themselves which entails additional work, and even if this work is performed, developers may not publish this data. Additionally, to our knowledge there is no published research that evaluates how the guidelines are being used by developers and the impact of the guidelines. Furthermore, the website does not make it clear whether people with disabilities were included in the process of designing the guidelines, the page only cites that the guidelines are a 'collaborative effort between a group of studios, specialists and academics…' with no mention of people with disabilities. It may be the case that people with disabilities are among those specialists, but this is not evident from the information provided. A similar set of guidelines are the XBOX Accessibility Guidelines (2021), and these share the same limitations wherein there is a lack of evidence based research that demonstrates the value of their application.

There is evidence that game developers make use of external knowledge such as guidelines and design patterns. The Accessible Player Experience (APX) design patterns (AbleGamers Accessible Player Experience, 2018) provides a list of various access and design patterns that intend to help developers understand different approaches to making games more inclusive. These patterns cover a wide array of different features that could support players across motor, visual, auditory, cognitive or mixed disabilities. Unlike more typical guidelines, the APX design patterns serve as more broad design lenses, encouraging developers to reconsider the way players can interact with their game. These patterns do not provide specific recommendations, for instance the 'Do More with Less' pattern encourages developers to consider how players might be able to simplify the games controls

while avoiding restrictions on what the player can do in the game. In an interview with (Eurogamer, 2021) a developer from The Last of Us Part 2 highlights the value of these access patterns. Elsewhere, PlayStation cites the game accessibility guidelines as being a valuable resource on their website (*PlayStation London Studio*, 2022). Indications that these resources are being used are dotted throughout the industry, in talks, webpages and other sources such as video game credits.

However, more research might investigate why and how these are being used by developers, and whether there are any barriers to moving from guideline to implementation. Where the guidelines appear to lack utility is in encouraging the organisational changes that see developers start to pursue resources like this. A guideline might be useful to a developer that has already decided they want to and have the resources available to improve their game accessibility, but it does not help us understand or resolve issues that might arise higher in the process chain. For instance, if the studio leadership will not allocate the resources towards game accessibility, then it is likely that the impact of awareness of guidelines is constrained.

While this has not been studied in games, in web accessibility we do see issues where developers are aware of accessibility guidelines yet the recommendations provided in the guidelines are still not being put into practice (Swallow, 2017). This highlights why a wider investigation of the organisations that make games, and the experiences of game developers is likely to be a fruitful area of research.

2.7 The Player Experience of people with Disabilities

Outside of developing accessible games, a number of studies have sought to gain a better understanding of players with disabilities. In their chapter, Power et al., (2018) suggest that designers need to step away from the idea that they can make successfully inclusive games without considering the vast range of ways that players will opportunistically use the in-game features, as well as the diversity of their play experiences based on the players own personal characteristics. The authors argue that by capturing these experiences developers can go beyond traditional approaches to game accessibility that focus on access and enablement, and push towards inclusivity of the overall player experience.

With this in mind, a review of the literature that has sought to investigate the experiences of players with disabilities may enable us to better understand what further research is needed. Looking at gaps in the literature in this area, and the methodologies that are effective here, could be valuable in understanding which approaches may be successful at investigating the experiences of players with disabilities.

2.7.1 Methods used to Investigate the Experience of Players with Disabilities

As the literature specifically focused on game accessibility is quite sparse, the summary of this literature first focuses on illustrating the value of the methodological approach and then discusses relevant literature to game accessibility that has sought to use this method. In some instances (such as diary study research and game analytics) the author is aware of no examples where the method has been applied specifically to game accessibility, and therefore we review the speculative value of this approach based solely on other research that has used these methods.

Interviews. Interviews can be a valuable method to investigate the player experience and have been used by a variety of different researchers to investigate different aspects of play (e.g. Ortiz De Gortari et al., 2011; Wästerfors & Hansson, 2017). Doody & Noonan (2013) highlight various advantages to using interviews to collect data which include gaining useful insight and context around the data, enabling the researcher to develop rapport with the participant, providing the researcher the opportunity to observe and listen alongside the interview, and allowing more complex questions to be posed by the researcher. This last point is a major advantage to the interview process in comparison to approaches such as surveys or data analytics, because in an interview study you are able to pose questions to the participant that they can feed back to you for clarification if the question presents any uncertainty. Additionally, the researcher is able to ask follow up questions if the participants response lacks clarity or in itself, poses more questions that are relevant. This back and forth between the researcher is very typical with semi-structured interviews (Bromley, 2018; Doody & Noonan, 2013).

Historically, interviews have been used to examine a wealth of different phenomena and groups of players. For example, within games research, researchers sought to better understand the experiences of female players and specifically their identities around online games (Kuss et al., 2022). The researchers used semi-structured interviews which enabled them to gather detailed experiences of each of their participants and used thematic analysis to identify themes from these interviews. The resulting analysis highlighted various key areas where the gaming experience was significant for female players such as in improving mental health and building social skills, and also highlighted key tensions with their identities as being people that play games.

But these types of interview studies are not without limitation and methodological concerns. Another study looking at the experiences of female gamers (Reinecke et al., 2008) found that the experiences of female gamers were distinct in that these players found winning to be a low priority. Despite this interesting finding, the researchers do not report the approach taken to analysing data

generated from the interviews. Analysing qualitative data can be challenging and there are many different approaches that researchers can use to investigate the data. It is important for researchers to select an appropriate analytical method for their data set, and to offer transparency on this chosen method so that readers are able to understand the proper context behind a study's findings. Without appropriate methodological rigour the research findings have diminished value, and this is especially unfortunate when the interview method is often time consuming for participants, and the themes discussed often have a significant degree of sensitivity.

In the area of game accessibility, there has been little investigation of the player experience of people with disabilities using interview methods. However, Wästerfors & Hansson (2017) used interviews to investigate the play experience of a sample of youth and young adults who played games while experiencing disability. In the study they found that they played for the sake of enjoyment, community, and identity shelter. The themes of community and identity shelter are especially interesting as these are elements of the experience that are relatively specific to virtual experiences like games, and this then highlights how crucial it is that these experiences are valuable when they can offer this ability to connect to others, or to just exist in a space where they are not being perceived as a person with a disability. In their research, the authors also found that for these players, their disabilities often complicated and altered their engagement with the games they played, but that the players would respond with different inventive tactics that helped them stay engaged. For instance, one player reported designing their own virtual keyboard layouts which helped them to perform actions in the game more easily. Critically work aligns with the suggestions made by Power et al (2018) wherein the authors argue that inclusive design is a matter of looking beyond merely providing access to game and enabling players to interface with it, but seeking inclusivity of experiences and enabling means in which players with disabilities can have a similar experience of play to those without.

Another study using interviews with players with disabilities examined the social play experiences with people with disabilities. Beeston, (2020) interviewed 17 on their experiences of multiplayer gaming, both cooperative or competitive. The researcher identified a number of interesting themes from these interviews relating to areas such as the benefits of play, accessibility, and the expectations of other players. One particularly interesting finding was that despite players appreciating the social aspect of play and finding that play was a means in which to 'get out of their head and into the world', they also felt that playing the wrong way elicits toxicity from other players.

These types of interview studies that investigate the experiences of people with disabilities help to illustrate the value of interview methods and their capacity to investigate the complex

phenomena associated with the lived experiences of disability surrounding play in appropriate depth and detail.

Surveys. Surveys can also be a valuable means in which to investigate the experience of a group of people. Some of the advantages of survey methods include the potential to deliver a survey to large numbers of people, and ensure that the data collection process is strictly standardised across participants (Fowler, 2013). This can make surveys especially useful when seeking to conduct quantitative research where the number of participants affects the statistical power of the study, leading researchers to seek larger sample sizes. However, survey methods can be effective for capturing qualitative data too, particularly if the researchers are looking to collect data from larger samples of a particular group. In games research, survey methods are often used to capture the experience of players on measures such as immersion (Jennett et al., 2008; Takatalo et al., 2010) and motivation (Tyack & Mekler, 2020).

While survey methods are widely used in HCI and games research, as there is only a small body of research considering the experiences of people with disabilities, there are still only a small number of studies using survey methods in this area. One study investigating the play habits of players with disabilities used surveys to gather information about player demographics, and behaviours (Beeston, Power, Cairns & Barlet 2019). This research revealed that these players with disabilities play mainstream video games while making use of a range of assistive technologies. These accessibility technologies ranged from common implementations like subtitles, to features like text to speech and eye gaze tracking. The majority of these players were reported to be playing on PC, likely because the PC platform is generally more flexible and supportive of a variety of assistive technologies (such as the option to use different controllers). Notably, these players expressed that they were playing with a wide range of different cognitive, motor, and visual disabilities, more than half of these players considered video games to be their primary hobby.

These players were reportedly playing a wide range of video games, across different genres, with different demands on the player. Many of the more popular titles among players with disabilities were reported to be games with significant elements of social interaction with other players, such as *Destiny 2* (2017), and *Overwatch 2* (2022). This might highlight the importance of further research into the experiences of how players with disabilities experience social interaction in games, and whether the current assistive technologies enable them to participate equally.

Perhaps most crucially, the study showed that these players are playing the same games as players without disabilities, which demonstrates the importance of inclusive approaches to game accessibility, so that players are able to comfortably play pertinent titles in popular culture, alongside

everyone else. While this study is the largest survey of players with disabilities to date, it is worth highlighting that the study's sample size is relatively small (154 players surveyed), particularly when divided across the different genres of play, leaving only a small amount of data on the play habits of players that play a particular type of game (such as racing or strategy). Consequently, there are still many questions about the experiences of play and use of accessibility features within specific types of genres. Additionally, further research is required to investigate the play experiences of these individual players, and how these players are using accessibility options in their games and how these options are affecting their play experiences.

Researchers have also focused on specific types of disability in order to gain a better understanding of how these specific groups of players experience games. One such study focused on players with visual impairments (Andrade et al., 2019). This study used an online survey to gain insight into the experiences of players with visual impairments, including their motivations for play, opinions on the industry and accessibility concerns, and then a selection of participants were followed up with a semi-structured interview. Participants had visual impairments ranging from loss of peripheral vision to blindness and impaired light perception.

The study had a number of key findings (Andrade et al., 2019). Players reported that they valued complexity in games yet acknowledged that sometimes they needed to be simplified in order to be played with a visual impairment. Some players felt that games specifically designed for players with visual impairments were too simplistic. Participants also expressed worries about emerging gaming technologies such as augmented and virtual reality. Critically, despite praising some mainstream efforts to improve accessibility, respondents indicated that the majority were playing specifically designed audio games, with only three players indicating that they played mainstream titles. This likely indicates that mainstream games do not feature sufficient support for players with visual impairments. The majority of these players reported that they use assistive technologies such as screen readers, and the fact that many modern titles do not feature screen reader support likely presents a significant barrier for these players that might want to engage with mainstream titles.

Despite the value of survey research, it is important to consider the potential caveats to survey methods in HCI research. Survey methods are valuable but as the survey is often taken remotely, surveys alone usually do not allow researchers to observe the participants behaviour in relation to the area of investigation. In many cases, these observations can be illuminating as we know that there are a variety of biases that can lead participants to provide inaccurate responses, such as social desirability bias where participants are more likely to respond in a way that they believe is socially acceptable for that particular scenario (Grimm, 2010). In games research, this could

be a participant exaggerating their enjoyment of a game because they hold a conception that the games designer would want the game to be perceived as enjoyable. In fact, there are many biases that can affect the participants' responses. For instance, a variety of different memory biases affect a participant's recall of events; the recency bias makes it more likely that participants recall events in recent memory (Natesan et al., 2016). Additionally, survey research has the limitation of being entirely dependent on effective survey design, participants often have no opportunity for clarification in survey research, and if survey questions are not understood consistently, the data collected is unlikely to be a reliably representative of the intended area of inquiry.

Case Studies. A case study is a qualitative method used by researchers in order to understand complex phenomena inside of its original context (Yin, 2014). Case studies are a particularly useful method when investigating phenomena that are difficult to separate from their context, such as when it is either impractical or unethical to separate the phenomena from its context. One aspect of the research process that can make case studies particularly valuable is how this approach often involves collecting data from a variety of different sources around a particular phenomenon and context, and these may include interviews, artefacts such as documents and direct observations. Similar to action research (Craig, 2009), case studies use the principle of triangulation between these various sources to help validate and test the reliability of the research findings. However, unlike action research methods, case studies do not necessarily seek to feed into action, in this sense the research approach could be seen as more focused on understanding phenomena inside of its situated context, rather than enacting change.

Case studies are sometimes employed by games researchers to understand the experiences surrounding specific aspects of games, such as games for educational (Watson et al., 2011), or therapeutic benefit (Tresser, 2012). However, there is only one case study that we are aware of within the context of game accessibility research. Beeston (2020) sought to examine whether digital games could be introduced into a neurological care home as a leisure activity. In this instance, a case study approach was appropriate because it provided an avenue in which the researcher was able to organise and analyse the findings from a variety of different sources applicable to the specific context of the care home setting. The case study illuminated various aspects of the activity relating to both the experiences of residents of the care home and challenges associated with the organisational context of the research. For instance, one finding from the research observed that despite the presence of compassionate and dedicated staff, it was often difficult to run the activity due to staff time being consumed by additional responsibilities. This is interesting as it highlights that the introduction of this type of technology can be more demanding than it might seem on the surface, while we might envisage a lone gamer playing their games console at home and unassisted, the care

home facility context highlighted that the introduction of these games placed additional demand on already limited resources.

This illustrates that something that likely needs to be a necessary consideration when considering the introduction of these types of digital leisure activities and this is something that could not be captured without investigating the introduction of these consoles within a real-world context. For instance, if the researchers had instead sought to abstract the experience of digital play to a lab-based setting, they would not encounter the same real-world logistical challenges associated with the introduction of the technology. This helps demonstrate the practical value of case-study research as it illuminates the phenomenon as it is experienced in the real-world.

2.7.2 Unexplored Methods

While there are a number of studies focused on the experiences of people with disabilities, the variety of research methods is quite narrow. As such there are opportunities to investigate these player experiences with research methods that have not yet been deployed, which could offer considerable value. This section does not review all possible methods but highlights a small number of methods were to the best of our awareness there have been no investigations using this approach. These methods were highlighted based on the perceived potential value of research using these approaches in this area.

Diary Studies. Diary studies can be an effective means of understanding the player experience over a longer period of time (Bolger et al., 2003). This type of longitudinal research can be paired with other research methods such as interviews and surveys to gather data from players at intervals throughout their play experience. Although this methodology is thought to be difficult to carry out - as it is very time intensive compared to other methods - it can provide value in testing the effectiveness of systems that are intended to have long-term implications on the player experience (Hillman et al., 2016). Within the games industry researchers at Electronic Arts (Hillman et al, 2016) found that the diary study methodology was effective in helping them understand how players experienced features like progression systems in their games. Despite this, this paper only presents a discussion of the diary study and not their methodology. In these cases, it is likely that corporate confidentiality policies limit the authors capacity to detail the value of the study, and therefore this industry lead research can only provide limited insight into the value of the methodology.

Outside of the games industry a number of researchers have been able to apply diary study methodologies to gain insight into the longitudinal player experience. One such study looked at game completion and motivation within a platforming game (Mekler et al., 2014). In order to do this the

researchers recruited 25 participants and had them complete the diary periodically throughout their play experience, with these diary entries featuring open text entry, this was accompanied with the Player Experience Needs Satisfaction Questionnaire (PENS) and a motivation questionnaire. Using this data, the researchers were able to plot the player's interest in the game over time, and the open-ended questions were able to identify the source of those frustrations (which tended to be getting lost in the game). This suggests that this style of methodology could be valuable to game developers seeking to identify pain points with their game design, or an accessibility researcher looking to understand how the accessible design accommodations enable players with disabilities to experience the game and its challenges, throughout the course of its development. Despite this, the study is extremely limited in its reporting of data from the diary entries, with no player quotes or excerpts used, and very light descriptions of the data from the researchers.

Despite the obvious value of diary study methodology when investigating the player experience, there are no diary studies that investigate the experiences of players with disabilities. This presents a large gap in the literature, wherein the experiences of players with disabilities are not yet well understood due to a lack of longitudinal and in-depth exploration. It is worth noting that it is likely that within industry, the cost of running a diary study is discouraging compared to methods that are less intensive (such as a single session playtest), and the time scale required to run a diary study may make it difficult to align diary study research output with time points wherein the diary study findings have opportunity to have an impact on the games development. Diary studies need to be conducted with considerable foresight to have an impact on the games that a studio is developing and key stakeholders would need to understand the value of the research compared to more traditional methods before it being likely that the cost felt justified.

Game Analytics. Game analytics can be used to answer a variety of questions about how a game is being experienced by players. Game analytics are a means in which to measure the player experience based on the recording of events that take place in the game, these can be used to answer a variety of different questions about the player experience including what is happening, how frequently it is happening and what is likely to happen (Seif El-Nasr et al., 2013). A practical example of game analytics might be recording the frequency with which people achieve kills in a game while using a particular weapon or recording the frequency with which players crash at each turn in a racetrack. In these instances, the developer can observe the frequency that these events occur in relation to other similar events (e.g. how successfully players use other weapons) and this can spark motivations to make adjustments to the game. In this example, the game analytics data might motivate a design change behind making the weapon stronger or weaker, so that it can match the efficacy of other weapons.

Game analytics might be applied in large-scale active development, or small-scale private testing. Today, analytics are used in some way by the vast majority of game developers to help them understand how players are experiencing their game (Seif El-Nasr et al., 2013). Fundamentally game analytics help game developers understand how players are experiencing their games which can enable them to test different designs with players and make data driven decisions about the future of a games design.

As such, it is conceivable that game analytics can be leveraged to answer questions about a games design that pertain to accessibility too. For example, one study uses a game analytics-based approach to evaluating the design of a learning game for people with cognitive disabilities (Cano et al., 2019). In the paper, the authors used game analytics to record the players' interactions with the game. This enabled them to understand features of the player experience such as the average competition time, and performance across the game's levels allowed them to understand whether the game was appropriately balanced for people with disabilities. Another study took a similar approach with people with Down Syndrome (Cano et al., 2018) and found that these analytics were able to validate their design for this group of players.

Despite these promising results, the body of research in this intersection between game analytics and game accessibility is very small and therefore many fruitful avenues are unexplored. There are no studies reporting this type of application within commercial game development, and it appears that there could be lots of potential in this area.

2.7.3 Conclusions on Research on Players with Disabilities

After reviewing the literature surrounding methodologies that have been and could be applied to the investigation of player experiences, and the experiences of players with disabilities, it is clear that on the whole, there is a scarcity of literature examining the experience of players with disabilities and our understanding of these experiences as a whole is subsequently limited. While methodologies like interviews, diary and case study research could provide fantastic insight into the lived experiences of people who play games with a disability, the body of research seeking to use these methods to better understand player experience of players with disabilities ranges from extremely limited to non-existent. This is a significant gap in the literature that may have deep implications for how we design games for these players, especially as the literature that engaged with game developers working in industry often highlights the value of drawing upon the experiences of players with disabilities (Gerling et al., 2016).

2.8 Summary and Direction

In summary, my review of the literature suggests that there is a sizable body of research dedicated towards prototyping and testing inclusive designs for players with disabilities. There is a large proportion of knowledge available that seeks to help developers understand how to make increasingly accessible games, and the release of large-scale commercial titles suggests that this knowledge is being applied very inconsistently. Subsequently, we think that this review highlights two critical issues.

1. There is very little research dedicated to either understanding the issues that are being encountered in game development, by game developers.
2. There is a scarcity of research that aims to provide a deep understanding of how players with disabilities are experiencing the games that they play, with a lack of methods like diary studies being used.

A deeper understanding of the role of the game developer in making accessible games is required before research can have an impact on the development of inclusive games within the games industry. Furthermore, a better understanding of the player experience is essential to being able to successfully design inclusive games that are considerate of the vast array of differences in ability, goals and prior experiences that each player brings to their player experience. As such this thesis seeks to first clarify the issues experienced by developers within game development, followed by research that aims to draw out a deeper understanding of the player experience of players with disabilities.

3. A Grounded Theory on Accessible Game Development

3.1 Introduction

Although it appears easy to make the case that video game accessibility is important for inclusion. Unfortunately, many video game titles are still difficult for players with disabilities to play comfortably or play at all. We know that players with disabilities frequently report experiencing difficulties playing digital games due to the absence of common accessibility features (Bierre et al., 2005; Wolfe, 2018) and players with disabilities that do play, often indicate that they rely on specific sets of accessibility features in order to play the game comfortably (Beeston et al., 2018). Therefore, we have digital games as this incredibly significant attribute of popular culture, and yet due to a failure to accommodate a wide range of ability, not everyone is able to participate or enjoy digital games equally. This then becomes a major problem for inclusion.

While there is substantial literature on what would make games more accessible for a wider audience (see chapter 2.6), this often neglects the fact that games are developed by people who have their own challenges. However, there is much less known about how developers go about making their games accessible and what might prevent them from doing so. Porter & Kientz (2013) interviewed game developers about their experiences making games and identified a number of key issues that affected the studio's ability to make accessible games. These researchers highlighted that the developers are often only focused on the 'low hanging fruit' of accessibility, wherein the developers would often only address the accessibility issues that were more straightforward or more widely employed – features such as colour-blind filters, and subtitles. The researchers also touched upon issues related to the internal processes at the game development studio, suggesting that accessibility issues were often only addressed if individuals present at the studio were conscientious of them, and made them a priority.

Despite illuminating an area that is not well understood, the research provides minimal information about the personal, organisational, and external factors that might contribute to a developer's ability to address accessibility issues in their game, or how issues originating in one of those areas might interact within a game development environment to make it easier or harder to make accessible games. For instance, it is unclear how a developer's personal knowledge and motivations to make accessible games relates to their organisational environment, and how that impacts the studio's ability to make accessible games. This knowledge might be pertinent when we

consider strategies that might help developers make changes to their internal processes towards making better games.

Other studies investigating the experiences of game developers have focused on more directly enhancing a game developers' ability to make accessible games, using different intervention strategies aimed at helping developers to improve the accessibility of their games (Gerling et al., 2016; Levy & Gandy, 2019; Westin, Brusk & Engström., 2019). As previously discussed, Gerling et al., (2016) used a workshop format to compare the effectiveness of both game designers and people with disabilities when designing a game for wheelchair users. This research identified a significant difference between how game designers imagine the experiences of disability to be, versus how they are experienced by people with disabilities. This is valuable, highlighting how game designers are likely to struggle to create accessible games without a connection to an audience of players with disabilities. However, this research does little to help us understand the organisational and personal factors that present a barrier before these helpful strategies can take place. For instance, it appears intuitive that creating a connection between the game designers and players with disabilities will aid in the developers understanding of disability, but perhaps the more pertinent question is whether there are barriers at play that prevent those connections from occurring, when developers are working inside of a real-world game development studio.

Ultimately, there is a very small body of research that helps us understand how accessible game development is experienced at commercial studios, and in spite of this, we have a very substantial body of research that is seeking to guide and instruct games developers on how to make accessible games. This presents a significant problem, as without a clear understanding of how accessible game design is experienced within commercial game development studios, it is difficult to know how to best support studios in their ability to make accessible games. With this considered, it is pertinent that we focus some of our research efforts into better understanding the experiences of game developers. Such knowledge could be an asset in directing future research and tools which seek to help alleviate the difficulties that game developers experience, and ultimately, contribute towards making games more accessible. The present study, therefore, aims to address this gap in the literature by interviewing game developers about their experiences making accessible games. This research was guided by the following four research questions:

- **RQ1**: What do developers understand about game accessibility?
- **RQ2**: What difficulties do developers experience when trying to improve the accessibility of their games?
- **RQ3**: What are the causes of these difficulties?

- **RQ4**: What do developers find helpful in making accessible games?

These research questions serve as a sensible foundation for our action research project, as in order to develop a successful approach to assist game developers, we need to first understand the problems experiences that game developers are having when seeking to make accessible games. Only then can we design research that can assist.

3.2 Methods

The present research aims to gain a better understanding of how game developers experience game development, and their knowledge and difficulties encountered surrounding efforts to make games more accessible. In order to answer these research questions, the present study takes a grounded theory methodology (GTM) (Charmaz, 2006) approach to explore the experiences of game developers making accessible games. This methodology was chosen with the view that GTM offers a valid framework for a rich exploration of largely unexplored and complex phenomena, while at the same time providing a number of tools (such as constant comparative analysis) which enabled the analysis to describe the relationships between themes that arise in the data.

3.2.1 Participants.

Participants held various different roles within the industry (programming, sound design, studio director, user interface design, user research and accessibility). These game developers worked within studios of different sizes, ranging from studios with under 10 employees, to large scale triple A studio with more than 200 employees. All participants had more than one year of experience working within the games' industry, with all but three participants having greater than 3 years of experience working within the games' industry. 3.2.2 Data Collection

In order to collect rich data on the experiences of participants working in game development, intensive semi structured interviews were conducted with a total of twelve participants. The first participant was recruited based on experience working as a game programmer working within the industry, and following participants were recruited using theoretical sampling, directed by the theory emerging from the data. Participants were recruited through game development channels on social networks such as Discord and Reddit, as well as the researchers' existing connections to developers working in the industry. These interviews lasted between 25 and 50 minutes and included five specific questions.

Research Design. The research was interview based, using semi-structured questions to investigate specific areas of the game developers experience of making games, while also allowing flexibility for the conversation to flow naturally and opportunity for us to explore the participants responses in additional detail where this was beneficial. Participants were asked a specific set of questions which are detailed below.

1. How would you describe your role in game development?
2. What does the term 'game accessibility' mean to you?
3. Do you always want to make a game more accessible?
4. How do you make a game more accessible?
    a) Are there any barriers to making an accessible game?
    b) Is there anything you find helpful when making an accessible game?
5. How does accessibility fit into the game development process?

During the interview process, as recommended in GTM, these interview questions evolved with additional follow-ups and questions that probed into specific subjects in order to gain more insight into emerging areas of the theory. For example, early on a question was used to elicit the differences in experience between working independently and working in industry:

Does the studio you are working for make it easier or harder to make accessible games?

This question was focused on understanding how the developers found their current work environment in comparison to previous places they may have worked (specifically regarding the phrasing 'easier or harder') and was later removed from the interview structure as theoretical sampling led to interviewing participants within larger studios, and these participants often only had experience working at a single large scale studio (and therefore the developers had no point of comparison to prior studios). During the later interviews, a question was added about the responsibility of accessibility within the studio. This was designed to encourage participants to discuss whether they had staff and resources dedicated to making their games accessible:

If belonging to anyone, whose responsibility is it to think about accessibility at the studio?

While the interviews were structured by this series of specific questions, these interviews were semi structured, and the individual questions were open-ended. This thereby allowed participants to freely express themselves on the topic in as much detail as they chose. Interview questions were adapted depending on the participant's responses to probe into subjects that arose through discourse with the participant.

Interviews were conducted between December 2019, and July 2020. All aside from one of these, interviews were conducted remotely using online video conferencing software of the participant's choice. Prior to participation, participants were provided with an informed consent form which informed them of the subject that would be discussed during the interview and the purpose of the study. Participants were asked if they had any questions about the study and given an additional opportunity to ask questions before the interviews began.

Before the recording began, the conversation was opened with a casual conversation on the games they had been playing recently, and how they were managing working from home during the coronavirus lockdown. This initial conversation aimed to provide an opportunity for the researcher and participant to develop rapport (Bolderston, 2012), so that when the game accessibility interview began, participants would feel more comfortable speaking naturally. Participants were asked if they understood what their participation entailed, and whether they had any questions about the information sheet. Following the initial conversation, participants were asked if they were ready to begin the interview and for the recording to begin. The recording began only when participants confirmed they were ready to begin. The starting point for the data collection began with a programmer with over 3 years of experience working inside the industry. This participant was chosen as an initial starting point as they had experiences working in game development both on their own and as a member of a team within larger development studios.

Theoretical sampling was employed to explore and refine the emerging theory and relationships between different attributes of the data. The recruitment initially started with people who had relatively smaller experience in the games' industry, and worked within smaller, often independent studios. This aimed to gain insight into how developers, who were working more independently or within small groups, were thinking about accessibility. Later, the recruitment focused more on developers working at larger organisations, taking into consideration how the organisational processes and structure may help or harm their ability to make accessible games.

Reflexivity. Charmaz describes the interview data as something that is co-constructed by both the researcher and participants, together (Charmaz, 2006). In this description, Charmaz suggests that the world view, status, and knowledge of the researcher may influence the interview and thereby, the data generated. This highlights how our own experiences in the games' industry may have impacted my understanding of the participants' world and vocabulary. Therefore, it is critical to highlight that the interviewer and data analyst for this research has several years of experience working in the games industry, alongside experience working in academic settings. . All participants were aware of

this industry experience in some capacity, and therefore it is likely that this uniquely influenced the data generated from the interviews.

While this could be construed as a limitation, Charmaz (2006) also highlights the importance of understanding the worldview and vocabulary of your research participants, something that my prior experience may assist with. My experience in the industry ensured that both researcher and participant were able to communicate with relatively equal status and shared understanding of the language that is often used within game development. Semi-structured interviews, unbiased questioning, and constant comparisons of the data during analysis were used to help ensure that the theory that was identified stayed grounded within the experiences provided by participants.

The age and gender of participants were not collected. This data was not collected from participants as a means of limiting any capacity in which the developers could be identified through their participation in this study. As many of the developers are under non-disclosure agreements relating to their work, it was felt that further distancing the data from their real identity would better enable developers to be open about their experiences at the studios they are working at, or have worked at. Any identifiable information that was mistakenly presented during the interviews was deliberately removed by the researcher during the transcription process.

3.2.3 Data Analysis

The audio for each interview was digitally recorded using a desktop computer. These interviews ranged in duration from 25 to 50 minutes. The resulting audio recording was transcribed using automatic transcription software and then manually checked against the original audio   and frequently amended for accuracy.

The data analysis adhered to the guidance offered by Charmaz (Charmaz, 2006). This specific approach to the analysis was chosen as it acknowledges the role of the researcher in the emerging theory and accepts that attributes of the researcher's experiences and prior knowledge in the subject area can contribute to the development of the emerging theory. At the same time, this approach retains the main tenets of GTM, including avoiding going in with a pre-formulated hypothesis, simultaneous data collection, making constant comparisons and theoretical sampling (Bryant & Charmaz, 2011; Charmaz, 2006). Analysis was performed within NVivo 13 software and initial line-by-line coding was first applied to the data, with a view to inductively identify patterns that may exist within the data. In-vivo codes were frequently employed as a means to retain the participant's voice within the data.

This initial line-by-line coding was then followed by focused coding (Bryant & Charmaz, 2011; Charmaz, 2006). This process was oriented towards grouping large sets of initial codes together into larger categories. This encouraged constant comparison between different elements of the data as a means of defining patterns and relationships that were identified within the data set. Theoretical coding was then applied in order to conceptualise how the focused codes may relate to one another as part of a larger theory. Throughout this process, themes were continually compared against the data to ensure validity and alignment with participants' experiences, memos and axial codes were used to document connections and define how themes related to one another. . To ensure that the theory was grounded in the participant's experiences, after theoretical coding (where the theory was mapped out visually via a diagram), the theory was presented back to three previous participants (showing the visual model of the theory and explaining its components) in order to evaluate whether they felt it encapsulated their experiences. Participants were asked how they felt about this theory and additional notes and memos were made based on these sessions and participants feedback led to small adjustments and helped validate the relationships between different elements of the theory.

3.3 Results

Based on this grounded theory approach, a framework for understanding the experiences of accessible game developers is presented. For game developers in this study, making accessible games is a complex process which involves their own personal motivations and knowledge about accessibility, alongside organisational factors within their work environment such as staff and processes dedicated to accessibility. Together, these personal and organisational factors alongside the leveraging of external resources can contribute to either barriers or facilitators that developers experience in making accessible games. Perhaps crucially, this data highlights the way personal motivations for making accessible games can be mediated by the organisational investment in this area. Without organisational resources invested in making accessible games (such as hiring staff dedicated to this task) the knowledge and motivations of game developers, which could be useful in making accessible games, is likely to be constrained and inhibited. Motivation to make accessible games appears to be abundant in game developers, but without organisational investment, opportunity and knowledge of developers on the subject is likely to be constrained. This can lead to the common barriers to accessible design that developers report, such as feeling as there are unclear pathways to have conversations about accessibility.

Figure 4.

Theoretical coding of the grounded theory, which seeks to describe how game developers experience designing accessible games.
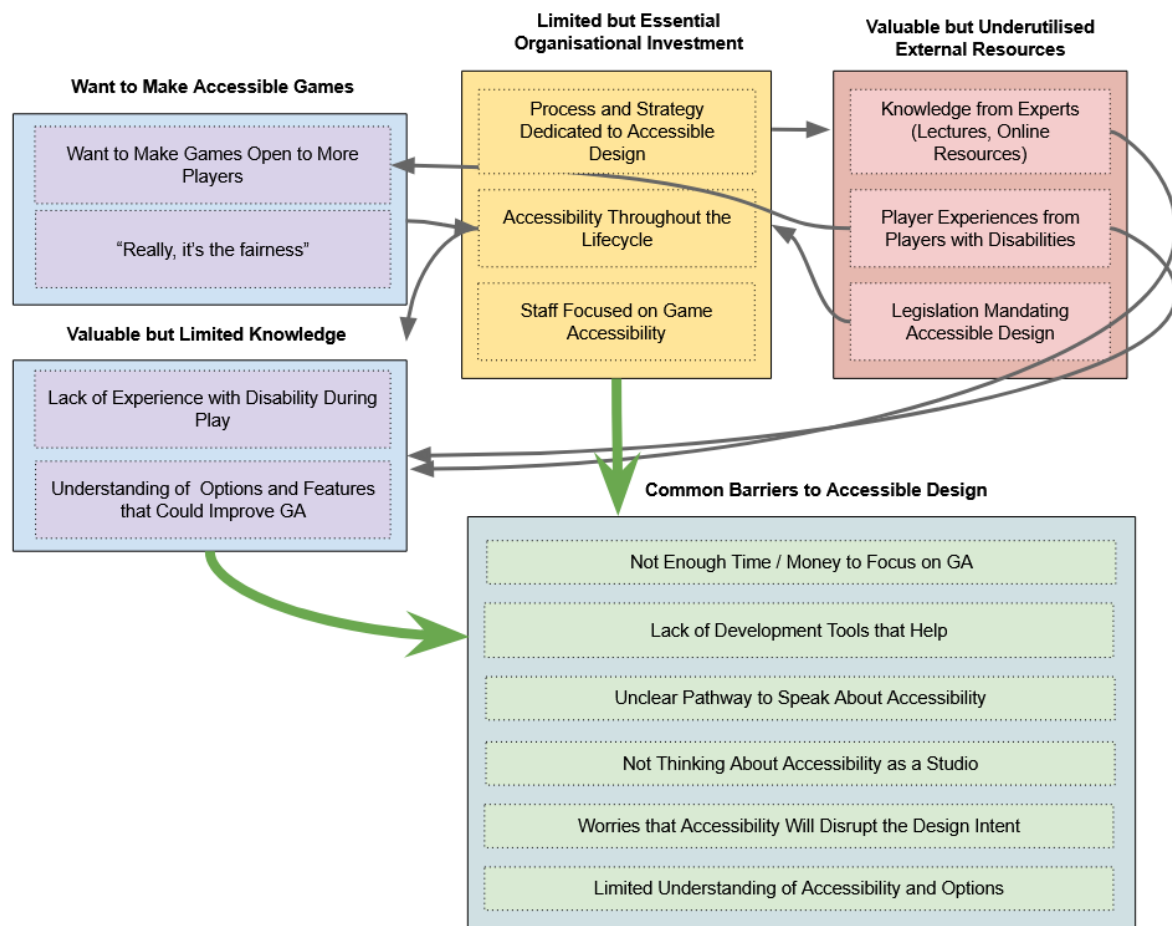
The remainder of this section will explain the components of this theory and illustrate the various components, the codebook for this work is included in the Appendix (section 5a)We do not attribute quotes to particular participants in order to protect their anonymity as their roles may be unique in their studio, or they may have told others they were participating, and we wish to avoid any risk that they may be perceived as criticising their own studio.

3.3 We Want to Make Accessible Games

Early portions of each interview focused on developer motivations, asking whether they wanted to make accessible games, if this was always possible, probing into their motivations to make games more accessible. Two key themes were identified from these conversations, the first that developers wanted to open the game up to more players, and the second around the ethical motivation, and the idea that it was fair to make games accessible.

***Wanting to Open the Game Up to More Players*.** When describing their motivations to make games more accessible, developers most frequently talked about simply wanting to open their games up to a larger audience of players.

> *To me. I think it means that just removing as many areas of friction points using specific design... to players on a whole range of spectrum, a whole spectrum of different needs of being able to access, play, enjoy, and have fun with the games that we make - P7 (UI)*

Some of these developers talked about opening the game up to more people, specifically within the context of players with disabilities, emphasising that they wanted to ensure that the game was accessible to players with disabilities.

> *Support people who have, say, for example, disabilities, for example, colour blindness or, you know, some motor disabilities. – P1 (Programming)*

> *So, it might cater for people who struggle with additional sorts of input or things like that. So, we cater for people who have various different disabilities in a way. - P1 (Tools Programmer)*

Developers often highlighted that these accessibility options had the capacity to improve the player experience for everyone.

> *Look at Ubisoft, in the subtitles you see statistics usage statistics from Ubisoft that tweeted that for Assassin's Creed that they shipped the game with subtitles turned off. And like a huge statistic I think up in the 90s percentage of players don't turn them off. Now, obviously not everyone is hard of hearing generally... It should be for everyone. - P7 (UI)*

"Really, it's the fairness". When speaking about accessible design for players with disabilities, developers often spoke about feeling that accessible design was what was fair for all players. For these developers, as well as appreciating the value of opening the game up to a wider audience, accessible design features were a matter of equality.

> *Really, it's the fairness, it's allowing everyone to play it's… you know no one wants to feel like they're left out or excluded… - P9 (User Research)*

These developers sometimes emphasised that this accessibility applied to the experience of playing the game, and not merely being able to access the game.

> *To me, it's kind of parity, it's kind of making sure everyone has the same or as close to the same experience. - P9 (User Researcher)*

This is significant because it reflects an idea that accessibility goes beyond merely accessing the game and relates to how players with disabilities can be better enabled to have the same experiences from the medium as other players.

3.3.2 Valuable but Limited Knowledge

When designing accessible games, the understanding of the experiences of players with disabilities, and the knowledge of design options that could benefit these players resonated as two key areas that would improve a developer's ability to make a game more accessible.

Knowledge of Options and Features that Benefit Accessible Design. When developers talked about their understanding of disability and accessible game design, developers most frequently spoke about their knowledge of options and features that could improve the player experience.

> *... rebinding controls is something that's really common that is useful for people who have motor disabilities. - P1 (Programming)*

> *I would increase support for peripherals that could help them obviously rebind controls. - P2 (Quality Assurance)*

Examples like colour blindness and subtitles were the most commonly cited, even when probed for detailed knowledge. It is likely that this reflects a limited understanding of the ways in which a game might be adapted to a broad range of disabilities. This relates to previous literature where developers who spoke about accessibility would frequently use examples of 'low-hanging fruit', accessibility options that were more commonly applied, or easier to implement.

> *... what you might think of doing is having... a toggle some way in your game, such that, you know, everything that is red and green becomes a different set of colours. - P1 (Programming)*

> *... support for people that might not be able to see certain things or different forms of UI or colour displays with people with different kinds of colour blindness. - P3 (Programming)*

Developers sometimes explicitly acknowledged that their range of knowledge in this area was limited. In the quote below, the developer suggests that this is due to a lack of lived experience.

> *I mean, you know, that's something I know about, but even though I'm not colourblind, it's just a very very well known kind of disability or people who might have. But there's definitely a lot of, you know, disabilities and accessibility things I don't know about, because I just*

haven't lived it. I haven't come across it. So yeah, for sure. There's a lot of people who don't know a lot of things. – P3 (Programming)

However, developers did occasionally mention some more far-reaching accessibility options, such as support for different types of inputs.

... haptic feedback as well, like vibration, can also be used to make certain things more or less obvious. Any kind of additional cues - P3 (Programming)

Designing so that you're not handicapping anyone in any way… well trying not to anyway and try and give various different sensory messages… - P4 (Programming and Audio)

The more experienced developers who were directly involved in accessibility related projects expressed the most comprehensive understanding of the range of options and disabilities that might affect how people were able to play the games.

I think now, there's the big four and accessibility isn't there. There are subtitles, colour-blind support, button remapping. And this is where I forget the other one… text size, that's it. That's the big four. So, I think it is the bare minimum. - P7 (UI)

This range of comprehensiveness in any one developer's understanding might reflect the value of processes that encourage knowledge sharing about accessibility, between staff members within the company. Some examples of these processes are described within the organisational factors segment.

A Lack of Direct Experience with Disability During Play

Despite recognising that understanding the experiences of a diverse array of players was key benefit towards making accessible games, developers recognised that they lacked lived experience with disability in the context of video game play.

The most difficult thing is like… I personally have a lack of lived experience… with a lot of the issues when it comes to like, catering for people have disabilities. - P1 (Tools Programmer)

This also relates to how developers frequently described the value of playtests and feedback sessions with players with disabilities, as these would allow developers to better understand how their game was being experienced by this audience of players. These playtests are described in more detail in the external resources section of these findings.

Perhaps crucially, however, some developers emphasised that they understood that games were experienced differently, by different groups of players.

> *Not everyone is going to have the same challenge when approaching the same game because of differences from person to person, so it's not like you can actually create one experience for everyone and everyone who plays the game is gonna' get the same experience. That's kind of not really what games are. - P8 (Game Design)*

This is important because it reinforces the idea that these developers understand that players with disabilities are going to have a different experience of their game than other players. This emphasises the idea that developers talking about their understanding of disability had a strong awareness that this was an area that they had limited knowledge of. Developers typically understood that their games were being experienced differently by players with disabilities, even if not precisely how differently, or which specific design considerations they should pay attention to when trying to design games that were more accessible to players with disabilities.

3.3.3 Limited but Essential Organisational Investment in Accessibility

Alongside personal factors that contributed to the experience of making accessible games, game developers spoke about various attributes of their work environment that had played an important role. In the context of this theme, the term investment relates to the processes that a developer has made available to ensure accessibility efforts are successful, the word investment is used to reflect that these ultimately, cost time and money to establish but bear fruit by making accessibility easier to achieve over time.

Processes and Strategy Dedicated to Accessible Design. Foremost, developers described the value of having processes and an overall strategy that helped the studio to focus on accessibility issues. This included things like organising accessibility playtests.

> *And get a diverse set of players to play your games. Not necessarily just people with disabilities but... if you have in mind that your game should be playable by people with certain disabilities, then you should absolutely get people with those disabilities to play your games to test them... to provide advice. - P8 (Game Design)*

Additionally, developers highlighted the value of processes such as scheduling things like accessibility reviews with members of staff.

> *But the nice thing is that the less is seen as like an 'other', and the more it's just kind of baked into what the team is doing, and they can plan for it ahead of time. They can fit it into their*

schedule, they can think about who's going to work on it when and it becomes less of a let's shoehorn it into what we're doing and more let's plan around it to make sure we can include it. - P9 (User Research)

In many instances, the absence of these processes related directly to the difficulties that many developers identified as barriers to making accessible games. For example, the presence of accessibility reviews may allow members of staff with more knowledge about game accessibility, to share that knowledge to less experienced members of the team. This, therefore, can demonstrate how an organisational process on game accessibility can interact with the knowledge of individual staff members.

Thinking About Accessibility Throughout the Development Lifecycle. Developers often talked about the importance of thinking about accessibility from very early stages in development, and throughout the development lifecycle.

I think it kind of has to be throughout the entirety. Just because I think I think the start, just like how you kind of evaluate you're making and the audience you're targeting. And like what things that audience expects and what you need to build to get that, you know, game to market. - P11 (Programming)

However, this was also an area that related to one of the key barriers in game development (thinking about accessibility too late) as developers often described scenarios where their studio had not considered accessibility early and encountered problems later in the game's development. This issue is described in more detail, alongside developer quotes in the common' barriers to accessible design section of these findings.

Staff Focused on Accessibility. Developers also highlighted the value of having staff who were designated as being responsible or advocating for accessibility at the studio.

They are… you know, they're very passionate about it. They want to make their games as successful as they can. And it's there. They're helping to inspire everyone else at their studios as well. So, it's kind of like snowballing from there, which is great. - P9 (User Research)

These people often spoke about the importance of having many people within the studio that were focused on accessibility.

And then it felt like I was the only person who was talking about it and pushing it. And I was the one who'd always have to keep going back to the teams and going 'Hey, cool, where are you at now?', let's talk. But over time, it's different you know, we kind of have like champions

in every studio now who I'm in semiregular contact with ... But they're pushing accessibility within their own studios now, which means that I don't have to be as hands-on. P9 (User Research)

Contrasting this, developers from other studios spoke about how it was difficult to speak about accessibility because they often did not know who to speak to or raise their concerns with. This further highlights the value of having designated responsibility. This difficulty is discussed in more detail in the 'unclear pathway to speak about accessibility' segment.

Or like if you if there's an art issue, you file that bug or you talk to that person, and then you expect them to drive that through to solution for accessibility. I'm not sure who you would necessarily talk to. - P11 (Programming)

In spite of the value of a clear communications channel for accessibility conversation, it is also important to highlight that both of the interviewed developers who were in accessibility advocacy roles in their studio, highlighted the importance of having everyone thinking about accessibility.

But like I say, because it affects everyone, and then you kind of you're in a situation as well, where you kind of need everyone on the team to kind of be on site and be aware of it. - P12 (User Research)

3.3.4 Valued but Underutilised External Resources

Developers who were interviewed also described the value of some external resources in their ability to make accessible games. These often had an outside influence on both the company as a whole, and the personal knowledge of the members of staff at the company.

Player Experiences from Players with Disabilities. One of the most important external resources that game developers often spoke about was getting insight from players with disabilities. Developers spoke about the value of being able to see players with disabilities playing their game.

... we find that helping change people's mindsets, exposure to players, disability, hearing their stories and how they play games is really just the most powerful thing. And it really changed. People just find it absolutely groundbreaking in the way that how quickly they can change their thinking. - P7 (UI)

It is important to highlight that despite recognising the value of playtesting with players with disabilities, only three developers in the study had any form of direct experience with this group of

players. For most developers this is likely related to the lack of organisational strategy surrounding accessibility, and resources that the studio was willing to invest into accessibility meant that the studio did not have the staff, processes, or facilities to organise playtests with this group of players. It is also important to emphasise that playtesting, and particularly playtesting with players with disabilities, can be logistically difficult for various reasons such as recruitment and having an accessible building.

Nevertheless, the lack of ability to gain insight directly from players with disabilities relates to one of the biggest barriers for game developers seeking to make their games more accessible - understanding how their studios' games are experienced by players with disabilities. For studios that were able to draw upon the experiences of players with disabilities, it was clear that these sessions directly contributed to their personal understanding of how their games were experienced by this group of players. This demonstrates a means in which organisational investment into accessibility had the capacity to impact the individual knowledge of an employee, and thereby, enhance their ability to make accessible games.

Knowledge from Experts. When speaking about resources that were helpful outside of the company, developers often spoke about knowledge from experts on game accessibility. Such as lectures on accessibility and resources like publicly available accessible guidelines.

> *Sometimes, I know, contractors are called upon to give more advice or greater feedback on these things. We do a lot of events as well with companies like Special Effects, who also provide additional information or feedback for these kinds of things. As they also come to visit the studio as well, on certain days, to give a kind of experience. - P3 (Programming)*

> *And we use Kat Holmes's inclusive design methodology really when it comes to working with accessibility, which is temporarily situational and permanent disability. - P7 (UI)*

This demonstrates the value of these external resources, particularly from the perspective of game developers, who were already thinking about accessibility and how their games could be more accessible.

Legislation Mandating Accessible Design. A small number of developers spoke about accessibility legislation and highlighted that this legislation helped convince stakeholders that accessibility was something that needed more of the studio's attention.

Then with legislation in North America or the USA with CVAA... if our game features in the advanced communication services. We need to make sure that access to use and customization of those services is accessible. - P7 (UI)

Thereby demonstrating that this legislation which exists outside of the company can be an effective motivator for the inclusion of accessibility features within a studio. In our interviews, no one spoke negatively about the presence of this legislation, only describing it as a motivator for accessible games. It is also worth highlighting that our study was not focused on gathering thoughts from people in more senior and executive level roles, these people might have different thoughts on legislation and how it affects their business as a whole.

3.3.5 Common Barriers to Accessible Design

While developers identified various aspects of their personal knowledge, motivations, organisational attributes, and external resources that contributed to their ability to make accessible games, they also identified many barriers to accessible design. In each case, these barriers could be directly attributed to one or more of these previously mentioned areas, suggesting that the challenges that developers face in making accessible games is reliant on a combination of the personal attributes of staff members, and investment into accessibility from the company, and availability of external resources such as playtesters with disabilities.

Not Enough Time to Focus on Accessibility. Developers often spoke about not having enough time to focus on accessibility, and how these made it difficult to make accessible games.

> *And when they have their own deadlines for other things that you know, you know, already expect and plan for them to add in additional work or what is seen as additional work is, you know, it's very difficult. - P9 (User Research)*

This directly relates to the studios' strategy surrounding accessibility, as without processes in place to ensure that accessible design is considered early on in development, it inherently becomes difficult to ensure that adaptations are made to the game later in the development lifecycle.

Developers that talked about how they only started thinking about accessibility late in the development lifecycle often described extreme difficulties implementing accessibility features.

> *... if you think about some feature too late, maybe the way you've architected your game just makes it, you know, too expensive to do that, or too time consuming to do that. - P11 (Programming)*

Some developers spoke about the budgetary concerns about accessible design, highlighting the cost-benefit of accessibility.

> *"If you've got a certain budget, and you've used it all up for the game so far to, to then have an additional development time to spend on different control methods, colourblind options, it's, I mean, I can mention publisher classes or there's just fans in general you it you want to go to keep the lights on." - P10 (Programming)*

As a symptom of these issues, developers often spoke about having difficulties continually justifying accessibility features to their team.

> *"Because it was a new process, there's always that kind of element of the justification of like, why teams should be doing this. And until some of the more you know, the higher ups in the studio can buy into it, then they'll obviously because they're the ones deciding budgets, things like that." – P9 (User Research)*

It is likely that this relates to two key motivators of accessibility for key stakeholders. First, having internal members of staff who are driven to think about accessibility, and second, external legislation that highlights the importance of ensuring that games are inclusive.

Lack of Development Tools that Help. A very small number of developers spoke about the absence of tools and features in their work environment that made it more difficult to make accessible games.

> *"... the way that I have to run it through right now, because we don't have any specific tools, and there's nothing that I'm really aware of on PC that works. And that takes a lot of time to, you know, get the images off the kit, put them onto my computer to put them into a special folder to then be able to run the colourblind analysis to then, you know, take the screenshots of that to then put it in a report. It's quite a long process to do things..." - P9 (User Research)*

It is likely that this type of issue was not raised often simply because the majority of developers were not at the stage where they were frequently working on accessibility features as they are hitting barriers earlier on in this process, such as not planning for accessibility ahead of time, or struggling to justify the value of accessibility features to the team. It might be the case that these more tech focused problems are seen as more common barriers for particular teams or for studios that already have a certain level of investment in accessible design processes.

Unclear Pathway to Speak About Accessibility. When asked if they knew what to do if they had an accessibility concern, developers frequently talked about not knowing who to speak to at their studio.

> *"… if there's an art issue, you file that bug or you talk to that person, and then you expect them to drive that through to a solution. For accessibility, I'm not sure who you would necessarily talk to." - P11 (Programming)*

This aligns with the perspectives of several other developers who found that having accessibility advocates within their studio acted as a valuable resource. It is likely that the absence of a clear pathway to raise an accessibility concern leads to accessibility issues either not being prioritised or not being raised by staff at all.

Not Thinking About Accessibility as a Studio. A significant barrier to designing accessible games, particularly for smaller studios, was the feeling that the studio as a whole was not thinking about accessibility.

> *"I mean, we did. It just never came up at all. Right? Like, it's not the kind of thing that we talked about very often." - P1 (Programming)*

Without someone present at the studio raising and elevating accessibility concerns or encouraging conversations about accessibility, then it is likely that does not encourage the organisation as a whole to think about accessibility. Although changing the mindset of an organisation that is not thinking about accessibility at all may be difficult, these interviews suggest that motivations for thinking about accessible design come from two key pathways: personal motivations of staff members, and external legislation.

This also relates to how other developers spoke about their accessibility efforts being 'grassroots', emerging from the personal motivations of the individual developers, as opposed to being pushed from the top down.

> *"No one likes to be told what to do. But if it's something that they become interested in, and then decide they want to do, they have much more of a drive to do that. … I think that's where we've kind of had this kind of success with kind of like grassroots, bottom up approach to accessibility within the company…" - P9 (User Research)*

Encouraging change in a studio with this issue might be difficult, as there is nothing to suggest that developers are likely to suddenly develop a motivation to think about game accessibility without cause. However, developers with more experience within studios with a stronger focus on

accessibility highlighted the value of player experiences in changing the mindsets of individual developers at their studio. This, therefore, emphasises things like playtesting and hearing the perspectives of players with disabilities as a key pathway to beginning to get a studio thinking about accessibility.

Worries that Accessibility Will Disrupt the Design Intent

Developers also provided some concerns about being able to implement accessibility features while preserving the game's design intentions. Although some developers recognised that there was always a means in which the accessibility of these games could be improved, others worried that accessibility features would harm the game's design.

> "You could end up undermining the point of the game take a game like Hellblade, a which has had incredibly positive reviews, especially from people suffering from schizophrenia, who have said that this piece of media has finally allowed them to explain their schizophrenia in a way that they've never been able to, to family members. And it has given them a great quality of life improvement because their parents after 30 years have finally understood what schizophrenia actually feels like. But yeah, the game is also really dark, so you can make it really bright. But if that undermines the message, is it appropriate to make the game lighter?" - P6 (Programming)

But other developers reflected on the idea that games are not experienced in the same way, by every player. These developers highlighted the importance of accessibility features existing as optional features that players could turn on if they felt that they needed them.

> *"Well, I think one of the easiest ways is just to include lots of additional options that a user may enable if they so choose." - P3 (Programming)*

> *"People being upset about that doesn't make sense to me, because it's like the original intended vision. You know, if that certain level of difficulty is still represented. You don't have to play on the easier option, right?" - P1 (Programming)*

It is likely that some of the concerns regarding the disruption of the design intentions relate to a lack of knowledge both about accessibility features that might be possible to include within a game, and about the experiences of players with disabilities and how their experience of the game is different. For instance, in the example provided by the developer above, if an accessibility option made the game 'much lighter', that increase in brightness would only be relative to the player's

ability to perceive light. For a player with impaired light perception, enhanced contrast or brightness options might merely enable them to perceive the game's environments at all.

These types of concerns are likely to be rooted in a lack of organisational investment in accessible design. With accessibility orientated design processes (such as inclusive playtesting) developers would be more able to understand the experiences of their players, both with and without disabilities and how the game was being affected by accessible game design. In our study, these concerns were discussed as hypotheticals, rather than on the basis of data observed from players both with and without disabilities playing their games. This is further reflected by how developers typically spoke of how they had very limited understanding of accessibility features, how they were being experienced by players and how to design for disability.

Limited Understanding of Accessibility Features and How to Design for Disability. Developers also often talked about their knowledge of disability being important when developing accessible games. These developers described the difficulty in designing for someone that was different from themselves.

> *"The most difficult thing is like… I personally have a lack of lived experience… with a lot of the issues when it comes to like, catering for people have disabilities". - P1 (Programming)*

This area appeared to be mediated by the developer's work environment in key areas. First, the organisation's investment into hearing about the experiences of players with disabilities through playtests and feedback sessions.

> *"And then obviously stuff like this accessibility workshop which was organised for us by our studio. Like that kind of stuff is pretty great to have." - P8 (Game Design)*

And the game developers also spoke about valuing the knowledge of other game developers in this area, particularly those who were recognised as having more expert knowledge on game accessibility.

> *"Someone might point out that including this feature might make the game... might exclude certain people from playing the game and from having the experiences that we're designing. And that's not that it's not met with criticism that's met with oh yeah, we need to rethink this kind of stuff." - P8 (Game Design)*

This links in with the value of having clear organisational processes in which staff members were able to speak about game accessibility issues, and how developers valued having people who were focused on accessibility on the team.

3.4 Discussion

By drawing insight from the experiences of game developers, the theory paints a vivid picture of how developers experience making accessible games, and the combination of personal, organisational, and external factors that can interact inside of a work environment in order to make it either easier, or harder to make accessible games. This research provides a significant extension to the existing literature that considers the difficulties and experiences of developers seeking to make accessible games (Gerling et al., 2016; Porter & Kientz, 2013; Westin, Brusk & Engström, 2019).

The theory generated answers to RQ1 ('What do developers understand about game accessibility?') by telling us that developers see accessibility as a means to open their games up to more players, improving the game both for players with disabilities, and for anyone that might benefit from the accessibility options. Developers also valued knowledge about options and features that could improve the experiences of players with disabilities and understanding how players with disabilities experienced playing their games, as key areas that could help them to better make their games more accessible.

When speaking about options and features that might benefit a game's accessibility, developers cited a number of different options. Some of these developers relied upon more commonly used examples, like colour-blind options and the inclusion of subtitles, which may reflect findings in the literature (Porter & Kientz, 2013). However, more senior members of staff often described a broader understanding of the range of options and how different types of disability affected how the game was experienced in different ways. This then highlights an example of how organisational attributes such as processes which encourage the sharing of knowledge between staff members (for instance, using accessibility reviews to share knowledge about accessibility) could be vital in enabling knowledge about accessibility to spread throughout a company.

It is worth highlighting how this work shares similarities with findings that have similarities to those from web accessibility. In their contextual inquiry work, Swallow (2017) found that web developers generally had intentions to make accessible websites but struggled with areas of knowledge relating to accessibility. However, Swallow also found that developers felt that it was tools and guidelines that were thought to be missing – developers in our research did not report this, instead citing these resources as helpful. It may be that the nature of game development work and the creative challenges that developers tackle mean that they are more capable of independent creative problem-solving. Accessibility could be argued as simply another design challenge, and developers are already demonstrably capable of collaborating across multi-disciplinary teams to build complex game systems to solve design challenges. Instead, of a lack of guidelines, developers'

challenges centred more towards having the time and resources, made available through their organisation, to spend on the work.

The analysis also identified a number of difficulties and barriers that developers identified when trying to make accessible games, which directly addresses RQ2 ('What difficulties do developers experience when trying to improve their games' accessibility'). These difficulties ranged from simply not feeling that they had enough time or money to prioritise accessibility, to challenges related to the way the organisation handles their internal process leading to barriers such as staff not having a clear pathway when they wish to raise an accessibility concern.

Significantly, the theory also better enables us to understand why these common barriers to accessible game development occur as the interviews with developers highlighted a number of personal, organisational and external resources that would actively help, or harm them in their ability to make accessible games. This then addresses both RQ3 'What are the causes of these difficulties?" and RQ4 "What do developers find to help them in making accessible games?".

For instance, developers often spoke about the value of external resources, and most commonly talked about the value of playtesting and getting feedback from players with disabilities. The interviews from both senior, and less experienced developers indicated that these sessions had the capacity to improve a developer's understanding of how players with disabilities experienced their game and also proved to be a useful tool in convincing staff members to think about accessibility. This also aligns with the game accessibility literature which found that alone, developers incorrectly estimate the abilities of players with disabilities (Gerling et al., 2016), as well as the web accessibility literature where practical knowledge about accessibility was observed to be a common limitation within designers (Swallow, 2017). However, despite the benefit that these playtest sessions could have on an individual developer's ability to understand and develop increasingly accessible games, these playtest sessions were dependent on the organisation dedicating time and processes to game accessibility.

This reflects the need for organisational buy-in when seeking to improve the accessibility of games developed at a studio. However, this also indicates how organisational involvement in game accessibility can improve the knowledge and motivations of an individual developer within the context of making accessible games. Importantly, the theory revealed that this relationship was bidirectional, with more senior developers citing the success of 'grassroots' approaches where the organisational change had emerged from the individual motivations of developers at the studio. When taken together, this theory indicates that individual developers can be a crucial catalyst for change within a studio, encouraging organisational processes like playtesting with players with

disabilities which can in turn, have an effect on how individual members of staff are thinking about accessibility at the studio.

3.4.1 Limitations

A limitation of this study relates to the challenges associated with recruitment of game developers in key stakeholder roles. It is likely that many of the final decisions that are made at the studio are made by the most senior members of staff such as directors, founders, and senior producers at a company. Due to these stakeholders being a small proportion of the people that work within the game's industry, and also that this group of people typically have very limited available time, these stakeholders were difficult to recruit as part of this study. While all members of staff at a studio have the capacity to influence their work process and make decisions within their teams, the distribution of resources in the form of development deadlines and budgets are often determined by these key members of staff. Therefore, it is a weakness that only one of the participants recruited in this study was occupying a director style role.

Future research under the action research framework could seek to leverage insight from this study to design and test successful interventions. In our case, we could explore one of the issues that game developers experience (such as player feedback) and design an intervention designed to provide developers with more effective, thorough feedback from the experiences of players with disabilities. With this approach we could potentially assist in helping make it easier to make accessible games, which would then lead to further rounds of action research as we seek to explore the success of these interventions.

Alternatively, in order to address some of the limitations, future work could seek to focus-in and conduct an investigation of the challenges associated with accessible game development from the perspective of the most senior stakeholders within a company. Further, as the participants were each recruited from different organisations, there is minimal opportunity to explore any specific strategies or processes that any one organisation is using to benefit accessible design. In the future, research could employ more in-depth exploration of the processes and experiences from individual organisations to paint a more detailed picture of organisational strategies and how different people from different teams communicate together about accessibility.

3.4.2 Conclusion

This exploration of how game developers are experiencing accessible game development provides a significant extension to our current understanding of how game developers experience

making accessible games and the challenges they may experience. The resulting theory is especially valuable, explaining how changes at either a personal or organisational level can have implications on the studios' ability to produce more accessible games. This then may have meaningful implications for efforts to improve a studios' ability to make accessible games, either through knowledge shared with individual developers, or through encouraging wider organisational change. This work also provides potentially fruitful avenues of further research into specific areas that are likely to help a studio's ability to make accessible games – such as exploring how knowledge sharing between players with disabilities and game developers can contribute to change at a game development studio.

4. Diary Research with Gamers with Disabilities

4.1 Introduction

Thus far, the focus of accessibility research has often been placed on developing means of creating accessible player experiences, outside of the triple A space, with games like Blind Hero (Yuan & Folmer, 2008) and universally accessible chess (Grammenos et al., 2005) offering bespoke accessible play experiences. While this work is valuable in that it provides a pathway to make these individual games accessible, it is not common to see these technologies adopted by game developers making commercial games. Porter, (2014) argues that in order to improve the player experience for people with disabilities, more research focus needs to be placed on understanding the barriers and challenges to accessibility within commercial and mainstream video games.

Although valuable, the research into the play experiences of people with disabilities has been very limited. Porter & Keintz (2013) interviewed players with a broad range of sensory, motor, and cognitive disabilities who played a variety of different games. Their work illuminated a number of valuable insights from these player experiences, particularly with regards to the sources of many common accessibility issues that players encounter in real world settings. However, the work does very little to help us understand the overall play experience as the authors do not report on features such as play motivations, tolerance and what kinds of processes players with disabilities go through when encountering accessibility barriers as they play. This more detailed understanding of the play experiences from people with disabilities is missing from the literature, and we argue could provide valuable insight that helps address some of the challenges game developers face when seeking to understand their play experiences in order to make more accessible games.

Additionally, despite the value of integrating feedback from players with disabilities into the game development process, the industry has often relied on techniques where it is more difficult to recruit feedback from people with disabilities. In-person usability playtesting often relies on travelling to an unfamiliar game development studio, whose building and facilities may not be accessible, which likely does not house the equipment that people with disabilities may be familiar with using at home. Industry advice on setting up a laboratory for games user research methods often neglects the necessary considerations (such as mentions of disabled access and equipment for play) that would enable people with disabilities to be accommodated into testing (Long, 2018). Further, in-house playtesting often relies on methods which are not themselves well suited for capturing the full range of play experiences that people have with a game, with methods such as

usability playtesting and appreciation focused playtesting only focusing on a few hours of the experience while under direct observation (McAllister & Long, 2018). While these methods are effective in honing in on specific areas of interest with a player population that you already know a lot about, our understanding of the natural play experiences that players have with consumer products in their own homes (as opposed to often artificially instructed, or lab-based play in unfamiliar environments, sometimes playing bespoke accessibility focused games) is limited, as long-term and at home playtesting methods are less common, and it is very uncommon that these methods are applied across the full experience a player might have with the game, from beginning to end.

As such, the present research seeks to build upon these insights by examining the play experiences of people with disabilities in order to develop a more comprehensive understanding of facets such as motivations, challenges, and adaptations that these players experience during play. Accordingly, our research was led by the key research question 'what the natural experiences of people with are disabilities and several subordinate questions which aim to illuminate this area.

RQ1. What are the play experiences of people with motor and sensory disabilities?

    a.   What motivates players to continue play or to cease play?

    b.   What are the difficulties and frustrations they experience during natural play?

    c.   How do players react when encountering accessibility issues, and how do these reactions affect ongoing play?

In order to pursue answers to these research questions, we used a diary study methodology which followed players over the course of a month-long play period with a singular game where players were followed with a combination of diary entries and in-depth interviews. This longer-term method allows us a detailed examination of the natural play experience. This enables us to consider things like longer term player engagement and how players with disabilities might experience play differently in an unobserved home setting in a manner that shorter term direct observational work do not allow. While additionally, it provides a wider scope to allow us to address key research questions that relate to how players may adjust and adapt over time when experiencing facets of the game, including accessibility issues.

This also fits with our wider action research strategy as this research direction stems from the insight generated by our first study, specifically relating to the challenges that developers felt they were encountering in relation to a lack of knowledge from lived experiences of disability. By

capturing this insight through a detail rich diary study method, we can seek to develop a knowledge intervention that may help developers make accessible games more easily.

4.2 Method

This section provides detail into how participants were recruited to take part in the study and provides details on the procedure that study participants experienced when taking part.

4.2.1 Participants

Initial Sampling. Participants with disabilities were recruited using the AbleGamers player panel. This panel allows players with disabilities to register their interest in taking part in research projects that aim to better understand the experiences of players with disabilities.

As well as having registered their data via AbleGamers, players were asked to complete an additional screening survey which clarified details of their current play habits and asked whether they had played *Gears of War Tactics* before. Players without disabilities were also recruited to see if they were having experiences altogether different from those with disabilities. These were recruited via gaming orientated online forums and discord groups that featured communities likely to fit the inclusion criteria (reddit.com/gaming, resetera.com) and from the student body at the University of York.

The inclusion criteria required that all players recruited were 18+ years of age. Players needed to have a device capable of playing *Gears of War Tactics* (2020) and were able to provide informed consent. Players must have specified an interest in playing strategy games. This was so that participants would have a natural interest in the genre and would not be likely to dismiss play entirely on the basis of it being a type of game that they do not enjoy. Players with disabilities were only included in the study if they identified as having a sensory or motor disability. For this study, players with cognitive disabilities were excluded as it was the goal to focus on a narrower area of disability and the process of ensuring informed consent and gathering data from interviews would need to be adjusted specifically for this audience of players. Players were also excluded if they had played *Gears of War Tactics* before, this is because their second-time experience may be distinct from their first time play experience, and they may have already made various adaptations to playing the game and this would make a comparison to the experiences of people playing the game for the first time more difficult.

Although the study was primarily focused on the experiences of players with disabilities, we also recruited two players without disabilities to ensure that we were able to assess the full range of

experiences that players could have with the game. This helped to contextualise the experience of our players with disabilities, enabling us to observe how their experience of the game might deviate from the experience of a player without disabilities. However, as players with disabilities were still the primary focus of our investigation, just two players without disabilities were included.

Figure 5.

A visual overview of the studies sampling and procedure in the sequence in which it was conducted for an individual participant either with, or without disabilities.
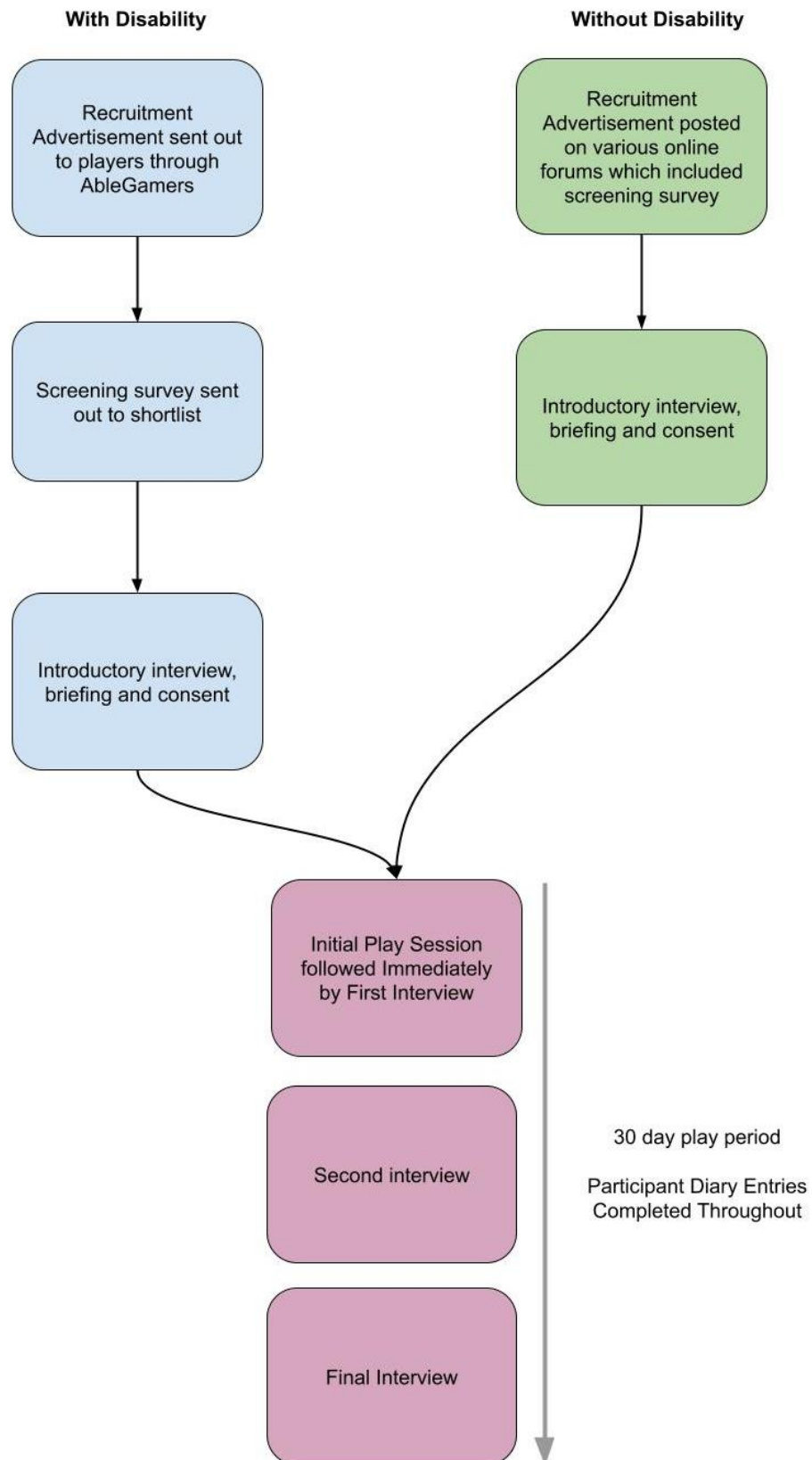
Sampling Results. The final sample, n = 10, included 8 participants with disabilities and 2 without. All participants reported that they played games regularly (between 10 and 30+ hours per week) and played games across a mix of console and PC platforms (though in the study 9 played *Gears of War Tactics* on PC, and 1 on console). All but one participant reported having played a *Gears of War* game before, but no participants reported having played *Gears of War* Tactics before.

All participants were provided with complete details of their involvement in the study, including details on *Gears of War Tactics*, and completing both diary entries and interviews. Participants were not encouraged to play any more than they had a natural desire to, this also meant that they could cease play entirely whenever they wanted to (two players chose to do this within the study). All participants provided informed consent for their participation in the study. As participants were recruited on the basis of having a natural interest in playing *Gears of War* Tactics, participants were provided with a free copy of the game as compensation for participation in the study (worth £49.99). In addition to this, participants were told that they could email the researcher with any questions or information around the research and would receive a copy of the research findings when the thesis was made available for public reading. Participants all identified as having either a sensory or motor impairment, these are listed in the table below. As we had no prior hypothesis around how gender would affect our data, details on participant gender identities were not collected.

Table 5

The impairments of each of the 8 participants with disabilities featured in the study. These are reported based on descriptions provided by participants.

Impairment
Quadriplegia, Wheelchair Bound
Legally blind
Spinal Muscular Atrophy
Legally Blind
Hard of Hearing

Legally Blind

Duchenne Muscular Dystrophy

Multiple Sclerosis

4.2.2 Data Collection.

Diary Data Collection.

At the beginning of the diary study period, players were briefed on how to submit digital diary entries (these were delivered to players using the Qualtrics survey platform). A re-usable link was provided so that they could access the diary entry form at the end of each play session. The survey was used to gain an overview of their experiences with the game, and an opportunity for the player to bring up any significant issues they experienced during their play sessions.

An individual diary entry asked players for the following details:

- Participant ID
- Date and time
- How long they played for during the current session
- A description of what happened during the session

A brief 5-point Likert rating assessment matrix was administered asking players to rate their experience with the session in terms of difficulty, frustration, confusion and sense of fairness. These are often characteristics associated with accessibility (Porter & Kientz, 2013) and usability issues (Bruun et al., 2016) and these were selected for the scale based on the idea that they would enable us to identify sessions participants where players might have experienced an issue.

Players were provided with a final open-ended question where they could write about anything that they thought was interesting within their session. They were reminded that these responses would be used as discussion points for the interview.

Diary Data. Players were asked to play the game as naturally as possible, and then to fill out a diary entry at the end of each session. A total of 53 (M = 5.3) diary entries were collected across the 31-day long study period. Data from diary entries were used for two purposes, first to track the player's play sessions, as after each session the player would provide a diary entry which provided an

indication of when they play the game, how long they played for and the content of the session. Second, the content that related to the experience within the sessions before the interview (the open text and Likert responses) were used to inform the content of the interview. Diary entries were reviewed by the researcher before each interview, and these were used as prompts during the interview when the topics mentioned in the diary entry did not arise naturally during interview. Diary entries were used in this way so that the interviews did not rely entirely on the player's memory from their play sessions, with the diaries capturing their thoughts immediately after the play session, and the interviews providing an opportunity to explore their experience in greater detail. Data from these diary entries was strictly used to enhance the quality of the interviews and monitor the sessions as they occurred, where necessary the data from these was fed into the interviews to remind players of their sessions and experiences within the interviews. Because of this process the data in the diary entries entirely overlapped with the richer interview data, and therefore they were not subject to their own analysis.

Interview Data Collection.

Three interviews were administered with each participant throughout the diary study process. These interviews enabled us to follow the player experience across the course of the 30-day play period. The first interview was immediately after the participant had completed their first diary entry and played their first session with the game. The second was after 2 weeks. A final interview was administered at the end of the study (either when participants decide that they have 'finished' the game (either due to having completed all the content that they want to engage with or simply choosing to cease play).

While these interviews were led by specific questions, the interviews were semi-structured and free flowing allowing participants to speak about any topic they chose, at any portion of the interview. These interviews began with a simple question, asking players to describe their overall experience with the game.

> *Can you tell me about your overall experience of the game so far?*

This was followed with questions that probed into specific areas of the game that the players may have enjoyed, disliked, experienced difficulty, frustration, or confusion. For instance:

> *Was there anything in the game that you particularly enjoyed/didn't enjoy? Can you tell me about that?*

> *Were there any areas of the game you found especially difficult, why was that?*

As the interviews were the sole focus of analysis, additional questions were formulated based on the participants individual diary data in order thoroughly capture their experience within the interviews. For example:

> *I can see from your diary entry that you really didn't enjoy this feature, can you tell me more about that?*

Every interview took place remotely, and the video conferencing software of choice was used. While participants had the option to use video during the recording, this was only used to help build rapport between the researcher and participant. Video data was not recorded, and participants were not required to use video if they did not wish to.

4.2.3 Data Analysis.

Diary Entry Processing & Analysis. Diary data was tied together using the participant ID and the date that the entry was submitted so that all the entries for an individual participant could be viewed in chronological order. The primary purpose of the diary data was to extract information from their play experience that could be then leveraged as to enhance the interviews. For instance, players might write that they experienced particular difficulty during one of the game's tutorials, or that they particularly enjoyed using a certain feature in the game, this would then be used to formulate questions that probed into that area of the experience during the interview. Likewise, the Likert data was used for a similar purpose, wherein if participants indicated a particular session was confusing or frustrating, the interviews would probe into this for more detail.

Surveys were also used to collect information about their session duration, for which the means and standard deviation are provided in the results section of this chapter (p109).

Industry Report. The findings from this study were also reported to Splash Damage through the form of a report containing a detailed list of accessibility issues (with annotated screenshots from the game and clear explanations) alongside a presentation of this report to the teams that had worked on the game. Further, an additional talk included an overview of our analysis which is outlined in the results section of this report. This was done with a view that the insight from our research may be able to help them make more accessible games in the future. While we do not evaluate the effectiveness of this intervention in this chapter, the follow chapter outlines an exploration of the experiences of making accessible games at Splash Damage and discussion of these reports emerged when gaining insight on the challenges and facilitators of accessibility work at the studio.

Interview Data Processing. The audio from each interview was digitally recorded using a desktop computer. These interviews ranged in duration from 25 to 50 minutes. Each interview was then manually transcribed by the researcher.

Interview Analysis. In order to analyse the coded interview data,) reflexive thematic analysis was employed (Braun & Clarke, 2019; Clarke & Braun, 2014). Thematic analysis was chosen as it allows us to consider prior theoretical frameworks when analysing the data and not remain open to existing theoretical knowledge. In this case, the previous studies grounded theory provided us with some theoretical basis for our exploration of player experiences and how we might expect players with disabilities to hold the knowledge that developers sometimes lack that could assist in making accessible games. Another practical benefit to thematic analysis is that data saturation is not required to complete the analysis. This was valuable due to the diversity of the player audience we were working with, and time-constraints when interfacing with research in collaboration with an industry partner.

The analytical process featured several stages:

1. Familiarisation with the data. As the data was received, the researcher both read and actively considered the implications of the data. This involved reading each interview transcript several times.

2. Generating initial codes. The researcher then generated initial codes using Braun and Clarke's (2013) description of an initial code as something that captures the useful essence of the data.

3. Transitioning from initial codes to themes. The researcher then sought to combine codes to form themes. The researcher used the idea that themes should capture "something important about the data in relation to the research question." (Braun and Clarke, 2006 p. 82) to guide the formulation of these themes.

4. Quality control. This stage involved reviewing the data and themes and adapting and adjusting both the initial codes and themes in order to ensure that they accurately fit the data. A significant component of this is reviewing each theme against the original data and ensuring that it accurately encapsulates the interviewees' experiences. This stage also included defining and deciding upon the final name of each theme.

5. Writing the analysis. The final component required that the themes be written up and presented to the reader. This is also where the order of presentation of the themes was decided upon, with the aim of effectively communicating the overall experience of

participants to the reader. Extracts were also selected from the transcribed interview text corresponding to each theme and explained in detail.

4.3 Results

Through analysis of the player interviews, a number of themes were identified which helped describe the experiences that both players with and without disabilities had with and surrounding *Gears of War Tactics*. These themes and their interconnections are shown in the thematic map below (see appendix 5b for codebook). In order to help structure the reporting of the data, three higher level categories are used (Contextualising Play, The Play Experience, Iterative Play) to both order the reporting of the data and help guide the reader through the visual map. Contextualising Play feature's themes that were identified that were centralised around the player, with regard to what they brought to the player experience themselves, including facets such as knowledge from previous games, player ability, and how they prepared to play their games. The Player Experience category encompasses the range of experiences that players had with *Gears of War Tactics,* including features such as challenge and orientation. Adaptation and Accommodation describes the processes which players experience in order to continue play when faced with elements of the game that provide an experience, they were unsatisfied with, most often relating to moments where the player did not feel able to engage with the game as they liked, either due to their understanding or difficulty performing an action they wanted to in the game. While these categories are not essential for understanding the data, they provide a helpful guide to help follow the player through their experience with the game, as such this the following section uses these three categories to structure the reporting of data with each described in detail alongside corresponding themes and quotes from players in reference to these areas of their experience.

Figure 6

A thematic map illustrating the various themes that were identified across three key areas of their experience with the game.
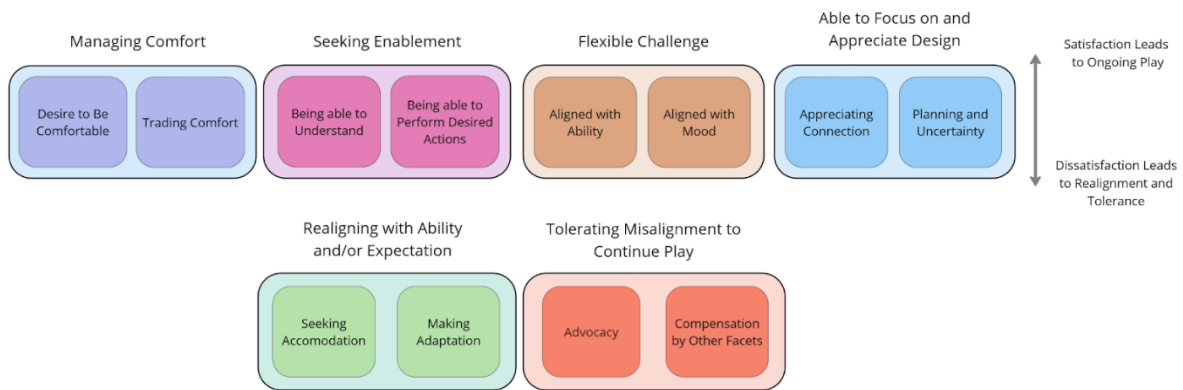
4.3.1 Managing Comfort

A key theme identified from the interviews related to the idea that for players with disabilities, playing games is a matter of managing comfort. This idea of management aligns with the idea that while players actively desire comfort and take action to make themselves more comfortable, this is also seen as a resource that they sometimes trade away for playability.

Desire to be Comfortable. As part of the interview process, players were asked how they got prepared to play games and specifically *Gears of War Tactics.* This theme described how players had already adapted aspects of their play environment to help ensure that they could be comfortable during play. Players had a wide range of different specific details that they needed in order as part of their setup process prior to play, such as seating configurations, headphones, and the type of controller that they used.

Players with disabilities usually had specific criteria for how they got comfortable to play, which included aspects such as sitting at a particular distance to their monitor so that they were able to see.

I have to sit really close. So, you know, a normal person, they can sit what, like, one or two feet away from their computer screen and play. And they can see the whole field of view. Like, I don't get that… I get snapshots… I sit probably three inches away, because I use a bigger monitor now. But I used to sit really close to the computer screen. But even with a 32 inch monitor, I'm looking in one specific direction at a time. - (A5)

Choosing an input device to interface with the game.

> *I also have a gaming mouse that has like 18 buttons on it on the side that I use - (Participant A5)*

Enabling various options within their operating system such as screen reading software which helped players who could not read information on the screen.

> *And I play on my laptop and use a screen reader (JAWS). Use the screen reader for Windows to play games. - (Participant A7)*

And in one case, using the assistance of another person to set up their gaming equipment.

> *Yeah, basically, I just set up my PC with my afternoon assistant here who plugged in my controller. And they started up DS for Windows and then immediately got into the game. I didn't try it with the mouse, yet it might actually work but the gamepad controls are pretty fun so far. (Participant A7)*

In general, a similar pattern of behaviour was reported by players who did not identify as having a disability though with fewer specific adjustments. Despite this, players without disabilities still had a specific configuration that they would like to get set up before beginning to play. This included details such as getting their headphones ready or sitting at a particular chair.

> *Yes. A big sofa with headphones. And so that's what I feel most comfortable with. - (Participant B2 without disabilities)*

However, typically the attributes required for setup were fewer for those without disabilities and shared with the players with disabilities. For instance, players without disabilities would talk about how they set up their audio, such as headphones or speakers, something which was shared by players with disabilities. Players with disabilities often described scenarios which were unique to how they got set up to play, such as the example above where the player requires an assistant to help get them setup. These more unique steps taken to get comfortable were the result of the adjustments being made by people with disabilities as an adaptation that was specific to their disability.

Trading Comfort. Despite an evident desire to be comfortable, comfort is also a potential resource that players could trade in order to be more enabled in the game. One player discussed a sequence of behaviour where they had tried to use the accessibility options to guide them around information in the game - specifically the text to speech system - but because this was ineffective, they needed to resort to their typical strategy of sitting extremely close to a very large screen.

Because it's not like I'm looking left and right, like, My head's all the way to the left. And then I have to swing it all to the right, you know, like, it's like an actual body movement. It's not like we're a normal person, or like you're sitting so far away and super comfortable. - (Participant A5).

Another player described how they generally feel most comfortable using a controller to play games…

I don't use any crazy adaptive controllers or anything, because so far, I can use, especially PlayStation controllers, very well and very comfortably. So, I'm using a dual sense right now. - (Participant A8)

But due to a change in circumstances where their assistant was unwell, they needed to use a mouse and play the game with the mouse and keyboard instead.

My assistants felt a little under the weather today. So I didn't want to disturb them and I wanted to play for a short while… So, I just thought, okay, I'm sitting here anyway, let's try it with the mouse. - (Participant A8).

Despite this, in this instance they did not experience major issues using the mouse instead, but crucially they stepped outside of their comfort zone in order to continue playing the game. The player returned to the controller in their next session when their assistant was able to help set up.

4.3.2 Seeking Enablement

The themes of understanding and enacting regarded several aspects of the player's state of being able to understand and do what the game assumed they were able to. This included both understanding what they needed to do and being able to perform the actions that the game required of them in order to progress through the game. This was a key area where the experience of people with disabilities was more significantly affected, as it was more common that they encountered issues and difficulties related to understanding and acting as a result of disabilities that the game's demands had caused when interacting with their impairments (such as low vision or motor impairments).

Players Want to be able to Understand What they Need to Do. Players who were having a negative experience in their orientation in the game often had difficulty understanding key systems of the game. For instance, one player with a visual impairment which prevented them from perceiving the

in-game battlefield in the way that the game expected had difficulty understanding what the tutorial was asking them to do.

For instance, when a player who was blind was asked how they found the tutorial in the game, they explained they had to skip forward through it because they could not understand where to go.

Well, I actually skipped past the tutorial because at first, I didn't know what the hell I was doing. - (Participant A7)

While in this case, this issue was a result of the interaction with the player's specific disability and the requirements of the game, it was often the case that these scenarios were not specific to people who identified as having disabilities. For instance, the player in the quote below experienced initial difficulty understanding how to use the grenades in the game.

And then I vividly recall that there was a section where I was supposed to use a grenade for something, and it told me how to use the grenade. And I blew myself up with it. I dropped it at my own feet instead of the opposing forces' feet and blew myself up. - (Participant A8)

This is an example of how both players both with and without specific disabilities often experience a degree of disorientation, but that players with disabilities simply have an additional layer of potential difficulties as the games demands create mismatches, leading to accessibility barriers more frequently.

Players who had a good understanding of the game's mechanics often reported their experience too. However, unlike when players had poor understanding, players very rarely spoke about how this understanding impacted their experience overall.

I understood very well, it was well put together and explained. Very understandable tutorial. - (Participant A3)

Being able to Perform Desired Actions. The second theme in this area related to being able to enact what they wanted to in the game, and specifically whether players were able to perform the actions that the game assumed that they were able. Like understanding, this was generally experienced either positively or negatively depending on whether they were able to meet the expectations of the game.

For instance, one player with visual disabilities was not able to identify where they needed to move their units to, and as a consequence they weren't able to perform the specific action required in order to progress.

Yeah. You know, I don't know where to go. Where to move my men? What to do? You know, to help them out? You know, it's a shame because I love the heck out of the game, it's awesome. - (Participant A7)

Note that this also highlights how these issues of understanding and ability to perform the actions required were often co-occurring. In many cases, the mismatch between the game's expectations and the players' ability led to both a difficulty to understand what was being asked, and a difficulty performing the task even if it was partially understood.

Similar to issues with understanding, issues related to being able to perform desired actions enacting were experienced both when interacting with a player's specific disability, and outside of this. For instance, it wasn't uncommon for players to perform actions by mistake, even for players without disabilities.

A lot of the time, I'm trying to move and end up confirming an action, for example. - (Participant B2 without disabilities)

Again, players who didn't experience difficulty in this area would typically place less focus on this aspect of the experience and instead simply moved on to playing further into the game. However, some players who felt particularly enabled by the structure of the game remarked on how they appreciated that the game was turn based. Specifically, these players felt that the turn-based nature of the game gave them an opportunity to perform the actions required of them without the time pressure that many other games often impose.

And I'll go into a spasm and lose control if I'm playing a game where I've got to be in control like a flying game... but in a strategy game like this is enjoyable, because if that happens, nothing happens on the screen. - (Participant A4)

For both players with and without disabilities, negative experiences in both of these areas would often be connected to a sense of frustration, particularly when the issue experienced was severe enough to make it difficult for progress to be made.

So, it's frustrating, but it's also a learning experience because it's allowing me to experience modern day mainstream games. - (Participant B1 without disabilities)

4.4.3 Able to Focus on and Appreciate Design

A key theme that was identified related to how when players were adequately comfortable, enabled and found an appropriate level of difficulty through the games' opportunity for flexible challenge, they were able to focus on and appreciate key areas of the game's design. Specifically, players spoke about how they enjoyed the connection they had to the story and characters in the game, and the planning and uncertainty that surrounded the strategic elements of the game.

Connection to the story and characters. Players who had a positive connection with the game's narrative and characters talked about wanting to see what happened to them. For instance, in the quote below the player talks about wanting positive outcomes for the characters in the game.

> *I want to get these people through this thing alive and see what happens next. So I'm really into the story. - (Participant A7)*

This was a positive characteristic that had the capacity to motivate ongoing play, and also came up when players talked about aspects of the game that they did not enjoy. Therefore, implicating that connection to the story and characters was important when we consider why players might tolerate certain negative play experiences and continue play.

In contrast, other players felt that they weren't able to connect with the story and often described feeling disconnected from the characters in the game due to particular themes that appear in the game and overall franchise.

> *I wouldn't, like wouldn't say this is just the game itself. It's just a franchise. I don't like this. Dude-bro militaristic stuff, it's just not my cup of tea. It feels a little archaic from the story. It's not very engaging to me, like, but like I said, this is not maybe not a problem with the game itself. - (Participant A8)*

However, players didn't express their disconnection from the narrative as something that demotivated them from playing. Instead, these players usually explained that they were motivated by other aspects of the game, such as the strategy gameplay.

In a similar scenario, a player felt that their connection to the game was affected by how certain aspects of the game lacked 'realism' relative to the particular sci-fi context. One player commented that they disliked how the AI behaved in a way that they felt was unrealistic when being shot at. Particularly with reference to their own experiences of being in armed-combat scenarios.

> *It's something that you know, having exposure, and trying to compare realism with gaming, you know, that it's something that I've been in the Armed Forces, and realistically, it wouldn't*

happen, you wouldn't put yourself in an exposed position. So … the game could have been

better written to put characters in a position where they're not exposed. That's the thing. -

(Participant A4)

This is an interesting example as this while players did often draw upon their experiences from other games, this player was exclusively able to draw upon their lived experiences from real-world scenarios in which they saw as similar in some way, to *Gears of War Tactics*. Comparison to similar experiences is a consistent element that players draw upon when making judgements during their play experience, and this indicates that they are not only made against other games, but broader life experiences as well.

4.4.3 Flexible Challenge

Another key theme that described an aspect of the experience that was significant to players was the level of challenge. Unlike the other attributes of the experience that we have discussed so far, challenge wasn't positively or negatively valanced on the basis of consistent characteristics. For instance, some players didn't necessarily want the game to be challenging, while others did. Within this, two key themes were identified.

Ability Appropriate Challenge. A sub-theme of this was the idea that players often wanted an ability appropriate level of difficulty. When describing this, they wanted the game to provide a good level of challenge without seeming insurmountable.

Just being able to overcome things just makes you have a good feeling. And it's a lot of fun.

And if it wasn't hard, I wouldn't like it if it wasn't… if it was too hard, it wouldn't be fun, but if

it wasn't hard enough, it wouldn't be fun at all. So, there's like a balancing act with that and

as I say it's just fun. - (Participant A2)

This sentiment was shared by a large number of players, both with and without disabilities. In line with this, players who were overly challenged often became frustrated with the game and its design. One player that had to retry a boss fight in the game multiple times across multiple sessions with the game found that it reduced their interest in continuing to play.

I tried the boss again, failed, and then tried the bosses a third time, and managed to get it

that time. But that boss that I mentioned, and complained about last time, really ruined most

of the fun I had with the game. - (Participant B1 without disabilities)

Mood Appropriate Challenge. Another sub-theme of flexible challenge related to how players did not always want a challenge corresponding to the limit of their ability. In some instances, players wanted the game to offer a lower level of difficulty in accordance with their mood.

> *I tend to play games more as an escape, rather than wanting to necessarily challenge myself straight off the bat. - (Participant A8)*

While this was reported by fewer players, it was thought to be significant as it explains how players seeking the opportunity to adjust the game's difficulty are not always motivated by a mismatch between demand and ability. In this case, the player did not provide any indication that they did not feel capable of overcoming the challenge of the normal or harder difficulties but sought an easier experience because they saw video games as an activity they engaged in when they wanted to escape or relax.

4.4.4 Seeking to Realign Mismatched Demands

The iterative play category features several themes which help us understand how players react to negative play experience. While positive play experiences (experiences that players expressed they enjoyed) naturally lead on to continued play without adaptation, following negative experiences players described a process that includes accommodation, adaptation and sometimes tolerance of negative play experiences that enables them to sustain play.

In the present study, two players also chose to discontinue play after the half-way point in the study. As this was experienced by just two players it is difficult to identify common themes that surround play cessation in the context of playing with disability, however this is discussed in more detail within the 'tolerance and quitting' section of our results.

Accommodation. In this area, a key theme of iterative play was accommodation. Players who had a negative experience with the game would most commonly first seek out options in the game that would enable them to eliminate or reduce the impact of these negative experiences. In the game, these accommodations included a significant array of options, including subtitles, text to speech and keyboard rebinding.

In many cases, players would use these options to resolve mismatches with what the (at the time) inaccessible game scenario was requiring them to do. For instance, the player below identified as having low-vision used the UI re-scaling to enable them to perceive various bits of in-game information.

I thought that the UI was really great, especially because it allowed me to choose some of the scales for things like when I set up the closed captioning, I was able to choose font size, which is critically important for me, so that I don't have to like squint away from the game in order to actually read what the text is saying, especially since the characters were giving me hints on things like have you tried shooting the aliens yet. - (Participant A3)

In other instances, players used these options to adjust an aspect of their experience with the game in a way that was not related to a particular disability. For instance, players would turn off features like screen shake or gore. Or in another instance, a player simply preferred to play the game with subtitles on because they felt that better enabled them to process the information the game was conveying.

Um, for me, um, like I said, I don't really have issues with hearing or seeing. So I didn't use any of the bigger subtitles or anything. I always switch on subtitles, because sometimes you just easily miss something. And it's also better if you can read it at the same time. But this is more like a convenience thing. (Participant A8)

Sometimes, these options enabled players to get a better experience of specific aspects of the game, such as players that used closed captions to receive information about the narrative.

Um, and I thought the captions were pretty complete. I don't necessarily know what anything is called yet, but I had no difficulty following the story. - (Participant A3)

Adaptation. Another very prominent theme was the idea of adaptation. Although looking for in-game accommodations was usually the first option that players sought out when trying to reduce the impact of particular issues in many cases, players often experienced difficulties where the game did not contain options to help remove or reduce the impact of these experiences.

In other instances, players used existing options in the game but found that they were not helpful. For instance, a player using the text-to-speech option found that it would not read the critical information that they required to understand in order to progress.

So instead of it giving you feedback like, where the objective is, or where you should be heading, it's just constantly repeating to move the camera… so eventually, it just got so annoying and frustrating. I just turned it off. So I was like, I can't, I can't deal with this. It's making me not enjoy the game. - (Participant A5)

Both of these types of situations would leave players in a situation where they could not use the game's options to improve their experience. In many of these instances, players instead found

ways to adapt in order to adjust the experience themselves. Based on patterns that were identified from conversations with players, these adaptations have been identified as belonging to several sub-themes that describe different types of adaptation (perceptual, physical, practice and simplifying).

In each case, the consistent trait of these adaptations was that players were seeking to preserve an aspect of their experience. All players in this study were able to access and play the game to some degree, but their experience was impacted by the issues they encountered. The adaptations were made so as to restore an element of the experience that they felt was intended by the game's design. For instance, a player that sought to use sound cues to compensate for visual information does so with the hope that they can then perceive and react to the challenges features in the game's level design.

1. Perceptual Adaptation.

Perceptual adaptations were categorised as adaptations that adjusted how players received information from the game. While infrequently occurring, players occasionally adjusted their perceptual environment so as to adapt to certain difficulties they experienced in the game. For instance, the player who reported finding the text-to-speech system entirely unhelpful and frustrating found that they had to rely on having close proximity to the screen in order to perceive the information the game required.

> *So, you know, a normal person, they can sit what, like, one or two feet away from their computer screen and play. And they can see the whole field of view. Like, I don't get that. I get snapshots of a wider field of view. I sit probably three inches away, and I'm looking in one specific direction at a time. So, when I'm looking through skills, like I'm looking at the bottom of my screen, I can't see anything else that's happening on the screen besides what I'm trying to read, because I sit so close. - (Participant A5)*

It is worth noting here that these adaptations were specific to the abilities of each particular player, and therefore not all players can perform the same adaptations. In this instance because the player had low vision but was not blind, they were able to compensate by sitting closer to the screen. However, a player in the same study who was blind was not able to perform the same adaptation and therefore, they were not able to perceive the information that the game required them to in order to progress.

Players also performed perceptual adaptations when they were not tied into a particular disability. For instance, one player decided to switch from their headphones to speakers because they found that their headphones became uncomfortable over time.

I actually switched it from my headset to my speakers at one point in time, just because wearing a headset for a long time gets kind of uncomfortable. - (Participant A3)

While this was not an adaptation to an experience caused by the game directly, it still reflects how both players seek to adapt how they perceive information as a means of accommodating their desired experience with the game.

2. Physical Adaptation

Another means in which players adapted their experience was categorised as physical adaptations. These were characterised by scenarios where players adjusted how they physically interacted with the game. Such as changing how they held the controller or switching input devices.

In some cases, there were significant adaptations in response to specific disabilities. For instance, one player that was able to play with only one arm adapted to playing the game with just the mouse when they observed that this was possible.

Usually, my hand is on my mouse and I use a microphone to issue commands to the computer… If I had to use the mouse and the keyboard of the same type, that's where I would have some issues because I can only really use my one arm to do anything. - (Participant A4)

While this is characterised as a player-driven adaptation because the player is adjusting how they interact with the game, it is also worth highlighting that these are also in part accommodation through the fact that the game's turn-based design allowed this player to make this adaptation without concern that slower speed of input would harm their ability to succeed in the game.

This was frequently praised by players with different types of disabilities and categories of adaptation.

Well, in this particular case, with this type of game, it wasn't really much of a consequence, it was just a matter of finding where the enemies were. And, you know, once I was able to find them, you know, but there wasn't like any timeframe that I had to do it. And even though, the other soldiers will kind of nag you if you don't do what they want you to do in a specific timeframe. But there's no penalty for not doing it fast enough. - (Participant A1)

In our research this finding was specific to players with disabilities, but it is likely that this also occurs within people without as even players without explicit disabilities have differences in their ability,

such as different hand sizes which can lead to different difficulties performing interactions such as pressing certain specific combinations of buttons on a controller.

3. Practice

Another avenue in which players adapted to their experiences in the game was through practice. This technique was often applied where players were unable to understand a particular aspect of the game, or unable to perform a particular result successfully.

> *And, of course, with time you wind up memorising everything. So in time it will not be the same thing. It will be easier. It will, it will not be as complicated as it was at first. - (Participant B2 without disabilities)*

This relied on the idea that with time, players would gain more fluency with their ability to process information in the game. As this was something that occurred naturally over time, it was not necessarily something that players sought out to do, but rather a process of naturally learning through feedback as they played the game.

One player talked about using this type of strategy to adapt against an accessibility issue posed by the game. This player was blind and therefore found it very difficult to know where to go, or what the shape of the battlefield was. However, through practice and trial and error, this player was able to improve and progress through some of the stages.

> *I'm basically wandering around. Yeah, basically, all of this that I'm telling you was self-taught and learned through trial and error… I'm just walking around and listening to different sounds in the environment, to see where I can figure out where to go next. - (Participant A7)*

Though, it is important to highlight that this style of trial-and-error based practice can only enable a player to progress in certain circumstances. In the end the player reached a mission with a turn-limit which meant that their approach to practising and learning the stage was no longer effective as they would consume their turns very quickly in simply trying to figure out the stage layout. However, this still highlights the importance of features like consistent feedback in enabling people to learn.

One player, who experienced quite a bit of uncertainty regarding what ability did in the game, felt that they wanted a better space to practise so that they could learn what everything did in a place that had no consequences.

> *It would be good if you had games like this, just a small tutorial or testing where you could actually sit, and you can just freely move the character around without getting killed. - (Participant A4)*

Together these experiences highlight how this process of learning via practice is important for players with disabilities and that game developers might be able to better support this process by first providing clear and consistent feedback across a variety of sensory outputs, but also by providing spaces so that players can practise without consequence so that they can test different approaches and adaptations as they learn to play the game comfortably and effectively.

4. Simplifying

A final sub-theme of adaptations was simplifying. Simplifying was a strategy that was used by players in response to feelings that they were overwhelmed, or in anticipation that they might be overwhelmed, where they sought to minimize the complexity of the game as a means of making it easier to process or engage with.

For instance, one player without disabilities described how they did not seek to use too many skills because they did not want to make the game complicated.

> *Well, I don't want to make things that complicated. As long as I can. If in the future, I can defeat my enemies, because I'm not using my skills. How I should be doing when, well, I will, I will start trying other things. - (Participant B2 without disabilities)*

In some cases, this type of adaptation also interacted with players with disabilities and the accessibility option they used. For instance, a player with a hearing impairment found their experience of the game with text-to-speech to be overwhelming, particularly as they did not find the text-to-speech option often helpful, and as such they chose to turn this option off in order to concentrate on more helpful elements of the game.

> *It was a little bit easier, just because I didn't have something like repeatedly saying the same thing in my ear. So I was able to actually focus and concentrate and do what the game required of me, I guess. - (Participant A5)*

This highlights how accessibility options, although well intended, can not only be unhelpful, but harm the experience when they are ineffective.

As well as being a strategy used to adapt against potential confusion and feelings of being overwhelmed, players also simplified the game to avoid negative play experiences related to

engagement. Specifically, some players would describe scenarios where they would deliberately avoid certain features of the game because they did not want to become bored or fatigued by them.

> *And I thought that that was a little bit of, you know, boring, but yeah, it's not like, it's not like, you know, I have to use the best gear to win. - (Participant B1)*

It is worth highlighting that these issues that players encounter that are encouraging them to seek this manual process of adaptation might be an indication that aspects of the game are not sufficiently designed and tested for use with players with disabilities. This is something that we see later in our interview study with the developers of the game, where the developers cite a lack of feedback from people with disabilities as a key area of challenge for the studio (see Chapter 5).

4.4.5 Tolerating Misalignment to Continue Playing

Alongside seeking different approaches to realigning the game's demands, a key theme of iterative play was also tolerance. Players both with and without disabilities that reported issues would often first seek to adapt or use in-game accommodations to make their experience of the game more comfortable (either physically or cognitively). However, in some cases that was not possible as the options were not available, or the adaptation or accommodation was only partially effective. In these instances, players are motivated by different factors, each of these is described below.

Disability Advocacy. A sub-theme of tolerance was a desire for advocacy, to use the study as a voice for both their own experience, and other people with disabilities. Players in this study frequently cited that they had a desire to help make games more accessible for people with disabilities broadly and expressed an interest in helping to teach people about their experiences. As such, some players explained that this was their motivation to continue even when their experience of the game was severely compromised.

> *And to help educate. Not only fine gentlemen such as yourself, but also game developers because I know this information that I'm giving you is going to go to the game developer that built this game, and others. So it's a win, win situation all the way around. And I could not be happier, honestly. And I'm glad you picked me for this study. - (Participant A7)*

This does also reflect a difficulty in the studies' ability to identify when players would have ceased play if they had been playing the game outside the study context. While two players stopped playing the game entirely before the end of this study, that number may have been greater if players had not felt they were helping through participation.

Occasionally as an extension of this was that when players were speaking about their experiences and the difficulties they had during the game, they would express how other people with different types of disability might have difficulties with particular features.

You've got to keep the mouse back down while you move the mouse at the same time. And even though for me, it's okay, but for one of my friends, they might find that extremely difficult. (Participant A4)

Further demonstrating this, a player who could not play the game any longer expressed how they were sorry that they could no longer contribute. Explaining that they wanted the participation in the study to be as valuable as possible.

Yeah, it does, it does. But I still feel bad. Because, you know, because, hey, because I can't get past a certain point. And I want to give you guys as much feedback as I possibly can to help you guys out. (Participant A7)

Tied in with this idea, players would frequently express that they wanted additional accessibility features. For instance, the player above wanted improved audio location features so that they could find mission waypoints that only had their spatial position communicated visually.

Interest Compensated by Other Areas of the Game. Another key theme that helped explain why players tolerated other negative experiences that they had with the game was that they drew upon other positive experiences. Players who experienced significant difficulties or required significant adaptations in order to play the game would often describe being motivated to continue play by particular areas of the game that they liked, such as the story, or strategic elements.

For instance, one player who was blind and experienced extreme difficulties playing the game and progressing (eventually quitting because they could progress further) said that it was the story that motivated them to continue.

Just the story, the storyline, I want to get these people through this thing alive and see what happens next. So, I'm really into the story. (Participant A7)

4.4.5 Quitting

Throughout the study only two players chose to quit playing Gears of War Tactics, so these instances cannot be described as though they fit with a consistent theme or behaviour from players. However, the consistent connection between these experiences was that they occurred when they

had a negative experience and felt that there was no adaptation or accommodation that could be made to adjust the experience to satisfy.

The first of the two players that chose to quit did so because they were unable to continue play because the game did not enable them to play and progress. This player is blind and while the text-to-speech information does provide some detail on what the player has on-screen in front of them, it does not provide details of critical aspects of the game, such as enemy positions or relative positions of allies and enemies. This player adapted by playing on the easiest setting and clicking around in a trial-and-error strategy which enabled them to progress, but only up until they encountered a mission that presented a turn limit. At this point their adaptation was ineffective and having already explored the in-game options and external online resources, the player felt they had no means of progressing further into the game.

> *I pretty much honestly haven't filled it in a whole lot, Joe, because honestly, I cannot get past the second mission. I am completely stuck; I love the game. Love the game and want to find out what happens next… (Participant A7)*

The player goes on to explain that this is the result of the time-pressure in the game, note that because of the structure of the game the player is referring to a turn-limit, not explicit time pressure.

> *I can't get him to the point where the screen reader says interact, which is where you can press the button, and they bust the pot open and get the guy out. Because I always run out of time. And that's a timed mission. (Participant A7)*

The second of the two players decided to stop playing the game because they found the game to be boring. This player identified as having a motor disability but their reason for ceasing play was not related to it, instead describing a scenario where they felt that the game had a lack of strategic variety which made them feel as though they did not want to continue playing at that point in time.

> *I started getting bored after a while with the same strategy over and over. (Participant A6)*

This demonstrates that dissatisfaction with the experience that can lead to quitting can stem from very different aspects of the overall experience.

4.5 Discussion

The present research set out to establish a better understanding of the video game play experiences of people with disabilities. This guiding question included a number of subordinate questions that were essential to understanding that overall play experience, and covered aspects of the play experience such as player motivations, difficulties, barriers encountered, and the consequences of those experiences on the resulting play experience. By following players both with and without disabilities playing Gears of War Tactics across a month with both diary entries, and detailed interviews, the present research pushes towards a more comprehensive understanding of the natural play experiences of people with disabilities.

In relation to understanding what motivates people to play (RQ1a), and continue to play, we observed that players were motivated by a variety of different facets of the experience. From enjoying the strategy and difficulty of the game, to wanting to see more of the story and find out what happens to the game's characters. This aligns with the data we have that indicates that people with disabilities are often playing many of the popular mainstream games that are enjoyed by a wide community of players already (Beeston et al., 2018). Our data indicates that players with disabilities engage in these games alongside with the wider community of people who play games, because they appreciate and are drawn in by the same facets of the game.

Further, evidence of this regards how our data ties into common motivational models such as flow and self-determination theory. Flow proposes that people are likely to be more engaged if the level of challenge sits at a position that is neither too challenging nor too easy (Chen, 2007) which aligns with our data wherein many players reported appreciating that they were able to find a difficulty setting that was just right for their ability. Elements of the player experience such how players in the study appreciated feeling orientated inside the game world and connected to the game's story and characters align with proposed vectors of motivation in self-determination theory (Ryan, Rigby, & Przybylski, 2006), which suggests that a sense of competence and development of mastery are significant components in motivating persistent behaviour. This collectively supports the idea that players with disabilities are motivated to play and continue to play through many of the same mechanism as people without disabilities. This emphasises the need for accessibility in mainstream commercial video games, and reduces the value of building bespoke, separate games for people with disabilities.

Not only this, but our data also indicates that both players with and without disabilities exhibit a similar pattern of behaviour in response to experiences that are either mismatched with their abilities. In our study, players both with and without disabilities would seek out different strategies to re-align their experience, resolving these mismatches. Accessibility issues did not

appear to be experienced uniquely in this sense, and manifested and were reacted to in a way that was very similar to usability issues where players would seek to realign the experience with their ability or preferences (either by using in-game accommodations in the form of accessibility features, or themselves adapting). There was also some evidence that players would be likely to tolerate a certain degree of mismatch and proceed with extra difficulty if accommodations were unavailable or accommodations were unsuccessful, though the study has limited ability to determine the extent to which players would naturally tolerate because people with disabilities expressed strong desires to continue participating for the purposes of disability advocacy.

Our findings are particularly interesting as they also have consequences on how developers might adjust games to make them more accessible. For instance, with the knowledge that both players with disabilities and without enter the experience with different sets of abilities, but each appreciate being challenged in different ways, single inflexible difficulty modes are likely to be inadequate. This supports the idea of enablement described by Power et al., (2018) wherein matching the level of challenge to the player's ability is essential to move forward with the player experience. This also aligns with previous research that has provided evidence that players value elements of the game such as the sources of challenge, and that accessibility options should ideally seek to be value preserving (Cairns et al., 2021).

In seeking to understand the difficulties and frustrations that people with disabilities experienced (RQ1b), our study also identified that despite the presence of a significant number of accessibility options, players with disabilities still experienced a number of accessibility issues, including issues pertaining to the experiences of players seeking to use the options that were aiming to improve their experience. Many of these frustrations can be explained by the impact of the lack of alignment between the demands of the game and the abilities and expectations of players. The available settings and their effectiveness also played a role and the successful impact that accessibility options were able to have also reinforces this idea that many frustrations stem from issues of access, usability, and inclusivity, experienced by players are a mismatch between ability and the game's demands. The instances where the game was unsuccessful in accommodating were instances where the game did not offer sufficient flexibility to realign the game's demands with the players' ability, and therefore it still presented usability or accessibility challenges. While the player's perspective on this is valuable, understanding the developer experiences behind the inconsistent provision of accessibility features is a valuable avenue of further research that is explored in chapter (3 & 5).

It is also worth highlighting how the experiences of inaccessibility in games were often similar to those outside. Our theme related to adaptation, and particularly those highlighting different physical, perceptual and cognitive (simplifying) strategies provide insight into the root cause of the accessibility issues that players were experiencing. For instance, players experiencing perceptual inaccessibility would often seek to adapt by changing how they perceived the game (such as by moving closer to the screen, in our study). This aligns with POUR accessibility principles (Web Accessibility Initiative, 2008) which defines web accessibility as needing to be Perceivable, Operable, Understandable and Robust in order to be accessible to users. This reflect how at a high level, the challenges facing game accessibility are similar to web. However it is also important to consider how aspects more unique and common to games, like intentional friction and uncertainty can be important to the experience of playing games (Deterding et al., 2022). With this in mind, these principles must be applied carefully to make the game accessible, while seeking to make it possible to preserve that intended friction and uncertainty that composes an important part of the play experience.

Additionally, despite the experiences of people with and without disabilities appearing similar, there were differences observed, as players with disabilities were the only category of player that ceased play as a result of any accessibility or usability issues. While both categories of players experienced issues and used similar types of strategies to overcome them, people with disabilities experienced an additional layer of barriers which in some instances could not be overcome, and in one instance this barrier was so severe that the player could not continue at all. Even when exhausting all possibilities to continue, including searching online and asking the researcher for support, this player was not able to continue. Therefore, it is likely that while accessibility and usability issues appear the same, accessibility issues are more likely to be the result of interactions with specific abilities of particular players and the impact of these issues is likely to be so severe that adaptation can be impossible. While this finding is interesting the small scale of this research limits our ability to reliably understand whether ceasing play because of issues of enablement is significantly more common for people with disabilities, this could be something to consider for wider and quantitative evaluations.

In relation to understanding how players are affected by issues that they encounter during play (RQ1c), we observed a diverse array of different strategies employed by players. The use of adaptations and accommodations demonstrate how players typically seek to make changes - either outside or inside the game - in order to preserve the value, they find in their experience with the game. In the present study, all players were able to interface with the game and perceive enough information in order to make progress. However, features that simply seek to provide access such as

options like text-to-speech were ineffective in enabling all players to experience the game and its intended challenge in a manner that could be enjoyed by all players. This aligns with previous suggestions that accessibility options should aim to be value-preserving (Cairns et al., 2021) and highlights the importance that these options go beyond merely providing access to the game but also seek to preserve the value of key facets of the designed experience (Power et al., 2018).

The range of adaptations and accommodations employed by players also demonstrated the variance in experience that people are likely to have as a result of their different impairments and disabilities. This further highlights the need for design practices that incorporate people with disabilities and their range of experiences with games into the game development process as iterative feedback, as the wide range of both disabilities and adaptations that that players make are unlikely to be something that designers are reliably able to anticipate. This aligns with findings from previous research, which have demonstrated the benefit of collaborative design processes that leverage knowledge from people with disabilities to help develop inclusive games (Westin, Brusk & Engstrom, 2019).

Ultimately, the most interesting observation from this research is the idea of mismatch and realignment, players with disabilities are likely to find similar value in aspects of the experience as people without disabilities, and when their ability to satisfy these needs is disrupted (which occurs more often due to a wider gap between ability and expectation), these players make efforts to alter the experience so that it is able to. Designers seeking to make satisfying, inclusive experiences should continue to prioritise flexibility and seek to provide different avenues for players to re-align the expectations of the game with a wide range of player ability. This means providing diverse sets of options to alter facets of the game such as how players interact with the game but also features related to challenge and the demand the game places on the player. Additionally, more recently we have also seen games allow players to adjust how players explore, and how much unpredictability they experience in the game world, for instance, *Assassin's Creed Odyssey* (2018) allows players to choose between exploration or guided mode which affects how the player explores and discovers new points of interest. Our findings support the idea that this type of flexibility might also be valuable in enabling players to satisfy their needs and have positive experiences with games.

4.5.1 Limitations

A limitation of this study presented itself as an additional difference in play motivations between players with and without disabilities. Specifically, people with disabilities were also motivated by the idea that they could offer feedback and serve as advocates for other people with

disabilities in an effort to help make more accessible games. This is a theme that has appeared in the literature before (Beeston, 2020), and similar to previous findings this appeared without prompt via questioning from the researcher. While interesting, this is also a limitation of the present research as participating players with disabilities are, in some instances, tolerating more and working harder to adapt around issues they encounter so as to continue play. These players feel that this continued play is required to give more feedback that they feel may help make games more accessible for themselves and other people with disabilities. While this finding is interesting, it makes it difficult to examine the natural play experiences of people with disabilities (how players would experience the game if they purchased it of their own will, outside of the study). Specifically, it may be the case that themes like tolerance that were identified were elevated due to participation in a study that they felt was a valuable avenue to advocate for better accessibility in games.

Many of the issues present in both the game and player experience regarded challenges which could be removed or reduced if the game were designed with a better understanding of the experiences players with disabilities have with the game and its features. Therefore, further research should seek to consider how this type of knowledge from players with disabilities is being received and used by game developers. Based on our earlier grounded theory work, we would expect insight in this area to help studios make increasingly accessible games and follow up research should seek to explore that notion.

.4.5.2 Conclusion

The present research offers a great deal of insight into the experiences of people with disabilities playing a particular game, and highlights how in many cases, these experiences are similar to those without disabilities. However, the present study also highlights some key differences and particularly emphasises that people with disabilities are experiencing an additional layer of barriers to their experience with the game in the form of accessibility issues caused by a wider or more common mismatch between ability and demand. The study also highlights that these players will look to make adaptations and accommodations that preserve the value of the game's design. Many of the in-game accommodations were helpful, however, features that are ineffective are likely to offer more of a detriment to the experience than they are to assist. This work both enhances our understanding of the range of play experiences of people with disabilities and highlights the absolute need to draw insight from the experiences of players with disabilities as an iterative component of the development process for studios making accessible video games.

5. An Applied Investigation with a Large-Scale Commercial Game Development Studio

5.1 Introduction

Our diary study work further illustrates that it is important that video games are developed in such a way that allows them to accommodate a diverse array of abilities so that players are not disabled by games with mismatched and inflexible expectations. When players cannot understand or enact their desired behaviour within a game, they seek accommodations first, before seeking to adapt. In some cases, these adaptations can lead players to trade off comfort, and if adaptation is not possible, they may cease play. In recent years a number of games have been released with a significant number of accessibility features and options to adjust the experience, including popular mainstream titles like *The Last of Us Part 2* (2021) and *Assassin's Creed Valhalla* (2020). However, there are still a large number of games with accessibility issues (Aguado-Delgado et al., 2018) and many that release with little to no accessibility features and complaints surrounding these titles within the accessibility community are common (e.g. Bayliss, 2022; *RNIB*, 2022). This was also evident in our own diary research (chapter 4) where players encountered an array of different accessibility issues.

The largest focus in the academic research has been on seeking to provide technical solutions for accessibility problems (e.g. Grammenos et al., 2005; Yuan & Folmer, 2008). However, only a small body of research has sought to understand the challenges and motivations that game developers might experience around accessibility work and this work either provides only a limited exploration (e.g. Porter & Kientz, 2013) and the work in this area often suffers from significant methodological limitations such as recruiting from student game developers (e.g. Levy & Gandy, 2019). Porter & Kientz (2013) investigated the experiences of both players with disabilities and game developers and generated some interesting insight into their experiences and challenges. However, the reporting of qualitative interviews from game developers is brief, and it does not offer much insight into the wider organisational structure and associated challenges that game developers might experience towards making accessible games. Additionally, as the video game industry moves and changes quickly, the age of this work calls into question the validity when compared to today's game

development environments, technology, processes, and cultures, particularly as the accessibility output has changed so significantly in recent years.

Our previous research investigating the experiences of game developers with disabilities (Chapter 3, Kulik et al., 2021) suggested the development of accessible games was dependent on the successful coordination of personal, organisational, and external factors which each had the capacity to act as barriers or facilitators to a studios' accessibility output. Despite generating various pieces of insight, this work was conducted on a wide array of different game developers at different studios of different sizes and structure, and therefore it was not easily possible to focus on particular aspects of organisational process that might be involved in the development of accessible games, as these were often different between studios.

One of the key findings of this research was that developers felt that their personally limited knowledge made it challenging to make accessible games and felt that feedback from players with disabilities was an especially valuable resource that their organisation could leverage to help (Kulik, Beeston & Cairns, 2021). As a follow-up to this research, we considered how insight from the experiences of players with disabilities might be applied and impact a game development studio's accessibility output (chapter 4). In order to investigate this, we communicated with an industry partner who was interested in learning more about the player experiences of people with disabilities who had played their game. With this studio, we conducted a diary study designed to investigate the experience of people with disabilities playing this game and these insights were then fed back to the studio.

This was a valuable piece of work due to providing us with insight into the longer-term, natural play experiences of people with disabilities playing a popular video game, but in line with our action research focus the goal was to investigate the impact of our prior knowledge interventions. Therefore, in this present work we also investigate how receiving feedback from people with disabilities might have affected their work.

Our present research seeks to follow up from these prior two pieces of work with two research questions.

- First, we how do the components of a specific organisation (including its people and organisational facets) related to its ability to successfully or unsuccessfully make video game software accessible for people with disabilities?
  .

- Second, what is the impact and implications of the knowledge generated from the experience of players with disabilities (delivered to the developers during the diary study)?

This ties in with our orientation towards action research on the basis that the previous research exploring the experiences of players with disabilities through a diary study was leveraged as insight at the studio (in report and talk formats). This then is a logical follow-up inside of that action research cycle as it enables us to investigate whether our intervention was able to have an impact on the studios ability to make accessible games.

5.2 Method

The present study is an interview-based study seeking investigate the experiences of game developers working at Splash Damage and including the barriers and facilitators to making accessible games, and the impact that they feel accessibility knowledge (such as the work we presented in our previous report) has on that work. In order to gain this understanding of their accessibility work and its challenges, we will interview developers employed at the studio across different departments, asking questions about their role, how it relates to accessibility, challenges, and successes they feel are related to this work and what they anticipate from the future of accessibility output from their studio and teams.

5.2.1 Participants

This section provides detail into how participants were recruited to take part in the study and provides details on the procedure that study participants experienced when taking part.

Initial Sampling. In order to seek answers to our research questions, specifically on the experiences and challenges of making accessible games and whether our prior accessibility work had been impactful at the studio, we recruited ten game developers directly through Splash Damage using our contact at the studio to interview on their experiences of making increasingly accessible games. The inclusion criteria for the study required that participants had attended any of the previous accessibility talks.

Developers were dispersed across different teams within the studio, but all worked within the same office (either in person or remotely), and were supported by the same top-level facilities, including the studio's head of accessibility who provides information and guidance on accessibility to all teams at the studio.

Participants were also recruited from diverse roles within the company in order to ensure that the study was able to collect information from different perspectives and working disciplines. All participants had been working at the studio for longer than 1 year.

Informed Consent Procedure. Once we had selected the participants we would like to include in the interview, participants were invited to participate in the study through our industry contact. This initial communication was performed through our contact at the studio, as they held the contact details for each developer.

The invitation to participate included an information sheet, and consent form. The consent form had to be signed both before and after participating in the study to confirm that each developer understood the purpose of the study, was consenting to participate, and still felt this way after taking part in the interview.

Final Sample. The final sample is detailed below, with information included on the role that each employee held within the company as well as the length of time they have been at the studio.

Note that detail has been removed from the specific job title that employees hold at the studio, as this was thought to make them personally identifiable. For example, if there were a 'head of animation' participating in the study, this would be generalised to 'animation'. This does sometimes mean we lose detail on the status of a particular employee, but this was felt to be a necessary sacrifice so that developers could speak freely about their studio without concern that it may affect them professionally.

Table 6

The job role and years spent at the studio for each game developer included in the study.

Area	Time at Studio (Approximate Years)
Audio (Recording and constructing the games audio, interfacing with the game engine to get the audio featured during gameplay)	5
UI (Designing and constructing user interface elements of the game)	2

Narrative Design	2
(Designing the story elements in the game)	
Technical Design	6
Artificial Intelligence	7
(Programming non-player character behaviours)	
Art	2
(Constructing artistic components of the game, such as animations, texturing, modelling or concept art)	
Technical Design	2.5
(Programming that involves the process of translating game ideas into code)	
Animation Programming	5
(Programming in relation to how the game is animated)	
Graphics Programming	3
(Programming that dictates how the game renders gameplay for the player to see)	
UI & Leadership	2
(User interface design, engineering and related process management, alongside and management of other people).	

While participants were sampled in this way initially, our contact at the studio provided the opportunity to recruit further participants if we felt that our research needed more detail in specific areas, subject to the availability of a limited pool of potential participants.

5.2.2 Data Collection

The interviews were semi-structured and included specific questions about the developers' involvement in accessibility work and thoughts on challenges related to accessibility. We chose to use interviews because it was a method that could generate highly in-depth insight from the developer's experiences, without consuming a large portion of company time.

Before the interview began, the researcher requested informed verbal consent from each participant, to ensure that they understood the purpose of the interview and were consenting to take part. Following which, the interviews began with some scene setting, with a simple question which asked developers to tell the interviewer about their role at the studio and how long they had been working there.

- Can you tell me what your role is at the studio?
- And how long have you been in this role at the studio?

These types of contextualising questions were followed by questions that asked developers about their understanding and involvement in game accessibility work.

- And in the context of game development, what does accessibility mean to you?
- Has any of your work involved or related to accessibility?

As the interviews were semi-structured. They allowed the researcher to probe for more detail or clarification based on the participants' responses. This would include follow-ups such as

- Why is that?
- Can you clarify that for me?
- In what way do you mean that?

In some cases, when the participants would speak for a long while, a strategy of summarising and asking for clarification was used.

So, just to make sure I understand. You're saying x makes y harder to achieve?

The interviews continued asking about various facets of accessibility work at the studio, and included additional questions such as…

Are there any challenges to making games accessible when working at the studio?

Is there anything that helps overcome those challenges?

Do you ever receive feedback from people with disabilities?

What are your thoughts on that type of feedback?

At the end of the interview, a question was used to help participants summarise their feelings on accessibility work at the studio.

Do you see future titles at the studio being more or less accessible than previous titles?

This was followed by an opportunity to add anything else on the topic of accessibility that we either had not talked about, or they would like to add more detail to. The questions featured in this semi-structured interview were motivated to understand both the personal and organisational facets that might be affecting a studio and developers' ability to make accessible games. This meant asking questions about specific areas such as whether they wanted to make accessible games and what challenges and successes they encountered. The interviews also focused in on particular topics such as 'feedback from people with disabilities' which were identified as important in our grounded theory work (see chapter 3).

Note that while one of the goals of this research was to gain an understanding of the impact of the knowledge interventions from the diary study insight, we did not explicitly ask developers about this work. This decision was made because we expected this to reflect value naturally in their responses to our questions around accessibility facilitators and challenges if the work were helpful and because we had concerned that social disability bias would lead to an inflated assessment of the impact otherwise. This social desirability bias was a particular concern because the developers recognised that the knowledge and reports from the Diary Study were delivered by the same person (Jozef Kulik) that was performing these interviews. This limited the depth of our investigation in this area but also helped us ensure our responses were authentic to how they experienced developing games at the studio.

Industry Relationship. This work was conducted as part of an on-going collaboration with our industry partner, Splash Damage. This studio was the primary developer of the game used as in our diary study research (chapter 4). This prior work helped foster a trusting relationship with the studio which led to them provided us access to staff for interview.

While the work was discussed with the studio ahead of time, this relationship did not lead to the studio prohibiting any types of conversation with developers on the topic of accessibility. This freedom to design our interview was valuable as it enabled us to ensure that we were able to develop the research material in such a way to examine our research goals as closely as possible without the influence of any biases that the studio might inherently have. These types of questions

were all designed by the primary researcher and supervisors and done so on the basis of what was thought to be the most appropriate to investigate our research aims.

Prior to the interviews being conducted with the studio, a report, three presentations and two workshops were delivered. These were designed to impart information from the diary study to the development team. Content these exchanges is outlined below.

1. **Accessibility Barrier Report and Presentation**: A report containing an extensive list of the accessibility issues identified during the diary study was delivered to the developer.
2. **Accessibility Barrier Presentation**: A presentation version of this report, outlining and explaining the accessibility issues that players experienced.
3. **Diary Study Findings Presentation**: Findings from the diary study were presented to the team. Instead of focusing on specific accessibility barriers, this presentation focused on the themes identified in our diary study chapter.
4. **Accessibility Workshops**: Two accessibility workshops were delivered with developers who had previously worked on *Gears Tactics*. In these workshops we used example scenarios from the diary study as starting points for designing accessibility solutions. APX cards from AbleGamers were used to assist developers to identify solutions.

5.2.3 Data Processing.

The audio from each interview was digitally recorded using a desktop computer. These interviews ranged in duration from 25 to 70 minutes. Interviews were transcribed using automatic transcription software (Dovetail) and then manually corrected for accuracy of transcription. Minor grammatical errors were corrected in speech while preserving semantic meaning. Each interview was then read, and the researcher also made summarising notes before coding.

Interview Data Analysis. In order to analyse the interview data, we used thematic analysis was employed (Braun & Clarke, 2019; Clarke & Braun, 2014). This analytical process featured several stages that were adapted from Braun and Clark, full details on this approach are broken down in the diary study chapter (see Chapter 4.2.3).

5.3 Results

The research identified several key themes that were thought to be significant to understand the developer's experience of making increasingly accessible games at the studio. These themes, their sub-themes and their relationship to other themes is visualised in the thematic map below.

Figure 7

A thematic mapping of both the primary and sub-themes that were identified during the analysis of the interviews from game developers working at Splash Damage.
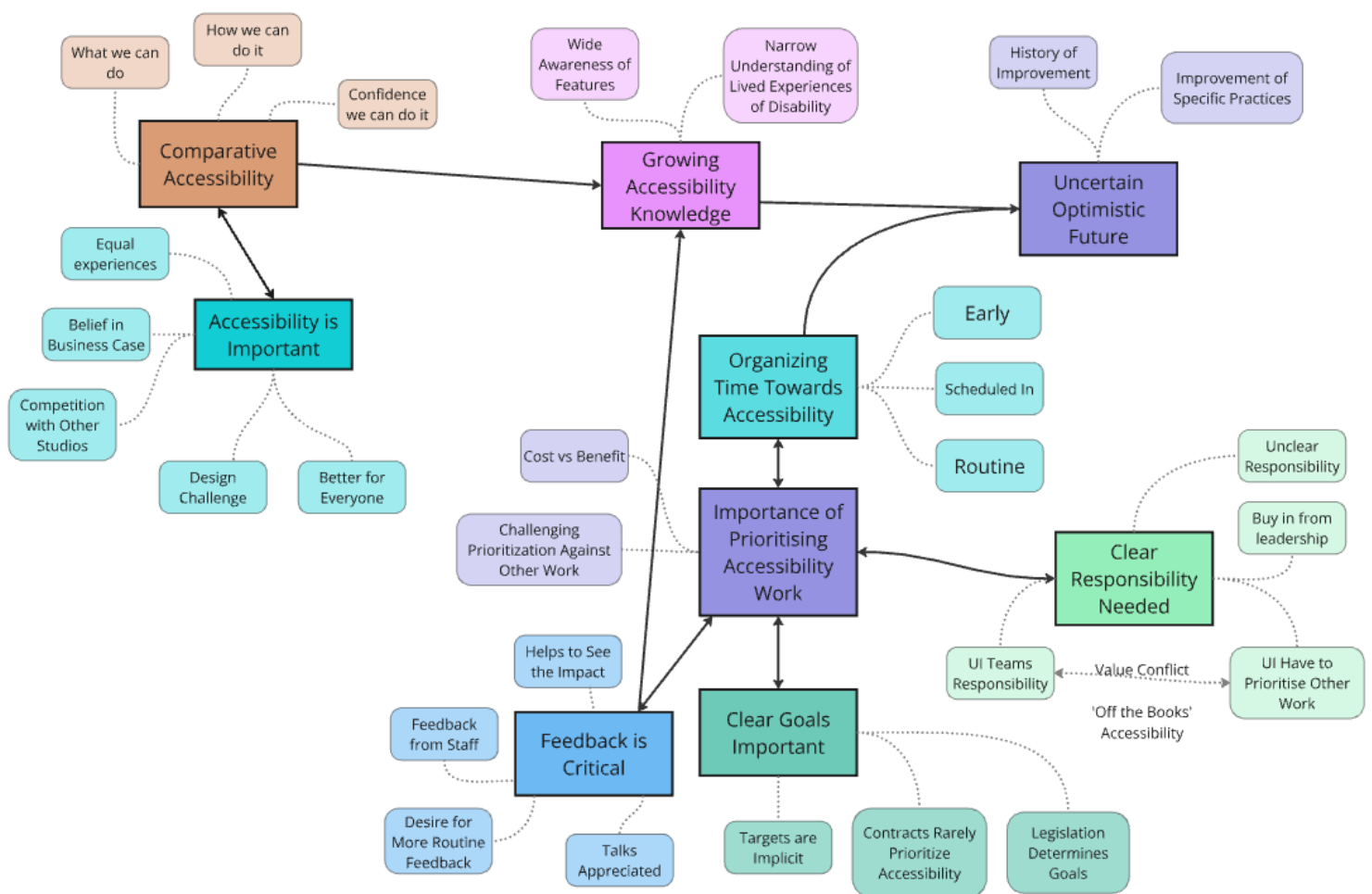
To summarise, we found that developers at the studio felt that accessibility was important and that they were motivated to make accessible games through a variety of different angles, these include a desire to provide equal experiences, development challenges and the notion that accessibility made the game better from everyone. Related to this, was the theme of comparative accessibility whereby far the most common source of knowledge that was cited in the interviews was insight from the accessibility of other games, these games helped to inform developers on the range of accessibility features and how they could be achieved. This comparison with competitors also provided the developers with confidence that they would be able to make increasingly accessible games (see appendix 5c for codebook).

Comparing other games was a key source of accessibility knowledge at the studio, alongside occasional feedback that was received through talks and people with responsibility for accessibility - specifically, their Accessibility Lead. However, the developer knowledge was characterised by mixed awareness of features that could be implemented and very limited understanding of the player experiences that were being had by people with disabilities.

In relation to more organisational aspects of the development of increasingly accessible games at the studio, the allocation of resources (allocation of time, schedule, and routine of accessibility work) was dependent on the prioritisation of accessibility work. Related to this, developers found it difficult to prioritise accessibility features and struggled with understanding the cost versus benefit of accessibility features. There were several critical areas that were connected to this and contributed to the challenges associated with prioritising accessibility work.

Specifically, developers valued feedback on the play experience from people with disabilities and would sometimes enact significant changes based on this feedback but found this type of feedback to be very scarce. Equally, developers felt that it was important to have accessibility goals, but that their accessibility goals were unclear and appeared to be implicit at the studio. They mentioned that external factors had the capacity to impact their accessibility goals, such as legislation and work with contractors.

Finally, connected to prioritisation was this idea of responsibility within the studio, where developers felt it was essential to have someone spearheading accessibility work but also felt that it was unclear where the responsibility for accessibility work lay across the department. This led to a conflict in work prioritisation for staff, where people working in the UI department felt as though accessibility was their responsibility but also that they had to prioritise the rest of their UI work, which was more central to their role. These findings are important because they highlight in detail the significant areas that can be factors in a studios' ability to make accessible games.

The following sections explore each theme in detail, using the theme names as headings and sub themes as subheadings.

5.3.1 Accessibility is Important

The first key theme is the idea that developers were motivated to make accessible games and felt that accessibility was important. In general, while developers presented with a variety of different motivations, all of the developers in the interview study felt that it was important to seek to make increasingly accessible games.

So yeah, I think it's just because it's a personal interest of mine, accessible design, and accessibility in general. It's because it's important to me. – (P9)

So if this can help people, you know, experience something that, you know, make a connection for them about their life, that's something that everyone should be able to experience.... – (P8)

Several sub-themes help us understand the different types of motivations that lead developers to feel that accessibility was important.

Equal Experiences. Perhaps the most common and significant motivation for developers to make increasingly accessible games was the idea that by doing so, they could provide better equality of experiences between players.

It's really the, the chance for anyone to get to enjoy it as it's expected, or it's wanted to be expected without any real difference. – (P7)

Significantly, developers often specifically mentioned disability or impairments and indicated that they wanted the games to be accommodating so that they offered experiences that were independent of those disabilities.

But yeah, pretty much just making it so that… if anyone has any limitations, it shouldn't stop them from taking part in something that's fun. It should be accessible to, to anyone. – (P1)

This is significant as it reflects that developers are often thinking about accessibility in terms of designing for people with disabilities specifically, rather than simply more approachable or generally welcoming to a wider audience.

Tied in with this was also the idea that they wanted players to be able to have fun with the game and be able to experience it positively.

> Yeah, I mean it's something… that it is to enjoy, it's a tool to enjoy disconnecting from the world to have a good time or to be challenged., So I think if that should be, that's something that is applicable to anyone regardless of their circumstances. – (P7)

This is important because it indicates this idea that accessibility means more than simply providing access to the game and experience (Power, Cairns & Barlet, 2018). The fact that developers commonly discuss wanting the experiences to be equal, including facets like challenge and enjoyment of the game to be similar between players, indicates recognition of the broad design implications that accessibility work needs to have in order to be effective.

Better for Everyone. Another key motivation was this idea that accessibility was better for everyone and that by making more accessible games, they were simply making better games for everyone.

> *Yes, it's, I feel like it's not just important to just broaden the access to just differently abled people, but it's also like investing in accessibility benefits the average player as well. – (P6)*

This is something that we echoed by player data reported from the industry, where accessibility features such as subtitles have been added or increased where developers see them being used by a much wider array of players than those affected by a particular type of disability (Gamesindustry.biz, 2019).

Developers also spoke about how this helped make the game better for groups of people which had varying abilities which were not the result of any form of impairment, such as non-native speakers to the game's default language who found it easier to read in English than process spoken word.

> *Because sometimes listening to, you know, someone speaking in languages is harder than reading sometimes because they're used to reading a lot on the internet and such. So, it's easier to, you know, make people that are not familiar with the language, for example. – (P8)*

Design Challenge. Developers also spoke about being motivated to make accessible games on the basis that it provided new and interesting design challenges for them to work with.

> *And yeah, I think it would make the development more unconventional because after a while you work, and you do, you work the same job, and you do, you get to do things over and over… you get some patterns, and it's a good way to break out from your usual way of thinking about things. And yeah, it's a fun personal challenge, to be honest. – (P10)*

However, this is likely offset by the idea that some developers felt that there was a conflict between their accessibility work and other day-to-day responsibilities. This is discussed later in our results within the section titled 'responsibility.

Competition with Other Studios. Another key motivation was seen to be this idea of competition with other studios, especially due to the impact that they can see that these accessible design implementations from other games are having on the player experience....

> *It's also just to make us competitive in general. Because I think there's an expectation now from AAA studios, that you have to be doing more than the bare minimum of accessibility… - (P9)*

Note, that in this instance we take the term 'AAA' to mean 'high budget' games, as defined by the subjective assessment of the speaker. In this instance, this suggests that the participant feels that a minimum level of accessibility features is expected for games competing in a certain budget category. We recognise that this category is not universally well defined and instead of inferring a specific interpretation, expect this to mean that they believe the studio is intent on producing games with a high production value compared to others on the market.

> *And you can hear the feedback from people online about what they loved about it and why it was useful to them. And, you know, seeing that kind of thing should inspire us to think, well, why don't we do that as well? – (P1)*

The Last of Us series (Sony Computer Entertainment, 2020) was the most commonly discussed when talking about the accessibility features of other games. This is valuable because it demonstrates how important accessibility work can be if it can not only lead to direct improvements in an individual game but also help motivate developers in other studios to push for accessibility in their games too.

This idea of competitive accessibility and the impact that accessibility features in other games can have is discussed in greater detail under the competitive accessibility theme.

Belief in Business Case. Developers also often cited the business motivation for making increasingly accessible games. This centred around the idea that if you would make the game more accessible, it would be played by more people. Interestingly, this perspective most commonly came from people with more senior or leadership roles within the studio, such as departmental heads.

> *Also, just business sense in that if you don't choose to make your game accessible you are literally saying you don't want that money literally just like from a game making perspective*

like cuz it comes down to money at the end of the day there's a huge demographic of people. – (P9)

While accessibility was felt to be important in getting people to play the game from a business perspective, developers also highlighted the importance that accessibility features play in keeping people engaged with a game. This is interesting as in our previous diary study findings we observed a cycle of play that saw players seek to tolerate and adapt to accessibility challenges but also observed that inaccessibility was something that could cause players to disengage over time (chapter 4).

I mean, if you compare the industry now from like 10 years ago or 10 years ago, you were a player, so you played all of the games pretty much, or maybe 15 years ago, I don't know. But nowadays, it's more like, oh, I'm a Call of Duty player, I'm a Gears 4 player. Right? So, I think it's very important to first draw as many people as possible in, and then also to keep them from a business perspective. – (P4)

5.3.2 Competitive Accessibility

Comparative accessibility was a key theme in our interviews, which reflects how impactful the accessibility work across the industry can be on the whole industry. Specifically, this theme regards how developers were constantly comparing their work to the accessibility work in other games with a view that this would help them improve the accessibility in their own title.

… I think the more those huge studios do that, the more it'll filter down to the rest of us. – (P5)

Developers highlighted the importance of looking at what other developers were doing and comparing their work against the output of their own studio in order to stay competitive.

So I think if we ever wanna' become competitive and make sure that we can not only be achieving more than basics in terms of our projects and the kind of level of standard accessibility that we are shipping within our games. – (P9)

Other game development studios were seen as being useful in helping them identify what they could potentially achieve, how they might be able to implement it, and to provide confidence that this was something that their studio should be able to do.

What W Can Do. One of the key areas of value that the accessibility work in other games had an impact on was in helping developers to understand the range of accessibility features that the type of game they were making might be able to include.

> *That, exactly that, and just doing that analysis, lets you know what is out there and what's possible. – (P1)*

This could be seen as a sort of shortcut to achieving a successful accessibility design implementation, as instead of coming at a design solution from the perspective of the problem - which in this case would be the deviation in player experience from the intended design that results from a particular area of impairment - drawing knowledge from competitors can enable a studio to provide appropriate solutions, particularly in the absence of internal feedback.

While almost all developers talked about accessibility comparisons with other games being valuable, one discussed this in great detail as part of a formal process that they had devised as part of a pre-production stage within their project and department. This took the form of a sort of comparative accessibility analysis, where they would systematically draw insight from the accessibility features of many different games.

> *So, I went off and just did a bunch of research online, looking at what games had, have done at least recently to, to kind of cater for accessibility. And, and again, it's sort of a competitor analysis in that vein, and I've got, I've got a whole confluence sheet of a breakdown that I did of all the things and then listed what, out of the things, that I found could be useful for us to use. – (P1)*

Again, the most common source of these accessibility insights tended to be *The Last of Us* Part 2 (2021) and that series of games, which have a large array of different accessibility features. This highlights the influence that high-quality, accessible games can have on the rest of the industry but does also pose questions about whether mimicking the features in this series, is necessarily the best approach. While advancing accessibility in the games industry is still in its relative infancy and there is a very wide possibility space that developers could explore to discover creative solutions for accessibility problems, alongside people with disabilities. It could be argued that over-reliance on information from other games might limit a developer's ability to engage with this creative, collaborative process.

How We Can Do It. As well as understanding the range of accessibility features that they could implement in the game, other game developers were also a source of understanding the specifics of how they might be implemented in order to be effective. Developers talked in very significant detail

about how features were implemented in games like The Last of Us Part 2 (Sony Computer Entertainment, 2022) and how they might be implemented into their current games.

They had actually another really good one was the enhanced listen mode they had, which was a way for the player, essentially scans over the environment with a kind of, there's a visual to it as well, which is kind of like a, a sort of ring that emits out from the player and kind of has a little wave overall of the, the environment up to a certain point within the player's kind of range. – (P1)

Developers also discussed how technical breakdowns and documentation on accessibility features would help them understand how these features are achieved in-game.

The more technical breakdowns of it really made me more aware of it because those are the types of videos that I would normally seek out already because it is something that kinda' helps me better understand why and how games are made. – (P3)

Confidence We Can Do It. Another aspect of the influence of other games and studios, which arose less often, was the idea that seeing accessibility in other games gave the developers confidence that they could achieve similar accessibility within their game.

There's no reason why we can't do that. Other people are doing it. – (P1)

When each of these areas are taken into consideration together, it is clear that the accessibility in other games has the potential to have a high degree of impact on the accessibility work within Splash Damage.

5.3.3 Growing Accessibility Knowledge

Connected to comparative accessibility, a theme that was present in the interviews with developers was centred around the knowledge that they have for game accessibility, which could be considered mixed or uneven. Although developers generally had a good awareness of the range of accessibility features that they could implement and some knowledge on the specifics of how those might be achieved, their understanding of the range and type of experiences that people with disabilities have with games or their own games was very limited.

Developers also spoke of their knowledge on how certain features would be implemented in the game, and generally had substantial knowledge for accessibility features they had already explored in past games.

As I said already with the previous project… we were using the maximum UI scaling as a default, making the wide frame so all the UI was already considered to be on the maximum size that you can reach. – (P2)

It follows sensible logic that the more specific knowledge was limited to the accessibility work they had been able to investigate already. Related to this, developers also felt by investing in more accessibility work, it would become easier over time.

I think the important part of that then becomes who knows how to use it and if you only have like one person and if for any reason they leave, you kind of take that knowledge with them. – (P9)

This can be explained by the limited internal resource allocation towards accessibility, and in particular the lack of routine and relevant feedback from players with disabilities (which is discussed in more detail under the theme 'Valued but Uncommon Feedback'). With this overall theme of growing knowledge accessibility at the studio, some of the sub themes help us to understand some areas of strength and weakness.

Wide Awareness of Different Features. In terms of their awareness of different features that they might be able to implement, developers that were interviewed generally had a wide awareness of the range of features that might benefit the games' accessibility.

These included things like adding in support for customisable button mapping or support for different physical controllers.

… you can input different controllers and different analogue inputs and stuff like that for people with motor disabilities. – (P7)

So, if someone can't use the right trigger, for example, they can change whatever was mapped to the right trigger to something else. So having that kind of granular way of working would be just super useful. – (P1)

Or the use of second channel audio support to communicate things that might otherwise only be communicated visually…

It could be an audio clue for what's going on around if you have a problem listening, for example. So, seeing for example, having the good 3D audio environment for your game allows you to have any idea what's going on without actually seeing it properly – (P1)

Many of these were cited alongside other games, which relates directly back to the idea that developers are gaining a lot of their knowledge on accessibility within their competing games.

Narrow Understanding of Lived Experiences of Disability and Play. Another sub-theme that was identified from the interviews related to the idea of developing knowledge about accessibility was the developer's understanding of the experiences of people with disabilities. Specifically, although developers reflected modest understanding of the experiences of people with disabilities that they had been exposed to, these were limited to occasional talks with consultants. Most commonly, this was a specific consultant who has a visual impairment.

We got exposed to Sightless Kombat and with this, I'm thinking a lot more about blind people now… like for me really this was a change in how I think about certain things, right? – (P4)

Therefore, the developers' knowledge on the experiences of people with disabilities playing their games tended to be constrained only to these limited experiences from players who had come into the studio to speak to them.

Additionally, developers also had more knowledge on disabilities and difficulties that were represented within the staff at the studio, such as people who were susceptible to experiencing motion sickness (discussed in more detail in the theme related to player feedback).

5.3.4 Organising Time Towards Accessibility

A central theme that was directly tied to the developer's accessibility output was the idea that in order to make accessible games, resources needed to be allocated towards accessibility tasks. From the developers' perspective, the critical resource was time, and they would often discuss different aspects of how time needed to be used in order to successfully make accessible games. Developers felt that without enough, and the appropriate regular allocation of time, it was difficult to make accessible games.

But for me, it's, it means that because there's no designated time to actually discuss and plan it in, it's not going to be discussed and planned in… - (P9)

As well as it being important to have enough time to engage with accessibility work, various sub-themes are discussed relating to how time is allocated towards accessibility work on a project including the timescale, routine and scheduling of time.

Early. A key sub-theme under this idea of allocating time towards accessibility work was the idea that the accessibility work needed to be engaged with at an early stage in the development process. In

many cases, developers spoke about it being important that accessibility is considered at the very beginning of a project.

I personally believe you need to integrate it into everything, to be successful, and you have to have it in mind almost from the beginning of the project. – (P4)

No, I think it's just more about having the habit of considering these at that stage. It should be like one of the first things that you have in the build. – (P2)

Developers spoke about how it was important to consider accessibility early in order to cater to specific types of disabilities, and reflected an understanding that it was difficult to simply add accessibility features at the end of a project. The developer in the quote below highlighted how thinking early helped them make more specific adjustments to the game.

Now that people are more aware that it's a thing, I think we can kind of carve out that time earlier on because we know it's not like, oh crap accessibility. We forgot. Let's just throw it in at the end. It's something that's definitely considered early on, which I think is important because it really does help you to cater specifically rather than like, we'll just put text to speech in and be done with it. – (P1)

Despite this, a smaller number of developers also felt that it was hard to think about accessibility early on in a project when it was not clear what the project's requirements were.

We need to have a base game first that anybody can enjoy, otherwise it doesn't make sense. – (P4)

Whereas you're having these questions, these, these conversations and, and it is that point where it is too early and like, look, we don't even know what the game is yet to, to worry about how, how people are gonna' be able to play it. – (P1)

This likely reflects differences in how accessibility work is perceived across different roles, what their role entails and what developers consider to be 'accessibility work'. Early accessibility work may not take the same form as late-stage accessibility work and may not necessitate the same input from all staff. For instance, if we consider the difference between setting accessibility goals and scheduling in accessibility work, this is work that can be completed early on a project and in itself can be considered working towards improving accessibility in a project. However, tasks that require more specific knowledge on the project specifications, such as building assets for the game or building tools for accessibility, are difficult to begin when the project still has many unknowns.

Scheduled. Another critical aspect to the allocation of time towards accessibility work on a project was scheduling and the idea that time towards accessibility work needed to be scheduled in for it to move forward.

At Splash Damage, developers most often spoke about this as a complication of completing accessibility work, with developers claiming that the lack of scheduling made it difficult to engage with accessibility work.

> *So anytime you have someone that is doing accessibility focused design and stuff like that, it's generally always on top of their other work requirements. – (P9)*

When asked about the biggest challenges towards making accessible games, this developer cited that they felt the studio's largest challenge was including accessibility in the planning phase.

> *The biggest thing is probably including accessibility in the planning phase. – (P1)*

They went on to talk about how without that schedule or planned accessibility work, developers would prioritise non-accessibility work and the accessibility work would get left behind.

> *I think people do get a bit lost in exactly what they're doing, because a lot I have to do is deliverable for this certain feature, and that's not to do with accessibility. – (P9)*

This also relates to the theme of Responsibility that we discuss later, in that theme developers who felt like they had a high degree of responsibility for accessibility work were compelled to engage with it despite it not being a scheduled component of their work.

Routine. Finally, developers also spoke about the routine or regularity of accessibility work being important in their ability to think about and engage with accessibility work on a project.

> *I think if you want to be like a, I guess a pillar to the work that you're doing, it is something that you should always kind of keep in mind. – (P3)*

This developer went on to speak about how the accessibility features in The Last of Us could only be achieved because they were considering accessibility throughout development.

> *... something like 'The Last of Us' was very much built with a bunch of accessibility in mind, I'm pretty sure that throughout development they had some of that... - (P3)*

While this developer does not know with any certainty what the development process for accessibility work was at the studio that made The Last of Us (Sony Computer Entertainment, 2012),

the fact that they imagine accessibility was considered routinely supports the idea that this is something that developers believe to be important in making accessible games.

Despite this, developers at Splash Damage often spoke about accessibility work and projects occurring in isolation and not having the opportunity to engage with that work very often.

There's the accessibility week there, there are those things, right? But in the day-to-day work, when we talk about new features for the game, I don't see it that much. – (P4)

Yeah. That is at least within, within my discipline, it's not something that really comes up a lot. – (P3)

This is something that has a relationship to the challenges we will discuss in prioritisation and responsibility. Specifically, the idea that because accessibility work suffers from challenges being prioritised and an unclear designation of responsibility, it becomes difficult to carve out time for accessibility work. This is discussed in more detail in the prioritisation and responsibility themes.

5.3.5 Importance of Prioritising Accessibility Work

A theme that was identified surrounding the discussion of accessibility work at the studio was the idea that it was important to prioritise that work. The essence of this theme was that developers recognised that without prioritisation, developers found it to be challenging to allocate time towards and therefore engage with work seeking to make the game more accessible.

So, I've talked about prioritisation. So, I guess the biggest challenge is to make sure that accessibility features have the right weight. In a project that can still be, you know sometimes you need to make compromises, sometimes you need to best make sure that still you maintain a set of things that are there, but with the, with the goal in mind that you want to, you know never go back, and we want to still provide kind of a basic feature set of like accessibility features. I think that's a good starting point. – (P9)

Here the developer speaks about it being important to prioritise accessibility work so that the commitment towards accessibility work does not decline over time. Something which they feel can be achieved by giving accessibility work the appropriate 'weight' or significance within a project.

Priorities dictate the amount of time that a developer can engage with a particular task, and therefore it seems only natural that many developers felt that the ability to improve accessibility came down to 'time and priorities.

But then I think it's also about time and priorities. – (P4)

Challenging Prioritisation Against Other Work. An important sub-theme that was directly tied to this was that it was often seen as challenging to prioritise accessibility features, or that accessibility features would often see a lower prioritisation than other aspects of the game.

> *So yeah it, it could have been potentially at times something could get some extra support on, but there it really wasn't a priority to be asking people to focus on that. – (P9)*

Some developers spoke, suggesting that it was a priority to make the game for people without disabilities first.

> *I'll be a bit rough, but most of the people are not, don't need special accessibility stuff. So, you start from making the game for the broader audience, and then you think about, at least that's my, my feeling about it to be honest. – (P10)*

This aligns with what we see in later themes where developers talk about the significance of feedback and the lack of feedback from people with disabilities and previous where developers felt that it was challenging to think about accessibility early. As only a small amount of feedback from people with disabilities is fed into the development of games at the studio, people with disabilities are effectively not seen and therefore at risk of not being considered as part of the core audience of the game.

Other developers felt that their accessibility work was often disrupted by project changes and shifts in specifications.

> *So, it's either it has to delay or not happen, or it gets pushed out, or it means that that person is having to double their, well maybe not double, but like let's just use double their work, or you know, and maybe end up doing overtime or things like that to try and get it to happen. – (P9)*

This relates back to the idea that accessibility work is not being committed to at early stages in a project and that in many cases it is something that is being engaged with later and then pushed back to a later date when other priorities become more important. The idea also links in with the notion of responsibility and how particular people at the studio feel a responsibility for accessibility and therefore a need to work excessively to try and compensate for the lack of prioritisation. This is discussed in more detail in the theme 'unclear responsibility for accessibility work'.

Cost Versus Benefit. A final sub-theme under the significance of prioritisation was the idea of cost benefit. When talking about prioritisation, developers often spoke about accessibility work as something that was considered through the lens of a cost benefit analysis.

So usually, we have an impact versus cost kind of let's say ratio for features obviously, yeah. – (P6)

While it follows that logically accessibility features pass through a similar cost benefit analysis to other aspects of the game, the difficulty here is that the developers feel that they do not get substantiated feedback on the accessibility of their games (see the theme 'valued but uncommon feedback'). As a result of this missing information, the studio is not able to adequately assess the impact or benefit of the presence, absence, or quality of accessibility features, and therefore this adds a difficult barrier for accessibility features to pass through.

... if not, everyone is really seeing the value of accessibility, then it may not have as much of a priority in the development schedule as perhaps another feature – (P9)

Feedback is critical for understanding the impact and value of accessibility work and a lack of feedback can make the prioritisation more challenging which then leads into this lack of time allocated towards accessibility work and this value conflict for people that feel they have a responsibility for that work (see 'Unclear Responsibility' theme for detailed discussion).

One explanation for this mismatch might also be related to the developer's motivation, something we previously identified (chapter 5.3.1) was that developers have different justifications to make accessible games. Among other things, these might be legal or based on justice and equality. It stands to reason that those with a more legal basis for improving accessibility (such as compliance with the Communications and Video Accessibility Act (CVAA) legislation in the USA) might only be willing to go so far to deliver accessibility features, whereas those looking at accessibility as a matter of justice might be willing to go further, towards establishing a broadly accessible end-to-end play experience for players. Our work does not have the sample size required to determine if people in senior and/or leadership roles are more likely to hold certain motivations, but this could be a worthwhile area of future investigation and helps explain some of the disconnection between what developers say they want to do, and what their development studio appears to be facilitating.

5.3.6 Important to have Clear Accessibility Goals

A significant theme from the analysis of our interviews was that developers felt that it was important to have accessibility goals, standards, or targets to hit within their projects that made it easier to make accessible games.

Making sure that everyone is aware of what we're actually aiming to do with the accessibility on our current project, basically. – (P9)

It's knowledge that we can easily share between projects that might be starting and all that so that we have a clear direction from the beginning so that we can implement and implement stuff properly without bugs or without having to evaluate if something is, should be fixed or is worth fixing or is not worth fixing. – (P7)

This theme relates to other themes such as the importance of having staff who had a stronger designated responsibility for accessibility work in that it suggests that personal motivations are not sufficient in enabling developers to drive for accessibility work to be completed. Developers need empowered staff and clear directives to be able to engage in impactful accessibility work.

One developer spoke about how they had worked at another studio which had clear accessibility pillars, which were helpful for them when working towards making the game more accessible.

My awareness of our accessibility has been greatly enhanced by working in children's media because it's taken more seriously… We had pillars that we would have to reach, like cognitive pillars, you know, there were colour tests done across all of the sensory content. There were so many more pillars that were a part of a formalised process that we went through… - (P5)

This ties in with how developers spoke of needing accessibility work to be prioritised. Accessible goals, targets and standards help establish a high-level direction for the studio towards accessibility work. Despite this, some of the related sub-themes help us understand why this is an area of challenge at the studio.

Targets are Implicit. One key sub-theme of having clear accessibility goals was that developers often felt that the accessibility goals were unclear at the studio, or that they were implicit.

It's almost like its good sense rather than, you know, like we should, this is our target. – (P6)

Developers spoke about how it would be valuable to have those goals more clearly defined.

It would just be a good idea to almost have a broader, almost formal step where we say like, this is now a thing and let everyone know that you know. We are now doing this for our games… - (P7)

This ties into the theme of prioritisation and the responsibility conflict that we see discussed in these respective themes. As the studio does not have clear targets for accessibility work it becomes harder to prioritise, which leads people who feel they have responsibility for the work to feel the need to work extra hours or commit to accessibility work on the side in order to keep things

moving in a positive direction. It follows then that developers would feel that having clearly outlined accessibility goals would help them in their efforts to make increasingly accessible games.

External Influences Can Determine Goals. Some developers also talked about the impact that external factors can have in determining accessibility goals. Specifically, they talked about how external partners and legislation had the capacity to influence the studios' accessibility goals on a project. For instance, developers spoke about the CVAA legislation (21st Century Communications and Video Accessibility Act, 2011) and how accessibility work that aligned with the CVAA was prioritised.

> *Unless it's some sort of mandatory or legal requirement like the CVAA kind of related features, very often those are gonna' end up being the things that get cut... - (P9)*

This CVAA legislation then stands in a set of goals or targets for a project to meet in the absence of any that are manually assigned by the developers. The fact that developers feel that these targets are prioritised helps to demonstrate that having clear goals and targets can help make prioritisation easier and lead to increasingly accessible games.

Elsewhere, developers spoke about their development partners in past projects (publishers and intellectual property holders that they had worked with to release a game), and how they would take guidance from these partners to determine which accessibility features were supported in the game.

> *It was our partners like [redacted that were very keen on providing support for several accessibility features as well. – (P6)*

This reflects how there are external pathways that have the capacity to influence a studio like Splash Damage towards making more accessible games.

5.3.7 Feedback is Critical

Developers spoke about the significance of feedback and how they felt that feedback was a critical component of making more accessible games. Specifically, developers spoke about how feedback helped them gain knowledge about particular types of disability and helped them design more accessible games.

> *Usually, they influence you in that moment because you will take that feedback and implement it, but at the same time it is something that you will take with you later on. So*

basically, it becomes part of your package of knowledge on how to move forward the next time. – (P2)

Yeah, like I said with, with Sightless Kombat, he came in the studio when we were making [redacted] and I remember he played some of it I remember and was sort of as he was playing it, listening off what things he was hearing and noticing, which was super useful just because, you know, when, when you are so close to a project, and you've played it hundreds of times, you kind of forget about the details that are in there. – (P1)

So how can we make game controls for them? How can we change the game logic a little bit to adapt to what they need, right? But yeah, it's very interesting. – (P4)

Additionally, developers spoke about how feedback was changing their mindset towards designing for accessibility, helping them think about the things like accessibility for blind people when designing the game.

Nowadays probably they have started something as well, but I think it, I mean especially Sightless Kombat, like for me really this was a change in how I think about certain things, right? – (P4)

Developers specifically called out the accessibility talks delivered at the studios, when talking about avenues of feedback which they had valued. This included the talks that were delivered in relation to the research we conducted with people with disabilities playing Gears of War Tactics.

Anyone that comes and talks about accessibility makes it more human and relatable and it kind of, I think puts a face to an issue, or a barrier I suppose. – (P9)

When talking about these types of accessibility talks, they usually categorised the talks we delivered based on the diary study work alongside talks that were delivered directly from people with disabilities who were explaining their own experiences with a game.

Despite recognising the value of feedback in the development process, there were a number of sub themes related to this that help us understand some of the challenges surrounding feedback and related processes at the studio.

Feedback Helps to See the Impact. Developers also talked about the impact of accessibility work and how feedback helped them understand the impact or effect of the work they were doing. This was a significant subtheme that helped to explain why developers felt that feedback was important for the development process.

In one example, a developer talked about how it was valuable to understand the effect that all of the games' smaller audio cues were having on a player's experience.

> *And it was really interesting to hear from his perspective, what he was picking out is like, oh, that was an enemy footstep. That was this person's footstep. That was someone placing down an ability or, or whatever. Like I can hear a fire over to the left when I move around it, it gets further left and behind me. So that kind of thing was super useful to see how he could navigate through the map just by using what we've had in place already. – (P1)*

This also ties back to the idea that feedback is important in helping developers prioritise accessibility feedback, as developers spoke about needing to understand the cost benefit of the work. Understanding the effect that the changes they are making to the game are having is essential to understand the impact of that work and be able to prioritise against other features which may be more or less impactful on the player experience.

Feedback from Team Highly Prioritised. With regard to accessibility work, developers spoke about how feedback from within the team was prioritised either above or in the absence of external feedback. Developers specifically used an example of how a motion sickness issue was affecting the developer's experience of a build internally, and this was something that was promptly resolved as a result of negative feedback from the games developers.

> *There are some things we have achieved in the last year though mainly focusing on developer requirements, I know a lot of people who are struggling with things like motion sickness when testing… - (P9)*

This demonstrates how effective feedback can be in informing the developers' ability to make increasingly accessible games. However, because a majority of disabilities are not represented among the development teams at the studio, this is not a viable avenue for many types of accessibility feedback. Therefore, this emphasises the need to draw insight from a wider range of people through accessibility focused user research, recruiting consultants and a potential value towards hiring designers with disabilities.

Desire for More Frequent Feedback. While developers spoke about the value of the feedback they had received through occasional talks and feedback sessions with consultants, they noted that these feedback opportunities were not regular…

I really would like for us to have kind of more regular consultants that we can kind of hire either remotely or on site, depending on what their requirements are or having us travel out with some, you know, dev kit, set up them, whatever the needs would be. – (P9)

…and narrow in scope, which made it more difficult to make accessible games…

But that's just one person with one opinion and one particular disability that he's going to be testing again. – (P9)

Although these comments were specifically centred around feedback, this theme also reflects the broader sentiment that staff expressed towards the studio's general frequency of accessibility work and the idea that it was important for accessibility work to be routinely incorporated into their development processes if it was to be successful.

Developers spoke about feeling that it would be better if this was something that was regularly scheduled into the development process through the form of formal playtesting with people with disabilities.

There is like a formal kind of step in the project where we, we say like, okay, now you know, this bucket of features they will go through, I dunno', accessibility testing, you know, or something like that. So, I think that that's like still missing as a, you know, in the normal pipeline of during production of a project. – (P6)

One developer spoke about how they made more regular support like they receive for other disciplines such as programming.

But yeah, I'd like to see regular, I guess I know that like programming, for example a monthly newsletter that they stand around for like hey did you know this thing about C++? – (P3)

5.3.8 Clearer Responsibility Needed

A major theme was that developers felt that it was important that there was a clear responsibility for accessibility work. Developers spoke about feeling that it was essential to have someone present with responsibility for the work to spearhead it forward…

Those little bits that are kind of there along the way when you're designing things at the time, if you've got someone there that is, that is their job, that's their title responsibility accountable for it, you've got someone that can own that and make sure that it's happening and that it's not being pushed to the bottom of the pile. – (P9)

Despite recognizing the significance of having people with dedicated responsibility for accessibility work, developers gave the impression of inconsistency or uncertainty towards the responsibility of this work. Some developers would explicitly say that they were uncertain who was responsible and that they needed staff with a greater responsibility for the work to spearhead it forward.

> *I'm not sure there is, I think it might be good to have just a nominated person. – (P1)*

This lack of clarity for the responsibility for accessibility work when taken alongside the experiences of user interface designers strongly supports the idea that there is a lack of clear or specific designation of responsibility regarding accessibility work at the studio. This also relates to the leadership and power structure within an organization, in most cases a discipline is represented with at least one member of staff with a fairly high level of seniority. If accessibility is not represented at that level of senior leadership, this is likely to contribute to why it is under prioritised and is not being spearheaded forward.

User Interface Team's Responsibility. Most commonly, developers felt that accessibility was the responsibility of the user interface team at the studio. This was especially the sentiment among members of that team.

> *I know that it, the UI team does a lot of it because obviously they have to look at a lot of things with colour blindness and, and that kind of stuff early on. So, they've always got accessibility in the back of their heads. – (P1)*

> *I also can imagine like as a UI designer we are trying, basically we are advocating for accessibility. – (P7)*

Reinforcing this, the user interface team were the most common to speak about explicit aspects of accessibility work that they were engaged with, such as making sure that the UI was flexible and could be presented at appropriate sizes.

Responsibility & Values Conflict. Despite this perception of responsibility for accessibility work being directed towards the user interface team, there was a sense that it was difficult to engage with this work alongside the rest of their responsibilities.

> *I have a hell of a lot there that I'm already having to do. So that accessibility work on top of it becomes something that is not sustainable… anytime you have someone that is doing accessible focus design and stuff like that, it's generally always on top of their other work requirements. – (P9)*

For at least one staff member this created a sense of conflict between their explicit responsibilities and their values, where they felt that it was important to make accessible games but the rest of their responsibilities towards other aspects of the project made it very difficult to engage with that work.

So, it's something I care about a lot, but have to make those decisions on priorities. – (P9)

This led them to seek ways to compensate for the lack of accessibility work such as engaging in 'off the books' accessibility work or seeking to engage with accessibility work through overtime.

What I had to do was, almost all 'off the books', was check in with those disciplines for the motion sickness book and get their kind of estimates on how long they thought this particular work would take… - (P9)

This particularly highlights the significance of having accessibility as a dedicated role at a studio, so that there are staff who are able to drive accessibility design and change and has the time to follow up on accessibility work without conflict with other priorities. This conclusion was also very explicitly felt by staff at the studio.

Because if I had someone that could focus on that just solely to test design things, make sure those conversations are had and estimated, we could have kicked some of, at least some of the discussions off around this to get bored and have those estimates a lot earlier. – (P9)

Consistent across this and the last theme it would appear that there is a lack of perceived fairness around the distribution of accessibility work. The UI team are needing to take a disproportionate load of the accessibility work, and in some cases, they have to make personal sacrifices to push that work forward. It would seem that this stems from the overall theme that there is a lack of clear or fairly distributed responsibility of the work, and as a result it is being picked up by the people with a personal motivation, even when they are not sufficiently supported by their organisation (such as being allocated additional time).

Drive from Leadership is Essential. As well as feeling it was important to have people with a more focused responsibility on accessibility work, developers interviewed felt that it was especially valuable to get leadership driving for the inclusion of accessibility features.

I think if you can get the people in the position of management and leadership that have the money basically and that control schedules and roadmaps and that sort of thing, if you can have those people having that sort of the initial mental considerations. – (P2)

Developers spoke about how it was critical to get people like producers onboard with accessibility work. This links back to other areas of challenge that we have identified within the studio such as organising time towards accessibility and prioritising accessibility as producers are usually heavily involved in those aspects of the work within a typical development studio.

Sometimes I even see producers say, 'okay but what about accessibility?'. That is a really big win… they have kind of the last word anyway, they have the ability to push for this stuff. – (P2)

5.3.9 Optimistic Uncertain Future

A final theme helps us paint a picture of broader sentiment towards the accessibility work at the studio and this was this idea of an optimistic, uncertain future for accessibility at the studio. Specifically, this relates to an overall sense that accessibility output would improve at the studio over time.

I hope it is more accessible, right? I think we will not go less accessible. – (P4)

So yeah, I would be hopeful, but I'm not sure what kind of games that we are creating. – (P5)

But developers were often unable to point towards specific processes that would be instrumental in that happening, which lead to some uncertainty.

I would love to see that. I am not exactly sure what the plans are for this sort of stuff, and within my project I am completely not sure really because we're early on again. – (P3)

Overall, this idea of an optimistic but uncertain future aligns with other themes where developers often spoke about some good practices that had been initiated at the studio related to accessibility work (themes related to prioritisation, feedback, and the distribution of time towards accessibility work), but a feeling that these needed to be improved or moved forward for them to be more successful in making accessible games.

History of Improvement. A notable sub-theme was the idea that historical improvement provided confidence to developers that accessibility in the future. This was the most common type of evidence that developers pointed towards when seeking to support the idea that the accessibility output would improve at the studio.

So, I would say that those kinds of things will obviously impact it as well. I think given our previous projects started out with pretty much no accessibility, like I know [redacted] has brought this up before, like the [redacted] game that we worked on had pretty much

nothing… and then you can look at some of our more recent games that we worked on like [redacted] and the other [redacted] games that we've done or [redacted], they've all had accessibility features in them… - (P9)

This historical improvement was often not just specific to the studio, but towards the broader attitude on accessibility change across the industry. Some developers spoke about how they had only begun to hear about video game accessibility while working at *Splash Damage*.

I had never heard anything about accessibility before I joined Splash. Right? So, from that point of view, it's already better than everything I had before. – (P4)

Improvement of Specific Practices. The other notable explanation for the idea that accessibility would improve at the studio was the idea of specific improvements in the studio's practices. For instance, developers would often talk about talks as evidence that accessibility work would improve, or the fact that they had someone managing their focus on accessibility.

So short answer, I think yes it will get better just because we are building that sort of structure to facilitate it. – (P9)

Some developers also spoke about their involvement in this research as evidence that the studio was thinking about accessibility more and therefore was likely to improve over time.

But I feel like, just because we have this interview and the previous collaboration that the company did with the with, your university, that shows that Splash is trying to make the game more accessible. – (P1)

5.4 Discussion

The resulting analysis and our themes paint a picture of the accessibility development culture at Splash Damage and clearly helps us answer our first research question regarding extending our understanding of the challenges and facilitators to making accessible games. The present research helps illuminate how particular processes involved in game development appear to be interacting to serve as either barriers or facilitators for accessible game development. Specifically, employees give the impression that accessibility work output is contingent on their own knowledge of how to solve accessibility challenges, and time and resources being allocated to completing accessibility work (which is often insufficient). The allocation of resources at the studio is dependent on the prioritisation of tasks, and the prioritisation of accessibility work is dependent on three key factors: the presence of accessibility goals and targets, the clarity of responsibility for accessibility

work among employees at the studio, and the presence of feedback from experts and people with disabilities. This insight is unique in that it is the only research that provides us with a detailed understanding of the mechanisms of accessibility work within a large-scale commercial studio, and this work has implications both for future research in this area, as well as application by developers working within the games' industry.

This work also draws support and extends the findings of some of the related work in this area. The motivations and knowledge of game developers and the overall idea that game developers are generally motivated to make accessible games was something observed in our grounded theory research (Chapter 3) where we interviewed a wider array of game developers from different studios and development environments and observed a similar pattern of expressing motivation to want to make more accessible games, but that this was constrained by their own limited knowledge and lack of lived experience with disability.

The grounded theory research also proposes the theory that in order for games to be made accessible, it requires involvement of personal, organisational and the drawing upon resources that are external to the organisation. This theory is supported by the interviews with Splash Damage which paints a picture of accessibility work that is constrained by the absence of some organisational processes around prioritisation and responsibility, as well as the lack of utilisation of valuable external resources (specifically, drawing insight from expert consultants and players with disabilities). Despite the developers being interviewed all wanting to work towards making accessible games, and players indicating that the accessibility efforts are positively impacting the player experience when they're available (Chapter 5), the overall accessibility still often fell short of what players needed. Our themes indicate that there is an organisational bottleneck where staff are both motivated towards making accessible games, and aware of the value that external resources can bring to their studio, but this is held back by a lack of top-down organisational investment.

In relation to some of the other literature in this space, while the pool of literature is quite limited in both depth and quantity, the themes from our research do show some similarity. Porter & Kientz (2013) reported that developers value in-house expertise and prioritise the low-hanging fruit of accessibility, and we can see some of this in our research as developers were seen to prioritise experiences affected by members of their own team (in the example provided this was addressing motion sickness concerns experienced by developers) which could be seen as the low-hanging fruit within their studio. Additionally, as found in Porter and Kientz (2013) report, we also saw that there is a priority towards accessibility work that contributes towards meeting CVAA compliance (21st Century Communications and Video Accessibility Act, 2011). Our data also helps explain why this is

the case, as spearheading the accessibility work essential and developers, we interviewed often felt that accessibility was a matter of cost benefit. The legal requirements provided by legislation like the CVVA provide that mandate required to spearhead accessibility work forward and incentivises this to happen by establishing a better cost benefit relationship (avoiding financial consequences of failing to comply with this legislation).

However, discussion of more technical facets of the work has not come through in our interviews and is rarely mentioned by developers in the present study, or our grounded theory work (see chapter 3). In Porter and Kientz (2013)'s research, the role of middleware was a theme that was identified that could help developers make increasingly accessible games. It might be that a certain level of investment in accessibility work is required before developers commonly encounter these issues and that this has not yet been reached at the studio, that the development environment for games as a whole has shifted significantly since 2013, or simply that developers did not feel the technical side of accessible game development was a barrier.

Many of our themes centred around the organisation of accessibility work do not manifest in previous work, but this is likely because our work had the unique opportunity to closely study developers working across an environment that is shared by each interviewee. (Levy & Gandy, 2019)'s study included just six developers, and only four interviews as three developers from the same studio were interviewed as a group, which might limit the ability to draw insight on the shared understanding of organisational factors if they either vary or are referred to with different language across different studios. Similarly, this level of detail on organisational processes did not manifest in our grounded theory, which saw 10 developers interviewed from 10 different development environments.

Findings in the present study also helped answer our second research question, which was focused on understanding whether our knowledge exchange (from the diary study output) assisted developers in their efforts to make increasingly accessible games. With developers discussing this work and other types of work like it as valuable and helping them to understand the impact that accessibility work can have. This echoes similar findings in the academic literature, where researchers found that content on the lived experiences of a group of people with disabilities was helpful in providing more accessible content for people with impairments (Levy et al., 2020). However, in our study, as with other types of accessibility feedback at the studio, developers felt that this type of work was limited by its frequency. This ties back to the central idea that accessibility work needs more top-down spearheading at the studio to have a greater impact.

The present study makes a contribution to the literature in this area through its ability to offer insight on the understanding of accessibility challenges as experienced by a group of game developers working at a single large-scale game development studio. In this capacity, this work is unprecedented and provides value in its ability to illuminate the types of experiences that game developers are encountering within this space. Knowledge generated from this study has implications for both the games industry and studios working towards making more accessible games, and for future research in this space. This research helps us understand why despite the high availability of solutions, guidelines, and experts available to help solve accessibility issues, a large-scale studio's ability to tackle these challenges is constrained by other internal factors related to its processes surrounding accessibility work, and top-down investment in accessibility. Future research might seek to translate this work into actionable insight for studios seeking to change their studios culture and process surrounding game accessibility in order to make increasingly accessible games.

5.4.1 Limitations

This research is not without limitation. One significant caveat to our analysis is the manner in which it was difficult to get certain stakeholders to participate in our research, such as producers. These types of people help manage decisions within a games company and may offer more insight into barriers and facilitators towards making accessible games. Another limitation is that the work is inherently very applied, and Splash Damage is a live games studio with many moving parts which do not wait for our research to occur. This is a challenge for all games research that seeks to examine phenomena as they occur in live game environments. While this can be seen as a limitation, the applied and naturalistic nature of the research also provides validity to our findings that prior studies which have examined students in more controlled and educational environments which do not have the same constraints (e.g. Levy et al., 2020) have lacked.

5.4.1 Conclusions

In conclusion, the work presented offers considerable insight into the experiences of developers seeking to make increasingly accessible games and both supports and extends our previous studies (Kulik, Beeston, Cairns 2020). The insight into the developer's perceptions of organisational processes such as responsibility, goals, prioritisation and feedback and the role that each of these play in the ability to complete accessibility work is valuable and each provide potential avenues for further research as well as insight for the industry to consider when seeking to make increasingly accessible games. There are many valuable avenues for further research which include but are not limited to exploring these areas such as case study work on the prioritisation of

accessibility issues, developing means of measuring change to accessibility development efforts and culture at a studio and examining how information on developing better organisational processes for accessible game development can be effectively fed into game development studios.

6. The Game Organisation Accessibility List (GOAL)

The lack of accessibility is a problem that needs to be addressed by the video game industry, and as we have discussed, this is an issue that is being addressed at different levels of success across different game development companies. Through three cycles of action research, we have identified a number of the challenges that both developers face in seeking to make accessible games and explored how insight from player experiences can help assist. This body of research holds a collection of knowledge that could be especially valuable in helping developers seeking to improve accessibility of their games through drawing attention to areas of process and organisation that can assist or present barriers that need attention. With this in mind, it is important that we consider how the knowledge generated from our research with developers might be translated into a useful resource to help developers identify and understand their own organisational challenges around accessibility.

From our research, we identified a number of key areas of importance to accessibility work. For instance, developers spoke of a wide range of different challenges, from experiencing difficulty relating to knowledge of how people experience their games with disabilities, and the type of accessibility features that could be implemented, to difficulty prioritising their time towards accessibility work. In some cases, these were clearly related to those identified in prior literature, such as the lack of depth of accessibility knowledge relates to how developers in Porter and Keintz's (2013) research tended to focus on the 'low-hanging fruit' of accessibility. However, our results were largely novel findings, likely due to our novel approach working closely with game developers.

However, this collection of knowledge is ultimately worth very little if it does not reach game developers. From our own research, developers mentioned various different resources that they used to learn about accessibility, such as accessibility guidelines, blog posts and features from other video games. Notably, none of these different sources that developers discussed drawing knowledge from included academic papers or PhD thesis. This highlights the importance of considering how knowledge generated from academic spaces needs to consider alternate forms of delivery if it hopes to impact the games' industry. Indeed, research in other areas has described a structural gap between the knowledge distributed in academic environments and academia, highlighting that academics need to effortfully bridge this gap by considering alternate approaches to how their knowledge is structured and disseminated (Gera, 2012). With this in mind, we considered approaches that we might adapt our knowledge into something that could be applied directly by game developers.

The problem of accessible game development could be described as one of extreme complexity. It is a vast array of interrelated factors, spanning both personal knowledge and organisational processes. One approach that has historically helped professionals tackle problems of high complexity is the idea of a checklist. Simply, a checklist has the capacity to dissect a complex multifaceted problem into manageable, smaller components and check the users' engagement with each of those smaller facets (Gawande, 2010). With this in mind, a checklist style approach could be a valuable tool that helps translate our insight on the challenges relating to accessible game development into a set of items for game developers to consider about their own process. Despite this, unlike a checklist that a doctor might use to complete a medical procedure, our insight does not offer a list of specific tasks in a procedure that need to be completed but rather a list of factors that we wish to encourage reflection on. The diversity of game development and varied approaches that need to be taken towards solving accessibility challenges would not be suited to a more rigid, prescriptive approach. In our case, the output of our research needs to help developers reflect on the organisational practices important to successful accessibility work, without being so overly prescriptive that they did not fit with each developer's different constraints and assets.

This checklist approach is a form of intermediary knowledge representation designed to translate the knowledge from our relatively complex series of studies into a format that can be used by game developers. With this awareness, it is also important to highlight why the checklist-based approach has been chosen as opposed to other forms of intermediary knowledge representation. Another common approach that is popular in game development is the use of design lenses. For instance, AbleGamers (2018) translated insight from their research into their Accessible Player Experience (APX) cards, this is an approach that can be valuable as means of communicating with designers, especially as the design lens approach is widely popular in game development (Schell, 2008). However, our knowledge is not specifically directed at designers, but the studio organisation as a whole, which includes producers, development directors, and designers too. With this in mind, the checklist format can be considered suitable as developers across a range of roles within a studio will be familiar with working with task lists through common task management software like Jira, and Trello.

An additional benefit to this style of tool relates to how we might expect change to occur within an organisation like a game development studio. While there are various different theories and analogies that describe how change might occur (Gera, 2012), monitoring the change is commonly highlighted as being important throughout. In their engage and learn model, Worley and Mohrman, (2014) describe monitoring of change as integral to the organisation's ability to detect error. In this case, a tool that inquired into key areas of importance around accessibility could help

enable an organisation to monitor the status of the change around their accessibility processes to help ensure that the change was in alignment with their desired goals. In this sense, the output of the reflexive checklist could be considered a tool which helps produce a key performance indicator of a studio's cultural change.

With this in mind, we sought to develop a checklist that could be used as a tool by game developers to help them reflect on their organisational strengths and weaknesses in relation to accessibility work. In this endeavour, we sought to translate the various key areas thought to be important to the successful development of accessible games into a checklist that would ask questions to developers about processes in relation to accessibility work. This aligns with the existing processes of games studios, which often use a variety of qualitative and quantitative measures as performance indicators for key areas of the business.

It is also important to emphasize how this connects with our action research process. If the purpose of our research cycle has been to help formulate action at towards enabling change towards making increasingly accessible games, then a means to reflect on and measure the movement of accessibility change can be a valuable tool for studios like Splash Damage. This could be applied in conjunction to making changes to areas of the business to help a studio understand whether the effects of their action are productive – effectively supporting further iterations of action research. This type of tool is critical in a game development environment where project lifecycles often span multiple years. During these lengthy project lifespans, it is essential that developers have tools to measure and monitor the success of what they are producing before it ships to consumers. As more and more developers push to make increasingly accessible games, it follows that this should extend to monitoring the health of accessibility at a studio as well. While we already have some of this insight from direct interviews with our industry partner, a wider tool that enables developers to both assess and reflect the components of a games business that are important towards making accessible games could help studios effectively initiate their own action research process.

6.2 Approach

In order to establish the components that would be covered by the checklist, we reviewed the research output from the two studies with game developers and the diary study with people with disabilities. Using the key themes and codes from these studies, we identified seven facets thought to be important to the accessibility output of a studio. We considered the codes that were related to discrete areas of the game development process in order to establish various specific components that were thought to be contributing factors. These codes were relabelled so that they

were directly aligned with the challenge as it relates to accessibility, and in some cases merged or split in that they each encapsulated a discrete area of the game development process. For instance, in our coding, two codes related to accessibility in competitor games titled 'how to do it', 'what can be done' were translated into 'awareness of competitor accessibility' and 'how to implement'.

These key areas, and their components, are detailed below alongside descriptions of how they manifested in our research. Note that within this table, the grounded theory work is referred to as the 'multiple developer study' and study focused on a single developer (Splash Damage) is labelled the 'single developer study'. This is to highlight whether item originated from a single studio or wider game development environments.

Table 7

The 27 components of the Game Accessibility Reflexive Checklist with references to their connections with our research. These references referrer to 'components' which correspond to the titles, themes and codes from our three studies.

Items	Components	Research
		Interviews from the second study with game developers highlighted developers use competitors as sources of knowledge, confidence, and motivation for accessible game development.
		Related Components
Knowledge	Awareness of Competitor Accessibility	Single Developer Study - Comparative Accessibility - Looking at competitor games is valuable & We look at competitor games often.
	Range of accessibility features	Both of our studies focused on game developers discuss the value of knowledge on a range of accessibility features and suggest this is an area that is often inconsistent and would benefit from improvement through techniques such as feedback from players with disabilities.
		Related Components

	Single Developer Study - Comparative Accessibility – Show's us what's possible, Keeps us up to date with modern features.
	Multiple Developer Study – Valuable but Limited Knowledge – Understanding options and features
How Disability Occurs in Games	Both studies that focused on game developers indicated that the range of ways that games can be disabling for players is an area of knowledge that is often missing or challenging among game developers.
	Related Components
	Single Developer Study – Narrow Understanding of player experience – Not sure how they experience games
	Multiple Developer Study – Valuable but Limited Knowledge – "A lack of lived experience" & Understanding options and features
Accessibility Mandates	Game developers in our studies indicate that accessibility mandates were a rationale for prioritisation when making accessible games.
	Related Components
	Multiple Developer Study – Organising Time Towards Accessibility – Scheduled In – The work doesn't happen unless it's scheduled.
	Multiple Developer Study – Target are Implicit – Goals make sure everyone is onboard, Contracts rarely provide accessibility requirements & Would be good if we had clearer goals.
Internal Availability	Interviews from both studies with game developers indicated that internal availability of information is valuable when completing their work. They spoke about accessing work on resources like Jira as well as the knowledge that other people

		who have a responsibility for accessibility work impart at the studio. Related Components Multiple Developer Study – Limited but Essential Organisational Investment – Has time and resources been allocated towards Game Accessibility? Single Developer Study – Growing Accessibility Knowledge – Gaining knowledge on accessibility
	How to Implement	A key area of knowledge from my interviews at a large-scale studio indicates that it was valuable to have knowledge on how to implement specific solutions. Related Components Single Developer Study – Comparative Accessibility – How we can do it – Technical breakdowns from other developers are valuable & Examples from inside other games show us how to implement.
Timescale	Early	In both studies focused on developers, they highlight the importance of engaging in accessibility work at early stages. Related Components Multiple Developer Study - Limited but Essential Organisational Investment – Are there processes for Accessible Design throughout Development? Single Developer Study – Organising Time Towards Accessibility – Early – Has to be very early in development & Hard to make changes later.
	Routine	In the second study focused on game developers study discussed the value of processes such as feedback but also described wanting more regular and routine feedback of this

		type. In the first study focused on developers, they discuss a lack of regular conversation around accessibility as a constraint.
		Related Components
		Multiple Developer Study - Limited but Essential Organisational Investment – Are there processes for Accessible Design throughout Development?
		Single Developer Study - Organising Time Towards Accessibility – Routine – It needs to be focused on more frequently & Important to always keep in mind.
	Enough Time	A common challenge described in both studies that involved game developers related to feeling as though they had enough time to engage with accessibility tasks. In some cases, developers described how accessibility work was being pushed into out of hours due to a lack of time allocation.
		Related Components
		Multiple Developer Study – Limited but Essential Organisational Investment – Has time and resources been allocated towards game accessibility?
		Single Developer Study - Clear Responsibility Needed – UI have to prioritise other work – We can't do it, we don't have the time to do it & Putting in extra time to do accessibility work.
Responsibility	Clear Responsibility	In both studies focused on developers, they described challenges related to the clarity of responsibility in work. One developer discussed how it was clearer for other disciplines, such as animation, as they always had a designated person that they could go to with issues related to that area, but this was lacking for accessibility.
		Related Components

		Multiple Developer Study – Limited but Essential Organisational Investment – Are there staff focused on Game Accessibility?
		Single Developer Study – Clear Responsibility Needed – Spearheading is important to get accessibility features prioritised.
	Access	In the study focused on a single development studio, (where their studio had someone with some responsibility towards accessibility) developers highlighted that it was important that they had access to the knowledge this person held on the subject. Typically, this was through the opportunity to speak to them and ask questions about accessibility.
		Related Components
		Multiple Developer Study – Limited but Essential Organisational Investment – Are there staff focused on Game Accessibility?
		Single Developer Study – Clear Responsibility Needed – Spearheading is important to get accessibility features prioritised.
	Spearhead	In both studies focused on game developers, they talked about the importance of having someone to take the responsibility for accessibility work. Developers in the study focused on a single studio, they explicitly called out the value in having people with this responsibility to spearhead the accessibility work forward.
		Related Components
		Multiple Developer Study – Limited but Essential Organisational Investment – Are there staff focused on Game Accessibility?
		Single Developer Study – Clear Responsibility Needed – Spearheading is important to get accessibility features prioritised.

Feedback	People with Disabilities	In both studies focused on game developers, highlighted the importance of getting feedback from people with disabilities on the game. Interviews with people with disabilities also highlighted that they wanted more opportunity to provide feedback to developers.
		Related Components
		Multiple Developer Study – Valued but Underutilised External Resources – Player experiences from players with disabilities.
		Single Developer Study – Desire for More Routine Feedback – We need more feedback, We don't get feedback very often & Design is hard without regular feedback.
		Single Developer Study – Talks appreciated – Experiences from people with disabilities are eye-opening.
		Diary Study with Players – Tolerating Misalignment to Continue Play – Advocacy – Wants to advocate for wider community & Research or development is important because it has scope to help.
	Range of Disabilities	Developers in the study focused on a single development studio discussed the importance of having feedback from a range of disabilities. Interviews with people with disabilities revealed that they often advocate for a wider range of people with disabilities, highlighting the significance of getting feedback from a wide range of people.
		Related Components
		Single Developer Study – Talks appreciated – Experiences from people with disabilities are eye-opening.
	Regular	Developers in the study focused on a single studio discussed how it was important that feedback from people with disabilities is regular. Interviews with people with disabilities

also highlighted how it was uncommon that they had the opportunity to provide feedback.

Related Components

Single Developer Study – Desire for More Routine Feedback – We don't get feedback very often & Design is hard without regular feedback.

	Developers in the study focused on a single development studio discussed how it was important for developers to be able to get feedback throughout the project lifecycle, rather than just at later stages. Related Components Single Developer Study – Desire for More Routine Feedback – We don't get feedback very often & Design is hard without regular feedback.
Throughout the Lifecycle	Single Developer Study – Organising Time Towards Accessibility – Routine – It needs to be focused on more frequently & Important to always keep in mind.
	Developers in the study focused on a single development studio discussed how it was valuable to see feedback from their accessibility work and see the impact of a game's accessibility features on the player experience. Interviews with people with disabilities highlighted the importance of impactful accessibility features, such as text to speech enabling someone without sight to navigate the games menus. Related Components Single Developer Study – Feedback is Critical – Helps to See Impact – Feedback helps us to understand the effect on the
Clear Impact	player experience

	Multiple Avenues	Developers in the study focused on a single development studio (where the studio received different types of accessibility feedback) talked about the value in having a variety of different feedback sources, such as first-hand conversations with people with disabilities and written reports. Related Components Single Developer Study – Talks Appreciated – Feedback from Experts helps us understand how to design for disabilities & Experiences of people with disabilities are eye opening.
	Helpful	Developers in both studies involving game developers discussed how feedback was helpful in enabling them to understand the experiences of people with disabilities. This item helps us understand whether developers feel that way about existing feedback they might be receiving. Related Components Multiple Developer Study – Valued but Underutilised External Resources – Player experiences from players with disabilities. Single Developer Study – Desire for More Routine Feedback – We need more feedback, We don't get feedback very often & Design is hard without regular feedback.
Goals	Clear	Developers in the second study described the value of having clear goals around accessibility work. Related Components Single Developer Study – Clear Goals Important – Goals make sure everyone is on board. Single Developer Study – Targets are Implicit – Would be good if we had clearer goals.
	Achievable	Developers in the study focused on a single development studio sometimes noted that it was important to have achievable

		goals for accessibility. This aligns with other research such as theories on flow, which supposed that people are likely more motivated in a task when it is sufficiently, but not overly, demanding.
		Related Components
		Single Developer Study – Clear Goals Important – Goals make sure everyone is on board.
		Developers in the study focused on a single development studio talked about the idea of working on accessibility tasks as potentially motivating, as it was different from their usual work and challenging.
		Related Components
	Challenging	Single Developer Study – Accessibility is Important – Design Challenge – A break in routine, Novel challenges & Enjoyable work.
		Developers in both studies involving game developers spoke about the significance of having accessibility work prioritised.
		Related Components
		Single Developer Study – Important to Prioritize – If it's not prioritised it doesn't happen
Priority	Prioritised	Single Developer Study – Important to Prioritise – Hard to prioritise against other work.
		Developers in the study focused on a single game development studio discussed how it was important for accessibility work to be weighted appropriately among other tasks. Sometimes challenges with accessibility tasks were said to be related to the work being seen as less important.
	Appropriate Weight	Related Components

		Single Developer Study – Important to Prioritise – Hard to prioritise against other work.
	Disproportionate Delay	Developers in the study focused on a single game development studio sometimes felt that work on accessibility features was disproportionately delayed and pushed back compared to other areas of the game. Related Components Single Developer Study – Important to Prioritise – Hard to prioritise against other work.
Future Accessibility	Process Visibility	Developers in the study focused on a single game development studio often found it difficult to point towards particular processes that were helping their studio make increasingly accessible games. Related Components Single Developer Study - Uncertain Optimistic Future – History of Improvement – A few years ago, I hadn't even heard of accessibility & You can see it's improved from our prior games.
	Output	Developers from both studies involving game developers generally felt that they were working towards better accessibility output over time. While this was often expressed by developers in both studies, this came through most clearly in our themes in the study focused on a specific studio. Developers with less knowledge of their studios approach towards accessibility would exhibit less confidence in the future of accessible games. Related Components Single Developer Study - Uncertain Optimistic Future – History of Improvement – I hadn't even heard of accessibility & You can see it's improved from our prior games.

	Single Developer Study - Uncertain Optimistic Future – Improvement of Specific Practices – We're doing these specific things, so it will improve as a result.

Reviewing our data we identified 7 key areas that were thought to be important to the making of accessible games, and these were translated down to a total of 27 components based on the complexity of each area – each of these was then translated into a checklist item to provide a tool that could be used by developers. Each item is framed as a statement to which developers could express their agreement with. These were accompanied by a segment for developers to reflect their agreement with the statement and an open text field for developers to express their thoughts on each component. We chose a three item Likert scale as a means to minimise the complexity of the checklist and help ensure that the checklist was easier to understand and complete in a short span of time. The opportunity for an open response enables in-depth insight to be provided if the developer wishes to provide more detail and helps supplement the narrow 3 item response options.

Table 8

Highlights components that were derived from codes relating to the theme of responsibility. This serves as an example from the full reflexive checklist, which can be found in Appendix 6a.

#	Area	Agree	Neither Agree or Disagree	Disagree	Examples and Comments
11	We have a clear designation of responsibility for accessibility tasks at the studio				
12	We have access to accessibility knowledge from accessibility experts within the studio				
13	We have staff who are responsible for driving for and monitoring accessibility work				

6.1.1 Developer Evaluations of the Checklist

In order to help ensure that this tool was aligned with the needs of game developers, stakeholders with positions of responsibility relating to accessibility were included in the evaluation and subsequent design of the tool. The checklist tool was sent to three game developers working in positions directly relevant to game accessibility – all three of these people reported working on accessibility tasks either their primary or a secondary responsibility. Developers were provided with information about the research and provided informed consent to provide feedback on the checklist. These developers were sent a copy of the checklist, which also includes an explanation of the checklists purpose (see appendix for full checklist).

After agreeing to take part, developers were provided with ample time to review the checklist. Developers were told they could use the checklist in whichever way they might like, such as filling it out themselves or with others. When the developers were ready, we scheduled a follow-up interview to collect feedback. These were informal feedback sessions, and the conversations were not audio recorded. Instead, the researcher made notes during the interview to capture key pieces of feedback. These conversations were designed with this informal nature so that developers could speak freely without having to worry about what they might say and how it might be quoted. This research was approved by the Universities ethics review process as an addition covered by the approval on study 3.

While informal, the researcher did bring a list of semi-structured interview questions that were asked to each developer. This was to ensure that the feedback was consistent and thorough across participants. Developers were also given time to speak openly on their thoughts on the checklist, so as to capture any feedback that might not have been captured by the semi-structured interview questions. A total of 9 questions were asked, each with follow-up questions that depended on the developers' response. Three examples from this list of questions are provided below:

Based on what you've read, what are your impressions of the checklist?

Can you see your studio using the reflexive checklist?

If so, how would you use it? If not, why not?

Is there anything that you would want to change about the checklist? What would you change?

When asked if there was anything that they felt missing from the checklist, this was also followed up by a specific probing question as to whether developers felt as though a question about technology and whether staff at the studio felt they were adequately supported by the studio's technology in their efforts to produce accessible games. Although this could be considered a leading question, this was motivated by the research from (Porter & Kientz, 2013) wherein they reported that developers felt that improvements to the technology such as engine level accessibility enhancements would assist in their efforts to make increasingly accessible games.

6.1.2 Feedback Results

From these conversations, there were several areas of valuable feedback that were identified. In this section, we will discuss each of these, followed by adjustments made to the checklist as a consequence. Overall, the feedback indicated that developers felt the checklist was valuable as a means of monitoring the status of accessibility processes in an organisation.

When providing their feedback, developers reflected that they felt as though the checklist would be valuable for their work process, and they could see the checklist being deployed within their organisation to useful effect. Developers specifically highlighted two areas in which they saw the checklist as being valuable.

1. Developers felt that the checklist would be valuable in assessing the current 'state' of accessibility at the studio that they were working at. Developers suggested that this could be valuable both across the studio broadly, but also to help them understand how the capacity for accessibility work might be experienced differently across different teams.
2. Developers felt that they could use the checklist to monitor changes in the accessibility processes at the studio, over time.

The checklist items appeared appropriate but would benefit from a section about technology. Developers also felt that the checklist items seemed comprehensive, based on their own personal understanding of important areas of process that contributed towards a studio's ability to make accessible games. However, when asked whether the checklist could benefit from a small series of questions about whether they were adequately supported by tech, developers felt that the survey would be enhanced with this question.

We also discussed a small group of checklist items that could potentially be removed from the checklist as they were likely to overlap other areas. Such as the question asking whether the accessibility feedback was 'helpful'.

The length of the checklist felt appropriate. When asking developers about the length of the checklist and whether they felt that it would be too long for developers to consistently respond to, developers reported feeling that it was just the right length. Developers reported that it would be difficult to cut many items away from the checklist without taking away things that were important and therefore losing detail in key areas.

However, one developer manually adapted the checklist to be used inside of their internal systems via email, and in doing so they also removed the majority of open text fields, substituting these with one open text field per section heading. When we discussed why this change was made, it was felt that it would be too lengthy to fill out if the checklist were deployed without supervision (e.g. in a digital survey format rather than one to one).

The checklist was easy to understand. Developers consistently felt that the checklist and checklist items were easy for them to understand. They appreciated the explanations that were included in the document and found that the checklist was easy to follow and determine how they would respond themselves.

6.2.4 Adjustments

Based on the feedback received from developers, we made the following changes to the checklist.

1. We added two questions aimed at monitoring whether developers felt supported by their technology in their efforts to make accessible games. This was driven by prior literature and supported by feedback from the developer sessions.
2. We removed two questions that were felt to overlap others.

6.2.5 Further Research and Application

In this chapter, we have documented our design of the Game Organisation Accessibility List (GOAL). This is designed as a tool that can be used to help game developers monitor key areas of their organisational accessibility processes as they seek to move to create increasingly accessible games. While the design of our checklist is rooted in our collection of data spanning both a range of game developers, and people with disabilities, establishing this design is just the first step in determining its value.

Application. It is also important to discuss how the checklist can be used by developers. We suggest that the checklist has three key points of value. First, it can enable a studio to identify the points of strength or weakness within their organization around accessibility work. Second, it can be used to help kick of the formulation of strategies to address these weaknesses - in many cases the solutions

are relatively implicit, for instance if a lack of feedback is observed, using user research or consultants to establish a feedback loop can be part of a plan to resolve this problem. However, how a particular studio achieves this will depend on their economic, geographical and cultural context. Third, the checklist can be used to monitor progress over time, with developers re-using the checklist to track movement of their accessibility efforts.

We suggest three potential approaches to applying the strategy within a studio:

- Using the checklist as focus points for a round-table style discussion. This might be conducted with an internal community (such as an Accessibility Advocates Network).
- Having key members of senior leadership fill out the checklist and provide their own expert assessment of the business that they take to developing a wider strategy.
- Deploying the checklist as an internal survey to gather the entire studios sentiment on accessibility across these different areas.

Any of these deployment strategies might be appropriate depending on the culture of the studio. For instance, deploying the entire checklist to a large-scale studio employing 500+ members of staff may be unnecessary, and perhaps forbidden by internal communications policies and in these instances, it may be more valuable to include specific members of a team within a series of discussions or deploying the checklist as a survey to. Meanwhile having senior leadership complete the checklist themselves can serve as a personally reflective process about the state of the business, making them aware of some of the ways that accessibility is struggling at a studio.

As discussed, an integral component of successful change management requires that the organisation is able to monitor and measure the change against its goals Worley & Mohrman (2014). To this end, we recommend that GOAL is used not just to make an initial observation, but to monitor the progress of accessibility initiatives over time. In order to understand the value of this tool, a thorough investigation of this needs to be undertaken within an applied setting. Ideally, this research would occur across a lengthy period of time so that the GOAL could be used to monitor change over time within a studio.

Within the context of our research process, this is an inevitable next step in the action research cycle. Action research describes a cyclic process of gathering and analysing data to produce further plans to orchestrate a desired outcome (Craig, 2009), and in this case the GOAL can be considered an output of this action research process. Which in turn, can spur further research, analysis, and action towards producing increasingly accessible, and ultimately better games. With this in mind, the next step would be to put this tool into the hands of people embedded into the

game development process and examine its value from the perspective of multiple embedded professionals and stakeholders in their respective studios.

In the context of our action research cycle where we are seeking to apply our research insight to encourage change towards making increasingly accessible games. This tool could be used directly at our partner studio to help them to monitor their studios movement in relation to accessibility culture and process, as they seek to implement various changes towards making increasingly accessible games.

7. Thesis Conclusions

To summarise, the work has been driven by simple core motivation; that accessible games are an essential matter of inclusion, and that people with disabilities should be able to participate in video game play alongside their peers. Subsequently, we sought to investigate the problem of game accessibility and with our review of the literature we established two key areas of concern. First, that there is still a wide array of inaccessible digital games, and that accessibility across the medium is inconsistent. Second, that insight into the experiences of developers making accessible games is extremely limited. Essentially there is a primary issue (inconsistent provision of accessible games) and relating to that, there is a secondary issue in the form of a lack of available knowledge on the personal and organisational processes involved in the development of increasingly accessible games. Therefore, it stands to reason that a better understanding of the development experiences can help us consider approaches to help support developers towards making more consistently accessible games.

As a result, our research was driven by two key goals. The first was to generate a better understanding of the experiences of game developers seeking to make increasingly accessible games, and the second was to understand and identify strategies that might help developers make increasingly accessible games. Based on this state of the literature, we initially sought to make a broad investigation of the experiences of game developers and their efforts to make increasingly accessible games, across a wide array of different studios. While there is some existing literature in this space, it was seen to be very limited, particularly due to the narrow scope of participants (Porter & Kientz, 2013). Our grounded theory study chose to take a wider pool of game developers from a variety of different development environments and examine their experiences of game accessibility. In doing so, our main finding was that successful game accessibility implementation was something that required a combined investment from the organisation, the inclusion of external resources such as knowledge from people with disabilities and the personal knowledge of individual game developers on game accessibility.

In terms of personal knowledge, we found that despite reporting a motivation to make increasingly accessible games, developers felt their understanding of game accessibility was very limited. This aligned with existing literature (Porter & Kientz, 2013) where they found that developers reported a tendency to focus on the low-hanging fruit of game accessibility. Developers particularly felt that they had limited knowledge of the lived experiences of people with disabilities and specifically how to design to accommodate them. This is significant because it means that any organisational efforts to make accessible games must not simply seek to provide time and resources

towards this task, but perhaps most significantly, help developers to build knowledge around solving these problems.

Specifically, organisational buy-in is the pathway through which valuable resources such as feedback sessions with players with disabilities can trickle down to the developers' knowledge. This very directly has the capacity to address some of the developer's key knowledge gaps around game accessibility but also is likely to be the most appropriate means in which developers can tackle more nuanced approaches to game accessibility. Specifically, Power et al (2018) argues that we need to go beyond merely accessible games and towards designing inclusive experiences, in relation to the challenges that game developers report they face. This further highlights the need for approaches that enable the developers themselves to understand the experiences of people with disabilities playing their games.

With the findings from our grounded theory in mind, provided there is organisational buy-in we should be able to leverage external resources (such as feedback sessions from people with disabilities) towards improving the knowledge of an individual developer. This, in turn, should be able to improve their ability to make increasingly accessible games. As a result of this position, we sought to investigate a means by which this knowledge from the experiences of people with disabilities could be fed into the game development process. This was planned as a two-part study, first exploring the experiences of people with disabilities, and then subsequently examining how that knowledge feeds into a real-world game development environment.

To this end, we partnered our research with a large-scale UK based studio and used diary methods to investigate the player experience surrounding one of their recently released titles. Instead of purely taking the form of an academic report, this work was also funnelled into the game development environment in the form of a number of formats that the studio would be familiar with, specifically user experience reports, and workshops. This work revealed both a variety of accessibility challenges that people with disabilities were experiencing when they sought to play the game and helped us develop a broader understanding of the play motivations and reasons for continued or ceasing play. Specifically, we found that players were motivated to play by the game's core design but faced more barriers to the intended play experience in the form of accessibility issues. We found that accessibility issues were experienced in a way that was very similar to usability issues (where the barrier did not result from an interaction with a particular impairment) and that both players with and without disabilities sought to be comfortable and enabled throughout their experience.

Another means in which this work supported the idea that people with and without disabilities experienced the game in a manner very similar to one another is how our findings overlap with common motivational models that are supposed to explain why people play. For instance, self-determination theory describes ongoing motivated engagement with an activity as requiring the development of a sense of competence, something which can be achieved through the delivery of optimal challenge (Ryan et al., 2006). It is easy to see within our own data, how a player who was faced with a disability would not be able or would have reduced ability to develop that sense of competence by playing the game. In this sense, we can explain the player experiences of people with disabilities as one of psychological need frustration (Ballou & Deterding, 2022), just as likely to be experienced by anyone where the design of an artefact and its demands, does not align with their level of ability.

In turn, our work emphasises the need for inclusive design in mainstream games (as opposed to bespoke, independent experiences) and supports a body of literature that indicates that people with disabilities are playing and want to play further mainstream games alongside their peers (Beeston et al., 2018). The research also illuminated the efforts that players would make to realign the experience with their ability when they did not feel enabled, and highlighted to developers how essential accessibility features and inclusive design are towards ensuring that people with disabilities are able to experience the game as intended, without barriers. This was also true of the idea of flexible challenge, where players would, from the outset, seek both ability and mood aligned levels of difficulty from the game.

Perhaps the most interesting finding of this research was this principle of misalignment and realignment. Both players with and without disabilities enter the experience with different levels of ability and although in different ways, expected that the game to be sufficiently flexible so that they are able to realign its demands with their ability. Where this was possible, players were able to play and engage with the game on an ongoing basis, but when this was not possible, players were often encountered barriers and were forced to either cease play, adapt or sacrifice areas of the experience to continue play. This reinforces the importance of the social model of disability (Oliver, 2013) as the lens with which we should design games through, wherein players are not inherently disabled but instead disabled by the game if it provides insufficient flexibility with which to align its demands to varying player ability. With this design approach in mind, we can avoid creating accessibility barriers, and more players will be able to engage with mainstream games, and reach a point where they are sufficiently comfortable, enabled and appropriately challenged, so that they are able to experience the game as intended and feel motivated to continue to play.

Following this diary study work, we sought to further investigate the experiences of game developers and the difficulties they experienced in making accessible games. This work had a major benefit that addressed one of the limitations of our first study and enabled us to gain an even greater understanding of the experiences that game developers had surrounded the development of increasingly accessible games. Specifically, having all developers in the study work in a shared environment enabled us to paint a richer picture of the specific organisational constraints and investigate the broader organisational challenges in more detail, as these were usually consistent between our participants. In addition to which, as this research was paired with our diary study work, the interviews offered an avenue with which we could investigate the impact of that form of accessibility knowledge being applied to a studio.

In addition to aligning with our previous work in study one, the investigation illuminated a vast array of specific factors that were important at the organisational level when seeking to make increasingly accessible games. These factors included features like having a clear responsibility for accessibility work at the studio, and the importance of being able to prioritise accessibility work alongside other tasks. In our research, some of these areas proved to be challenges at the studio which had cascading consequences that made it harder to make accessible games. For instance, developers reported that a lack of clear goals around accessibility made it more difficult to prioritise accessibility work alongside other tasks. In turn, this difficulty in prioritising accessibility tasks made it challenging to allocate time towards accessibility tasks and that made it less likely that they would be completed. In another example, developers felt that a lack of clear responsibility for accessibility and accessibility tasks meant that no one was present to spearhead those tasks forward, again this led to a more challenging prioritisation of those tasks and in turn had consequences on the studios' ability to deliver these accessibility features.

7.0.1 Reflections on the Social Model of Disabilities

Considering our findings within the context of the social model of disabilities (Oliver, 2013), our diary study particularly illuminates how that when games are not designed with a wide range of users in mind, they often disable people. This echoes the key idea of the social model of disabilities, which highlights how people with disabilities are not inherently disabled, and that their environment, and how it has been designed has the ability to disable them. Through this model, it is clear that that the responsibility lies with the developers and the organisations that develop games to provide experiences where players are enabled – and failure to do so has the capacity to disable players. As reflected in our diary study and previous work (Beeston et al., 2018), there are players

with a wide range of abilities that want to and actively are playing video games, and yet these players can be disabled by the design of the game.

However, what our work with developers also highlights is that this lack of accessible design is not typically the result of a lack of effort from individual developers, but a broader lack of organisational investment, establishment of process and designation of responsibility when it comes to making accessible games. Game developers as individuals often recognise that there is a social responsibility to produce accessible games, citing aspects like fairness alongside other motivations, yet highlight common barriers that are rooted in their organisation, its structure and organisation of the work. Our work therefore highlights that yes, the social model of disabilities provides a valuable lens and high-level explanation of the challenges that games face in seeking to be accessible, but our work also extends beyond this towards a deeper understanding of how the inner workings of how these game development studios, can contribute to the success, or lack of success of accessibility efforts based on various organisational factors. With this in mind, our GOAL tool offers one potential means to assist development organisations to identify their internal weaknesses around accessibility, monitor their progress, develop strategy to better support accessibility that is specific to their organisation and advance forward over time.

7.0.2 Reflections on Change Management Theory

Based on our research, our insight points more towards wider organisational theories of change management having more direct relevance to scenario that game developers face when seeking to make accessible games. For instance, Satir's (1991) model of change management suggests that individuals would generally go through a process of 'chaos' wherein developers might struggle with the change or put up resistance to the change. In our research this was not what we observed, instead the developers we spoke to generally felt that they needed more support from their organisation to achieve the changes required to make increasingly accessible games. It might be that the theories of change management that are more strongly applicable to individuals would be more relevant to the executives and leadership within organizations. While our research did feature some senior leadership only our grounded theory work included someone operating at the executive level. These challenges that Satir proposes relating to the 'chaos' introduced by a 'foreign element' might only need to feature in small number of members of senior leadership, within a very large organisation, in order to have an effect.

Instead, our research more strongly aligned with change management theory that describes broader organisational change. Senge's (1999) theory that proposed several common barriers to

change, including key challenges such as feeling as though they did not have gave enough time, or not having sufficient support to enact the change, were also observed in our work. Developers in both studies focused on developers often felt as though they did not have enough time, or enough support to make the changes required to make increasingly accessible games. While these theories of change management help us to understand that some of the challenges that game developers experience in seeking to make accessible games are possibly part of a natural and common process that organisations experience when going through change, our work also provides us with insight towards the specific types of support that developers feel that they lack, such as feedback from people with disabilities.

Common to many theories on change management is also the concept of using some degree of planning to establish how the change might be achieved. Kotter (1995) describes this as 'planning and creating short term wins' with this in mind, our GOAL can be seen as a tool that can help organisations reflect on their current processes and identify opportunities for improvement that could set a studio on a path to realising some of these short-term wins, and moving accessibility forward within their studio culture and improving the accessibility of the games that that culture produces.

7.1 Recommendations for Industry

Understanding these factors can help us understand how organisations might better approach the challenges of making accessible games. Based on this, we make several key recommendations to developers seeking to improve the accessibility and inclusive design of the games they're developing.

1. **Accessibility has a clear designation of responsibility at a studio**. While accessible design can be the responsibility of the studio as a whole, without people directly responsible for spearheading those tasks forward it can be challenging to prioritise accessibility features against other aspects of the game.
2. **The studio has clear high- and low-level goals for accessibility**, and that these are communicated widely throughout the studio. It helps developers to prioritise and allocate time towards accessibility features when the studio has clear goals that clarify the need for and importance of accessibility at the studio.
3. **There are multiple and frequent avenues for accessibility feedback.** Developers highlighted the importance of feedback from multiple sources, including experts and players with disabilities.

4. **That the studio is aware of accessibility in competitor games.** Developers discussed accessibility in competitor games (such as The Last of Us (2019)) as a major source of accessibility knowledge. It is important for developers to have the time and resources to keep up to date with the knowledge and technology being implemented towards accessibility in competitor games.

5. **That accessibility features are appropriately prioritised.** Accessibility features often see lower prioritisation against other features of the game, as they are seen as less important by people making decisions around prioritisation. Other aspects such as feedback, responsibility and goals should help make it easier to prioritise accessibility features.

6. **That time is being allocated appropriately to accessibility features.** Fundamentally, all development work committed to a game requires time, and therefore it is important that developers feel they have sufficient time to work towards improving the accessibility. Other areas of process (most directly, prioritisation) should have cascading consequences on the designation of time towards accessibility tasks.

7. **Consider using the GOAL checklist to better understand your organisations challenges, develop strategies and monitor your progress.** Each of these recommendations cover areas that the GOAL checklist (see chapter 6) is designed to help developers reflect upon. The GOAL has potential to be used to help studios identify their challenges and monitor their progress over time and based on our research into the challenges that developers face, using the GOAL to identify your studios challenges, and then taking action to address those challenges towards making accessible games, could be valuable in helping teams improve the efforts in this area over time.

While this knowledge is valuable, we also acknowledge that getting this insight into the hands of developers is a challenge. From our own research, developers cited various sources of knowledge and none of which included PhD thesis or academic publications. With this in mind, we sought to translate the insight from our research into a tool that could be educational and useful for game developers. This tool, the Game Organisational Accessibility List (GOAL) is a list of statements for developers to assess their agreement with, related to key areas of challenge that (based on our research) are seen to contribute to a studio's ability to make accessible games. The GOAL provides a means in which game developers can reflect on their own organisational processes surrounding game accessibility. By probing into each of the key areas thought to be of importance in designing accessible games, the GOAL has the capacity to spotlight organisational weaknesses and in

coordination with studio leadership can be used to develop an action plan for improving processes around accessibility, and in turn working towards improving the accessibility output at a studio.

Foremost, it was our original intention to better understand the experience of, and challenges associated with designing accessible games and to this end studies 1 and 3 which focused on interviewing game developers around these experiences, have helped us generate considerable insight in this area. The GOAL then takes that understanding and translates it to a format where it can be reflected back at game development studios. With this, it is our intent that the GOAL will enable us to transfer the insight generated from our research to other studios, and by helping other studios reflect on their own organisational processes, help game developers more broadly to make increasingly accessible games. Crucially, this aligns with our second research question focused on understanding the strategies that might be helpful in making accessible games, as the process of reflection on a studios organisational process around accessibility, is in itself a crucial strategy that should help studios identify their own weaknesses around accessible game development. With this insight, studios can begin to consider strategic changes to their own organisational processes that could help better enable them to develop accessible games.

7.2 Limitations

While this research has obvious value, it is also important to highlight key limitations. One such limitation is that the research insight from the GOAL is based predominantly on the experience of a single studio. Although our first study did explore the perspectives of a variety of game developers and this insight was synthesised with that of the single studio exploration to produce the checklist items in the GOAL, we have still only been able to explore a single studio's experience in this level of detail. This calls into question the transferability of our findings. Despite this, it is also important to highlight that as the GOAL is designed to encourage reflection rather than provide a prescriptive solution, it is our belief that other studios should be able to find value in using the GOAL, even if they have different strengths and weaknesses than other developers. The other risk is that as the GOAL's items were based on this specific exploration with a single studio, they could be under sensitive and, in effect, missing areas that might be important to making accessible games at other studios. We have taken steps to mitigate this risk by developing the GOAL questions in collaboration with developers from other studios with high-level insight into the studios' accessibility work, but further work is required to determine the value of the GOAL with a wider audience.

Another limitation of our research is that while our sampling has sought participants with diverse professional backgrounds, both studies featuring game developers were, on the whole,

lacking people in positions of senior leadership. Although the research did feature a diverse range of seniority, the research lacked participation from people in executive roles, such as CEOs, creative directors, and game directors. More research focusing on these key decision makers in the development process could have been especially valuable, but unfortunately people in these roles tend to be in very high demand and therefore, less willing to participate. Additionally, it is worth highlighting that our research did feature two participants in these types of roles, and therefore they were not entirely unrepresented. However, an investigation of the problems around accessible design purely from the perspective of the highest levels of seniority could be especially illuminating. This is particularly true as our research highlights the value of having buy in from the top down within a studio, with solutions to challenges such as unclear responsibility requiring strategies that would need to be greenlit by a studio's senior executives (such as hiring people to manage that responsibility or operating an accessibility championship scheme within a studio).

A further limitation of our research relates to the fact that through our action research cycle we have not been able to directly observe any effect on the studio's output. While we used a diary method with people with disabilities and observed how players were experiencing their recently released game, the timescale of a PhD thesis does not provide adequate opportunity to take further action on our insight from the studio and to examine its effect on their further commercially released games. This is always likely to be a challenge for this type of work as we are not conducting research within a controlled environment and therefore do not get to select the timing of organisational movement such as the release of a new video game title. Additionally, factors such as delays, and project shifts would make it impossible to schedule that kind of work into the span of a PhD project. Additionally, we were at no point directly embedded with the studio, which means that there is more potential for effects like social desirability biases to take hold as developers aim to present themselves or their studio within a positive light, in relation to accessibility. Ultimately, the final cycle of this thesis has only gone so far as to translate the insight from developers into strategy that can be applied at the studio. Further cycles of action research would be required to understand whether our approach has been successful in helping the studio make increasingly accessible games. A logical next step would be to seek to apply the GOAL checklist both as a means of measuring the health of accessibility at the studio over time, but also to direct initiatives towards process and cultural change while using the GOAL to measure the effects. If the GOAL is a valuable tool for game developers (which our research driven approach to identifying its components indicates that it should be) then the GOAL should be capable of identifying the challenges a studio is facing around accessibility at any given time. This would make the GOAL a valuable tool both for identifying challenging areas to take

action on, but also to help a studio monitor change across those areas of concern over time, to identify whether their action is having the intended effect.

At Splash Damage the next step should be to deploy the GOAL survey with a wider sample of staff and determine if it reflects the challenges identified in our previous smaller scale, interview driven approach. From there, the GOAL could be used to prioritise changes that need to occur at the studio while being applied recurrently to monitor the effect of these changes.

7.3 Further Research

Although the thesis has been effective in answering our key research question on understanding the experience and challenges associated with making accessible games, the insight generated has also illuminated many avenues of potentially fruitful further research. An obvious avenue would be to continue the action research cycle with our partnered studio and investigate whether the suggested strategic adjustments (to their processes and organisation of accessibility work) are effective in helping to facilitate the development of increasingly accessible games. One key challenge associated with this will be that any strategic changes around the organisation of accessibility work will inevitably not be the only change that occurs within a studio, and therefore it will be difficult to isolate the key catalyst of change. However, triangulation of data from multiple sources, such as the output of the game itself, interviews with people with disabilities playing the game and interviews with developers could paint a rich picture of the change occurring at the studio and help us understand whether the changes have been helpful to their ability to make increasingly accessible games. Together, this could compose a form of case study or example of how change might occur at a studio around their accessibility work, which would have ample transferable insight for studios facing similar challenges.

An additional avenue of further research would be to further explore the value of the GOAL. This could be a component of an additional cycle of the action research process as well as an investigation independent of that, with other game development studios. Critically, the aim of the GOAL is to help studios reflect on the facets of organisational processes that are important for game development, and help studios identify weaknesses that make it harder to make increasingly accessible games. Deploying the GOAL with other studios and then evaluating whether it helps them to achieve these ends may be important in establishing the value of the GOAL. While the development of the GOAL did involve interviews with key stakeholders in the accessibility output at several studios, our evaluation did not require that they put the GOAL into practice within their organisation. This more in-depth investigation could be a fruitful area of additional research that

helps our findings support a wider base of the game development community towards making increasingly accessible games.

Extending our investigation from a single organisational unit of study (specifically, a single developer) to multiple could also be a valuable avenue of research, as this might enable us to model the stages that studios are likely to pass through in their pursuit of increasingly accessible games. In his chapter on user research maturity, McAllister (2018) argues that maturity models help studios understand where they are at, and what they could improve within their organisation towards making better games. If this is a format that developers find useful and would help motivate developers to pursue greater accessibility, a similar model could be explored for game accessibility. Using the GOAL as a means to examine the different challenges experienced by studios at different potential stages of accessibility maturity, we could consider establishing a Game Accessibility Maturity model. The idea that this might motivate developers forward along the roadmap aligns with our own research, wherein developers reported that seeing the accessibility successes of other studios could be a motivator. In this regard, an accessibility maturity model that lays out the scope of organisational investment in accessibility, might also motivate developers forward.

7.4 Concluding Remarks

In following our research aims, we have effectively explored the challenges around developing accessible games. Studies 1 and 3 make notable contributions to literature in this area and our understanding of the experiences of game developers making games in the real world, this is significant due to the range of developers studied in study 1, and the in-depth opportunity that we were afforded by focusing on this issue with a specific large scale game developer in study 3. Study 2 served a key role in our action research cycle, helping to contextualise the findings of study 3 and provided key insight into the experiences of people with disabilities playing games. These contributions provide valuable foundational knowledge around the challenges developers are likely to face when seeking to make accessible games, and from this we can begin to explore strategies that enable these games to be made accessible, with increasing efficacy. With the GOAL, we have taken these first steps towards translating this insight into something valuable and applicable by game developers. Further research in this area should consider how accessible processes and cultural changes can be monitored, and the GOAL itself may be a valuable tool in this research pursuit.

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Appendix

Ethics
1.a

Physical Sciences Ethics Committee

UNIVERSITY
of York

Date: 28th April 2020

PSEC Application Ref: Kulik20200305

Dear Josef,

Thank you for your recent revised application to the Physical Sciences Ethics Committee for the project entitled "Making Accessible Games:Understanding the Experiences of Game Developers". I am pleased to inform you that the committee has reviewed your application and supporting documents and we approve the research to be conducted on the basis described on the application form.

Please note the committee must be informed of any amendments to the protocol and/or participant information/informed consent prior to the research taking place. Please follow the amendments procedures using the reference above in any correspondence concerning this project in the future.

It is also your responsibility to ensure continuing conformance to the University of York's ethical policy over the life-time of the project.

Yours Sincerely,

Angus M. Marshall

On behalf of the Physical Sciences Ethics Committee

1.b

Date: 7th December 2020

PSEC Application Ref: Kulik20201126

Dear Jozef,

Thank you for your recent application to the Physical Sciences Ethics Committee for the project entitled "A diary based investigation of the play experiences of people with disabilities", and your subsequent email clarifying the situation re use of audio recordings and transcripts. I am pleased to inform you that the committee has reviewed your application and supporting documents and we approve the research to be conducted on the basis described on the application form and in your clarifying email.

Please note the committee must be informed of any amendments to the protocol and/or participant information/informed consent prior to the research taking place. Please follow the amendments procedures using the reference above in any correspondence concerning this project in the future.

It is also your responsibility to ensure continuing conformance to the University of York's ethical policy over the life-time of the project.

Yours Sincerely,

Angus M. Marshall

On behalf of the Physical Sciences Ethics Committee

UNIVERSITY of York

Physical Sciences Ethics Committee

Date: 18/08/2022
To: Jozef Kulik
Subject: Ethics Approval
PSEC Application Ref: Kulik20220705

Dear Jozef,

Thank you for your recent application to the Physical Sciences Ethics Committee for the project titled "Game developer interview study". I am pleased to inform you that the committee has reviewed your application and supporting documents and we approve the research to be conducted on the basis described on the application form.

Please note the committee must be informed of any amendments to the protocol, participant information, or informed consent prior to the research taking place. Please follow the amendments procedures using the reference above in any correspondence concerning this project in the future.

It is also your responsibility to ensure continuing conformance to the University of York's ethical policy over the lifetime of the project.

Yours sincerely,

Dimitar Kazakov
PSEC Committee Member, Dept. Computer Science

On behalf of the Physical Sciences Ethics Committee

Consent

2a

Understanding Game Accessibility: Perspectives from Game Development
Informed Consent Form

Thank you very much for offering to take part in this on understanding how game developers make accessible games. The present study aims to gain an understanding of the experiences of game developers making accessible games.

Participation in this study involves a brief semi-structured interview where you will be asked questions about your range of game development experiences. This data will be used to develop a theory of how developers experience making accessible games.

Before you participate in interview please complete **Section A**.

Once the study is over and you have been debriefed, you will be asked to initial the three statements in **Section B**, to indicate your agreement.

Section A

1. I confirm that I have read and understood the information explaining this interview and the implications of taking part in it. I also confirm that I have had an opportunity to ask questions about it.

2. I understand that my participation is voluntary and that I am free to withdraw at any time without any negative consequences. In addition, if I do not wish to answer any questions, I am free to do so. I understand that if I withdraw after taking part in some or all of the interview, I may request that the information I provided be deleted but that I must do so within one week of the interview. If I do not make this request, my data will be used by the researchers.

3. I agree to the interview being audio recorded.

4. I also understand that my information is confidential and will remain anonymous. Only Jozef Kulik and their supervisors (Dr Paul Cairns and Jen Beeston) will have access to the information in its original format. I understand that I will not be identified or identifiable in any materials related to the research.

5. I understand that there are no known risks to participating in this interview.

6. I agree to take part in this research activity.

Signed:	Date:

Section B

Please initial each of the following statements when the activity has been completed and you have been debriefed.

I have been adequately debriefed   Your initials: _____

I was not forced to complete the activity   Your initials: _____

All my questions have been answered   Your initials: _____

Researcher statement

I …………………………………………...………………………………..... confirm that I have carefully explained the purpose of the interview, what their information is to be used for, who is involved in the research, what will happen to their information, and outlined any reasonably foreseeable risks or benefits (where applicable).

Signed:	Date:

Video Game Diary Study
Informed Consent Form

Thank you very much for offering to take part in this diary study focused on understanding more about the experiences of players with disabilities.

Participation in this study involves playing a video game for a month-long period, while filling our surveys about your experience. In order to participate in this study, you will also be required to participate in three interviews which regard your experiences with the game.

Before you participate in this study please ensure that you have read the information sheet for complete details of this study (provided separately).

Once you have read the information sheet, please read **Section A** on this form.

Once the study is over and you have been debriefed, you will be asked to initial the three statements in **Section B**, to indicate your agreement.

Section A

7. I confirm that I have read and understood the information explaining this study and the implications of taking part in it. I also confirm that I have had an opportunity to ask questions about it.

8. I understand that my participation is voluntary and that I am free to withdraw at any time without any negative consequences. In addition, if I do not wish to answer any questions, I am free to do so.

9. I understand that if I wish to withdraw my data I need to provide my unique participant code (provided by the researcher), and that I can withdraw my data from some or all of the interview or surveys. I may request that the information I provided be deleted but that I must do so within one week of the end of the study period.

10. I agree to the interviews being audio recorded and survey data being collected.

11. I also understand that my information is confidential and will remain anonymous. Only Jozef Kulik and their supervisors (Dr Paul Cairns and Jen Beeston) will have access to the information in its original format.

12. I understand that I will not be identified or identifiable in any materials related to the research.

13. I understand that there are no known risks to participating in this study.

14. I understand that the content of the game featured in this study is for mature audiences (18+), and that I am 18 years of age or older.

15. I agree to take part in this research activity.

Signed:	Date:

Section B

Please initial each of the following statements when the activity has been completed and you have been debriefed.

I have been adequately debriefed   Your initials: _____

I was not forced to complete the activity   Your initials: _____

All my questions have been answered   Your initials: _____

Researcher statement

I ……………………………………..…………………………….…….... confirm that I have carefully explained the purpose of the study, what their information is to be used for, who is involved in the research, what will happen to their information, and outlined any reasonably foreseeable risks or benefits (where applicable).

Signed:	Date:

Video Game Accessibility Study
Informed Consent Form

Thank you very much for offering to take part in this interview study focused on understanding more about about the experiences of making accessible games.

Participation in this study involves taking part in a 30-60 minute interview where you will be asked questions about your game development process and how where accessibility fits.

Before you participate in this study please ensure that you have read the information sheet for complete details of this study (provided separately).

Once you have read the information sheet, please read **Section A** on this form.

Once the study is over and you have been debriefed, you will be asked to initial the three statements in **Section B**, to indicate your agreement.

Section A

16. I confirm that I have read and understood the information explaining this study and the implications of taking part in it. I also confirm that I have had an opportunity to ask questions about it.

17. I understand that my participation is voluntary and that I am free to withdraw at any time without any negative consequences. In addition, if I do not wish to answer any questions, I am free to do so.

18. I understand that if I wish to withdraw my data I need to provide my unique participant code (provided by the researcher), and that I can withdraw my data from some or all of the interview or surveys. I may request that the information I provided be deleted but that I must do so within one week of the end of the study period.

19. I agree to the interviews being audio recorded and survey data being collected.

20. I also understand that my information is confidential and will remain anonymous. Only Jozef Kulik and their supervisors (Dr Paul Cairns and Jen Beeston) will have access to the information in its original format.

21. I understand that I will not be identified or identifiable in any materials related to the research.

22. I understand that there are no known risks to participating in this study.

23. I understand that the content of the game featured in this study is for mature audiences (18+), and that I am 18 years of age or older.

24. I agree to take part in this research activity.

Signed:	Date:

Section B

Please initial each of the following statements when the activity has been completed and you have been debriefed.

I have been adequately debriefed   Your initials: _____

I was not forced to complete the activity   Your initials: _____

All my questions have been answered   Your initials: _____

Researcher statement	
I ……………………………………….. confirm that I have carefully explained the purpose of the study, what their information is to be used for, who is involved in the research, what will happen to their information, and outlined any reasonably foreseeable risks or benefits (where applicable).	
Signed:	Date:

Accessibility Reflexive Checklist Interview Study
Informed Consent Form

Thank you very much for offering to take part in this interview focused on gathering feedback on the reflexivity checklist for organisational challenges in accessible game development.

Participation in this study involves taking part in a 30-60 minute interview where you will be asked questions in relation to accessibility work and your perspective on the reflexivity checklist (see other document).

Before you participate in this research please ensure that you have read the information sheet for complete details of this study (provided separately).

Once you have read the information sheet, please read **Section A** on this form.

Once the study is over and you have been debriefed, you will be asked to initial the three statements in **Section B**, to indicate your agreement.

Section A

25. I confirm that I have read and understood the information explaining this study and the implications of taking part in it. I also confirm that I have had an opportunity to ask questions about it.

26. I understand that my participation is voluntary and that I am free to withdraw at any time without any negative consequences. In addition, if I do not wish to answer any questions, I am free to do so.

27. I understand that if I wish to withdraw my data, I can withdraw my data from some or all of the interview. I may request that the information I provided be deleted but that I must do so within one week of the end of the study period.

28. I also understand that my information is confidential and will remain anonymous. Only Jozef Kulik and their supervisors (Dr Paul Cairns and Jen Beeston) will have access to the information in its original format.

29. I understand that I will not be identified or identifiable in any materials related to the research.

30. I understand that there are no known risks to participating in this study.

31. I understand that the content of the game featured in this study is for mature audiences (18+), and that I am 18 years of age or older.

32. I agree to take part in this research activity.

Signed:	Date:

Section B

Please initial each of the following statements when the activity has been completed and you have been debriefed.

I have been adequately debriefed   Your initials:

I was not forced to complete the activity   Your initials:

All my questions have been answered   Your initials:

Researcher statement

I …………………………………….................................…..... confirm that I have carefully explained the purpose of the study, what their information is to be used for, who is involved in the research, what will happen to their information, and outlined any reasonably foreseeable risks or benefits (where applicable).

Signed:	Date:

Surveys

3a

Game Accessibility Survey for Game Developers

Start of Block: Consent

Q1

Thank you for your interest in this study on game development and game accessibility

We are interested in your understanding and experiences in game development and with making accessible games. You will be asked to small number of demographic questions (e.g. age), followed by a number of questions on your experiences in game development and game accessibility.

Please be assured that your responses will anonymised and handled with care, in accordance with the University of York's Research Data Management Policy.

The study should take you around 15 minutes to complete. Your participation in this research is voluntary. You have the right to withdraw at any point during the study, for any reason, and without any prejudice. If you would like to contact the Principal Investigator in the study to discuss this research, please e-mail jk1315@york.ac.uk.

By participating in this study, you acknowledge that your participation in the study is voluntary, you are 18 years of age, and that you are aware that you may choose to terminate your participation in the study at any time and for any reason.

Q2 Please provide responses to the following statements:

	Yes (1)	No (2)
I agree that the research project named above has been explained to me to my satisfaction (1)	○	○
I understand that if I decide at any other time during the research that I no longer wish to participate in this project, I can notify the researchers involved and be withdrawn from it immediately (2)	○	○
I have read both the notes written above and the Information Sheet about the project, and understand what the research study involves (3)	○	○
I agree to take part in the study, which will include use of my personal data (4)	○	○

End of Block: Consent

Start of Block: Demographics

✳

Q3 Please enter **your age** (in years)

_____

✳

Q4 Please enter **your country** of residence

_____

Q5 Please indicate **which gender** you identify as

○ Male (1)

○ Female (2)

○ Non-binary (3)

○ Other (please specify) (4) _____

○ Prefer not to say (5)

✳

Q6 **How long have you been developing games?** Please describe your answer in terms of years / months.

_____

Q7 Have you ever been **formally employed in a game development** role?

○ Yes (1)

○ No (2)

Q8 Which labels best **describe your role in game development?** Please select as many that apply.

☐ Production (1)

☐ Marketing (2)

☐ Game Design (3)

☐ Art (4)

☐ Programming (5)

☐ Research (6)

☐ Analytics (7)

☐ Support (8)

☐ Administration (9)

☐ Other (please specify) (10)

_____

Q9 Where did you learn to develop games? Please select as many that apply.

☐   Self teaching (1)

☐   College / University (2)

☐   Online resources (3)

☐   Video tutorials (4)

☐   Text books (5)

☐   Workplace learning (6)

☐   Talks and conferences (7)

☐   Social media (8)

☐   Other (please specify) (9)

Q10 What does the term 'game accessibility' mean to you? Please explain your answer.

_____

Q11 Are there any particular features which are important to making an accessible game? Please explain your answer.

_____

Q12 Are there any difficulties associated with making an accessible game? Please explain your answer.

_____

Q13 At which stage in the games development do you consider game accessibility? Please explain your answer.

_____

Q14 Where did you learn about game accessibility? Please select as many that apply.

☐   Self teaching (1)

☐   College / University (2)

☐   Online resources (3)

☐   Video tutorials (4)

☐   Text books (5)

☐   Workplace learning (6)

☐   Talks and conferences (7)

☐   Social media (8)

☐   Other (please specify) (9)

End of Block: Block 3

3b

Gears of War Tactics Diary Study Screener

Start of Block: Consent

Thank you very much for your interest in taking part in this diary study focused on understanding more about the experiences of players with disabilities. Participation in this study involves playing a

video game for a month-long period, while filling our surveys about your experience. In order to participate in this study, you will also be required to participate in three interviews which regard your experiences with the game. Before you participate in this study please ensure that you have read the information sheet (provided in the email that this link was received).

1. I confirm that I have read and understood the information explaining this study and the implications of taking part in it. I also confirm that I have had an opportunity to ask questions about it.

2. I understand that my participation is voluntary and that I am free to withdraw at any time without any negative consequences. In addition, if I do not wish to answer any questions, I am free to do so.

3. I understand that if I wish to withdraw my data I need to provide my unique participant code (provided by the researcher), and that I can withdraw my data from some or all of the interview or surveys. I may request that the information I provided be deleted but that I must do so within one week of the end of the study period.

4. If selected I agree to the interviews being audio recorded and survey data being collected.

5. I also understand that my information is confidential and will remain anonymous. Only Jozef Kulik and their supervisors (Dr Paul Cairns and Jen Beeston) will have access to the information in its original format.

6. I understand that I will not be identified or identifiable in any materials related to the research.

7. I understand that there are no known risks to participating in this study. 8. I understand that the content of the game featured in this study is for mature audiences (18+), and that I am 18 years of age or older.

9. I agree to take part in this research activity.

By confirming and completing this form you agree that you consent to participate and for your data to be recorded. An additional consent form will be sent to participants selected to participate in the study.

Page Break

Q1 Please provide your email address (this will be the default means of contact for information about the research)

_____

Q2 What is your preferred method of contact for reminders and updates regarding the study?

○ Email (1)

○ Other (please specify) (2) _____

Q3 Please write your age

_____

Q4 Please specify your time zone (in GMT)

_____

Q5 Please indicate your gender

○ Male (1)

○ Female (2)

○ Non-binary (3)

○ Other (please specify) (4) _____

○ Prefer not to say (5)

Q6 On average, how frequently do you play video games per week?

○ Less than 5 hours per week (1)

○ Between 5 and 10 hours per week (2)

○ Between 10 and 20 hours per week (3)

○ Between 20 and 30 hours per week (4)

○ More than 30 hours per week (5)

Q7 Which video games have you played in the last month? Please list all that apply.

_____

Q9 Please indicate which genres of games you are interested in playing (tick all that apply):

☐ First person shooters (1)

☐ Action games (2)

☐ Role play games (3)

☐ Racing games (4)

☐ Strategy games (5)

☐ Platforming games (6)

☐ Simulation games (7)

Q10 Please select which (if any) of the Gears of War games you have played

☐ Gears of War 1 (1)

☐ Gears of War 2 (2)

☐ Gears of War 3 (3)

☐ Gears of War Judgement (4)

☐ Gears Pop (5)

☐ Gears of War 4 (6)

☐ Gears of War 5 (7)

☐ Gears of War Tactics (8)

Q11 Do you identify as having a form of disability?

○ Yes (1)

○ No (2)

Q12 If you selected yes, please specify the nature of this disability or disabilities

_____

Information Thank you for completing this screening survey! You will be contacted by the researcher to let you know if you have been selected to participate in this study.

If you have any questions, feel free to email jk1315@york.ac.uk.

Interview Questions

4a

Game Developer Study Questions

Note that the interviews are intended to be semi-structured and partially open ended, not all of these questions will necessarily be asked within every interview, and the phrasing may be different each time. Additionally, participants may be asked specific follow up questions depending on how they respond to questions in the interview.

1. Can you tell me about your role in game development?
2. Have you heard of the term game accessibility before?

    a. What does it mean to you?
    b. What makes a game more or less accessible?
    c. Who are those options for?
    d. People with disabilities?

3. How do you make a game more accessible?
    a. Are there any difficulties?
    b. Can these be overcome?
    c. What are the experiences of making accessible games at your studio?
    d. How do you gain the knowledge?

4. Does the studio you work with make it easier, or harder to make accessible games?
    a. How so?
    b. Is it different to working on independent projects?
5. Whose responsibility is it to think about game accessibility?
    a. If you have an accessibility concern or idea in your studio, what do you do?
6. How does thinking about accessibility fit into the game design process?
    a. Specific processes?
    b. When?
7. Is there anything you might want to add?

Diary Study Ethics Additional Material

Digital Diary Entry Form

Player ID

[*Players input their unique ID code here so that their diary entries can be tied together*]

How long did you play in today's gameplay session?

[*Answer in hours*]

Briefly describe what you did in this gameplay session

[Free text entry]

Please rate your experience in this session

I found the gameplay session frustrating

I enjoyed playing the game in this session

I found the gameplay session too difficult

The game felt fair in this session

I felt that there were elements of the session which were confusing

[Strongly agree – Agree – neither agree nor disagree – disagree – Strongly disagree]

If there is any detail about your experience you would like to include, please add this here. These surveys will be used to formulate discussion points for the interviews.

[*Free text entry*]

Follow-up Interview Example Questions

Can you tell me about your overall experience of the game?

Was there anything in the game that you didn't like? Can you tell me about that?

Was there anything in the game that you particularly enjoyed? Can you tell me about that?

Were there any areas of the game you found especially difficult, why was that?

Were there any features in the game that were especially helpful?

You mentioned in X (e.g. one of your early diary entries) that you had difficulties with X (e.g. moving units around during missions), can you tell me more about that?

Is there anything about your experience with the game that you wanted to say that you didn't feel fit into the diary entries?

Follow-up Research Design Questions

So now that we've spoken about the game, I just want to get feedback from you about what it was like to participate in this study as a whole.

This could be anything to do with either the interviews, surveys, or your experience with the game itself.

Was there anything that you didn't like about participating in the study?

    Interviews

    Survey

    Game and setup

Was there anything that you liked about participating in the study?

    Interviews

    Survey

    Game and setup

Was there anything that you thought that we should have done differently?

    Interviews

Survey

Game and setup

4c

Questions

Can you tell me what your role is at Splash Damage?

And how long have you been in this role at Splash?

How long have you been in the industry? Were you always in the same role?

These questions establish context for the interview and subsequent questions.

And in the context of game development, what does accessibility mean to you?

This establishes the developers high-level understanding of what accessibility means. It helps us ensure that we're on the same page in conversation.

Can you just tell me a little bit about the *type* **of work you've been doing over the past year?**

Here I want to understand what type of work they've been working on, and if any of that would naturally (or not) relate to accessibility work. For instance if they tell me their project has been held up and they've been doing nothing for 6 months because they've been pushed around different projects, then that might affect how significantly I probe with follow up questions about that work (e.g. asking about the different roles they've had during each of those and whether each was tied to any accessibility work.

Has any of that work involved or related to accessibility?

In what way?

Why is that?

Is it important to make games more accessible?

What makes you feel that it's important?

Here I am wanting to get at the developers motivations for wanting to make accessible games.

Are there any challenges to making games accessible when working at Splash?

What are they?

Is there anything that helps overcome those challenges?

What are they?

With these two sets of questions *I'm wanting to get an understanding of what they see the big challenges to making accessible games, this will help me understand whether the direction my research has taken is helping to address one of the areas of concern at the studio.*

We talked a lot about more organisational/personal aspects there, what about things that might relate to your wider organisation/your personal ability?

Do you see future titles at Splash being more or less accessible than your previous titles?

Why is that?

Do you ever get any feedback from people with disabilities who play your games?

What are your thoughts on that type of feedback?

Does that affect how your work in any way?

Here I'm probing a little more deeper into how the player experience might help developers make accessible games, and seeking to understand whether the developers see value in that. It's possible that the Gears of War Tactics report is mentioned here organically.

4d

In what way does your work relate to accessibility?

Have you had the opportunity to have a look at the reflexive checklist?

We can go through it together if not.

Based on what you've read, what are your impressions of the checklist?

Is there anything on the checklist that you found to be unclear or confusing?

If so, which? Why did you find this confusing?

Could you see yourself or your studio using the reflexive checklist?

How would you use it? Would you make any changes to the checklist when using it?

If not, why not?

Are there any items in the checklist that you felt had more or less value than the others?

Was there anything that you felt was missing from the checklist?

Is there anything that you would want to change about the checklist?

What would that be? Could you describe it?

Tech question?

How did you feel about the length of the checklist?

Is there anything about the checklist that we haven't discussed, that you'd like to talk about?

Any additional limitations?

Codebooks

5a

Grounded Theory

Theme	Subthemes	Codes
We Want to Make Accessible Games	Motivation	Want to make games more open to players
		"Really it's the fairness"
	Knowledge	"A lack of lived experience"
		Understanding options and features
Limited but Essential Organisational Investment		Are there processes for Accessible Design throughout Development?
		Are there staff focused on Game Accessibility?
		Has time and resources been allocated towards Game Accessibility?
Valuable But Underutilised External Resources		Knowledge from experts (lectures, online resources)
		Player experiences from players with disabilities
		Legislation Mandating Accessible Design
Barriers to Accessible Design		Not enough time/money to focus on GA
		Lack of development tools that help
		Unclear pathway to speak about accessibility
		Not thinking about accessibility as a studio
		Worries that accessibility will disrupt the design intent
		Limited understanding of accessibility and options

Diary Study with Players

Theme	Subthemes	Codes
Managing Comfort	Desire to be comfortable	Want to be comfortable during play
		Making adjustments to get more comfortable
	Trading comfort for function	Sometimes have to trade comfort for functionality
		Prioritising comfort where possible
Seeking Enablement	Being able to understand the game	Unhappy with unresolved confusion or lack of understanding
		Appreciates when things are clear
	Being able to perform the actions as desired	Familiarity is a big factor in understanding
		Undesired difficulty performing actions in the game
		Issues might be related to disability or not
Flexible Challenge	Aligned with ability	Doesn't want to be out of depth of overwhelmed
		Wants moderate difficulty, not too high or too low
		Difficulty can exacerbate accessibility and usability issues
	Aligned with Mood	Not in the mood for high challenge
		Plays to relax
Able to Focus on and Appreciate Design	Appreciate connection with the game	Connected or immersed into the story
		Wants to see what happens next
	Appreciates Planning and uncertainty	Appreciates being able to plan and strategise in the game
		Enjoys a degree of uncertainty
Realigning with Ability or Expectation	Seeking Accommodation	Making adjustments to enable
		Want adjustments that are not present
		Appreciates accommodation by design
		Accommodations not always successful
	Making Adaptation	Making cognitive, physical, sensory adaptation
		Adapting through practice and learning over time
Tolerating Misalignment to Continue Play	Advocacy	Knows someone that needs a feature to play
		Wants to advocate for wider community
		Research or development is important because it has scope to help
	Compensation by other facets of the game	Likes the game overall despite issues

Appreciates particular areas of the game which act as drivers to continue

Expects things will get better with time or practice

Splash Damage Study

Theme	Subthemes	Codes
Accessibility is Important	Equal Experiences	Ability to appreciate equally
		Everyone should be able to experience it
	Belief in Business Case	More money from more players
		Live services depend on player engagement
	Competition with Other Studios	Desire to Match or Exceed Competitors
		Competition is Motivating
	Design Challenge	A break in routine
		Novel challenges
		Enjoyable Work
	Better for Everyone	Not just about disability
		Options make experience better for all
Comparative Accessibility		Looking at competitor games is valuable
		We look at competitors often
	What we can do	Show's us what's possible
		Keeps us up to date with modern features
	How we can do it	Technical breakdowns from other devs are valuable
		Examples from inside other games show how to implement
	Confidence we can do it	Proves it can be done
		No reason we can't do it in comparison
Growing Accessibility Knowledge		Gaining knowledge on accessibility
	Wide awareness of features	Features that help people with different types of disabilities
		Understanding the value of flexibility
		Different features for different age groups
	Narrow understanding of lived experience of disability	Uncertain about Audience for Accessibility
		Not sure how they experience games
		Need more Training
Organising Time Towards Accessibility	Early	Has to be very early in development

		Hard to make changes later
	Scheduled In	The work doesn't happen unless its scheduled
		A lack of scheduling makes me uncertain it will happen
	Routine	It needs to be focused on more frequently
		Important to always keep in mind
Important to Prioritise		If it's not prioritised it doesn't happen
	Cost vs Benefit Analysis	If it's not valued it doesn't get prioritised
		The cost and budget of the studio needs to be factored.
	Challenging Prioritisation Against Other Work	Accessibility features go through same process as other work
		Hard to prioritise against more important features
Feedback is Critical	Feedback from Staff	Issues staff experience are prioritised
		Staff experience issues with motion sickness
	Helps to See Impact	Feedback helps us to understand the effect on the player experience
		Feedback helps us understand our players
	Desire for More Routine Feedback	We need more feedback
		We don't get feedback very often
		Design is hard without regular feedback
	Talks Appreciated	Feedback from experts helps us understand how to design for disabilities
		Experiences of people with disabilities are eyeopening
Clear Goals Important		Goals make sure everyone is onboard.
	Targets are Implicit	It's just 'good sense' that we will do it.
		Would be good if we had clearer goals.
		Contracts rarely provide accessibility requirements
	Legislation Determines Goals	Legislation used as targets
		Legislation makes certain people listen
Clear Responsibility Needed		Spearheading is important to get accessibility features prioritised.
	UI Teams Responsibility	The UI team are interested in accessibility
		The UI team provide a lot of accessibility support
		Their work relates to accessibility
	UI have other work to prioritise	We can't do it, we don't have the time to do it
		Putting in extra time to do accessibility work

	Buy in from leadership	Great sign when leadership are interested in accessibility
		Spearheading from leadership is important
Uncertain Optimistic Future		
		Optimistic about improvement overall
	History of Improvement	A few years ago, I hadn't even heard of accessibility
		You can see it's improved from our prior games
	Improvement of Specific Practices	These talks prove that people care about accessibility
		We're doing these specific things, so it will improve as a result

Reflective Checklist for Accessible Game Development Practices

About the Checklist

This reflective checklist is a tool that is designed to help teams, leads, managers and accessibility leads reflect on the state of the game accessibility processes at the studio. The checklist items have been generated through considerable research that has focused on understanding the challenges and facilitators of accessible game development. By interviewing a range of different developers involved in game accessibility work we have identified various factors that appear significant in determining a studios ability to make accessible games. This tool is designed as a lens on these factors, so that developers can reflect and identify areas of improvement that might require further attention within a studio in order to push towards making increasingly accessible games.

Using this Tool

As the tool is designed to provide insight on how groups and teams are considering accessible design, this tool should be applied when thinking about the team as a whole. This might be considered as part of a group discussion with the team or performed by someone in a leadership role that is likely to have an estimation of the strengths and weaknesses within each area.

It is the intention that this tool then serves as a form of 'health check', to approximate areas of success and concern within a team. This can be used to identify areas that might require intervention, and for on-going monitoring of the effectiveness of accessibility processes over a period of time.

Note that this tool is not fit for quantitative comparison of the success of accessibility work between teams or studios. While this may be used to identify key risk areas within a particular team, context dependent differences between teams may see items interpreted differently. This tool can help to answer questions such as 'where does this team feel we are successful and where can we help them further?' and 'do our teams feel they receive enough accessibility feedback to make appropriate design decisions?' but not 'which team is the least successful in their accessibility work?'.

Further Information

This tool was developed by Jozef Kulik, PhD Researcher on Game Accessibility at the University of York, supervised by Paul Cairns and Jen Beeston. If you have any questions or concerns you can direct these to joe.kulik@york.ac.uk.

Knowledge

Knowledge relates to the team's understanding of different accessibility features and the range of disability that players experience. The what, why and how of accessibility.

#	Area	Agree	Unsure	Disagree	Examples and Comments
1	We have good awareness of the accessibility features offered in our competitor games.				
2	We have good awareness of the range of accessibility features that could be implemented into our game.				
3	We have had good awareness of the different types of disabilities that are experienced by players.				
4	We have good awareness of different accessibility mandates such as the CVAA legislation and what that means for features in our game.				
5	We have good access to internal knowledge on accessibility shared between departments.				
6	We have a good understanding of the technical details on how to implement key accessibility features.				

Timescale

Timescale relates to the designation of time related to accessibility tasks. Whether accessibility is being planned for early, routinely and sufficiently. Without this accessibility tasks can fall by the wayside and as projects move forward it can be difficult to make even simple adjustments.

#	Area	Agree	Unsure	Disagree	Examples and Comments
7	We begin accessibility work at early stages in the development lifecycle of a project				
8	We have regular opportunities to discuss and engage with accessibility work				
9	We have sufficient time allocated towards the accessibility work				
10	The accessibility work is scheduled in appropriately				

Responsibility

Responsibility relates to the designation of responsibility for accessibility at the studio. A clear responsibility for accessibility can help ensure that accessibility work is not competing with another discipline and is appropriately spearheaded forward.

#	Area	Agree	Unsure	Disagree	Examples and Comments
11	We have a clear designation of responsibility for accessibility tasks at the studio				

12	We have access to accessibility knowledge from accessibility experts within the studio				
13	We have staff who are responsible for driving for and monitoring accessibility work				

Feedback

Feedback is pivotal to player centred design and understanding as well as iterating on the designed experiences in order to push towards making better and more accessible games. The value of feedback depends on features such as the diversity of disabilities feedback is collected from and whether the feedback is provided at a time point in the development lifecycle where it is useful.

#	Area	Agree	Unsure	Disagree	Examples and Comments
14	We receive feedback from people with disabilities on our projects				
15	We receive feedback from a people with a range of disabilities				
16	We receive feedback regularly throughout the development lifecycle				
17	We receive feedback at appropriate times to help us make more accessible games				
18	We can see a clear impact that the feedback				

	has on our work				
19	We receive feedback from multiple avenues (e.g. playtesters, consultants, experts)				
20	Feedback is successfully applied to help us make more accessible games				

Goals

Goals help developers focus towards the same objectives and prioritise accessibility tasks. Effective goals need to be clear and achievable but also challenging enough that they push things forward for accessibility.

#	Area	Agree	Unsure	Disagree	Examples and Comments
21	We have clear and specific accessibility goals for our project				
22	We have achievable goals for accessibility on our project				
23	We have accessibility goals that push our accessibility forward and encourage us to improve				

Priority

Prioritising accessibility work is essential in order to ensure that the necessary resources are allocated to achieve the accessibility goals. It is important that accessibility work is appropriately prioritised against other features, and not persistently and disproportionately disrupted.

#	Area	Agree	Unsure	Disagree	Examples and Comments
24	Accessibility tasks are prioritised within the team				
25	Accessibility tasks are given appropriate weight against other features				
26	Accessibility tasks are not disproportionately delayed or disrupted compared to other features				

Future Accessibility

This future accessibility segment is designed to capture a higher-level sense for whether developers feel that accessibility is improving in the studio. It is important that developers not only feel that accessibility will improve, but they feel that processes related to that work are improving too.

#	Area	Agree	Unsure	Disagree	Examples and Comments
27	Accessibility processes are improving at the studio				
28	Our future titles will be more accessible than those released in the past				