

# Towards Greater Inclusion and Accessibility for Physically Disabled Players in Location-Based Games

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Most research on Location-Based Games (LBGs) has been conducted on non-disabled players, meaning the experiences of disabled players are not well understood and potentially overlooked. As such, this research aimed to address the following questions: 1) What are the barriers and needs of disabled LBGs players? 2) How can LBGs be made more inclusive and accessible? To address these questions, two studies were conducted in the form of an online qualitative questionnaire and a series of co-design workshops. Results articulate the needs, barriers, and desired features of 60 participants. Based on our findings and through the collaborative work with disabled players we articulate 4 guidelines for game designers and developers aimed at improving the accessibility of LBGs: 1) Adding avatar features that better represent disabled characteristics, 2) Providing different input options for phone interactions, 3) Allowing for disabled specific accounts and 4) Introducing a messenger feature to LBGs.

CCS Concepts: • **Human-centred Computing** → **Accessibility**; *Accessibility technologies*

**KEYWORDS:** Location-Based Games, Pokémon Go, Disability Inclusion, Qualitative Studies

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## 1 INTRODUCTION

Digital games are now ubiquitous with an estimated total of 2.6 billion users spanning a variety of different demographics, including older adults and individuals with mobility issues [18, 33]. This extensive audience has resulted in researchers exploring digital gaming's impact on both user behavior and well-being [19]. One type of digital game that has received particular attention is Location Based Games (LBGs), such as Pokémon Go [29], Jurassic World Alive [25], and Harry Potter: Wizards Unite (HPWU) [28] [5]. This genre of gaming utilises mapping technologies (e.g., Global Positioning System – GPS) in tandem with mobile devices (smartphones and tablets) to allow users to digitally interact with their physical environment by showing them their location relative to their surroundings via a screen [40]. As such, these games require users to move between different locations to complete challenges and goals set within them.

The three key pillars on which these games are built (exercise, exploration and social engagement) [1] have resulted in positive outcomes for users of LBGs. For instance, Wang and Skjervold [39] surveyed 2191 Pokémon Go players and found that usage of the game was significantly associated with health and social benefits including weight loss, improved stamina, reduced stress and increased interactions with peers. They reported that this was a result of the game encouraging users to go outside in their quest to catch elusive Pokémon.

Despite the positive potential of LBGs, limited research has been conducted on disabled users', even though over 20% of video game players identify as disabled [38]. This highlights that there is little awareness concerning the needs, barriers and motivations of disabled users.

Recently, the COVID-19 pandemic saw disabled LBGs' players voice their delight as long-awaited changes were made due to lockdown restrictions [14, 22]. For instance, the walking distance necessary for eggs used to hatch rare Pokémon was halved. However, as lockdown restrictions have globally eased and people are now allowed to interact with one another in co-located spaces, games such as Pokémon Go have decided to revert to game rules that existed before the pandemic [13]. Unsurprisingly, disabled users of LBGs have shared their frustrations with these changes and together with other players have threatened to stop playing these games entirely, because of their inaccessibility [35]. Following the backlash, Niantic decided to reinstate some of the changes in question.

Levy et al. [24] argue that having to wait for users of LBGs to highlight a lack of inclusivity before changes are made suggests that accessibility within game design is an afterthought. As an alternative, Cairns et al [10] propose that, if inclusive design is implemented both during and after the production of a digital game, disabled users would not be marginalised. In this paper, we investigate the experiences of individuals who identify as having mobility issues when playing the popular LBG, Pokémon Go. For ease of understanding, throughout this paper, we use the term disability or disabled to refer to individuals with mobility-related disabilities.

Our research questions are as follows:

1. What are the barriers and needs of disabled players in playing LBGs such as Pokémon Go and what are their motivations for playing these games?
2. How can LBGs such as Pokémon Go be made more inclusive and accessible for people with mobility-related disabilities?

To address these questions, we conducted a qualitative survey with 60 participants, who identified as disabled, to gain a better understanding of their motivations and the challenges they experience while playing LBGs. Findings from Study 1 were then used to conduct two co-design workshops featuring 6 disabled LBG users focusing on redesigning inaccessible or problematic features of LBGs.

This paper makes three main contributions: (1) in-depth insights specifically of the experiences of mobility impaired Pokémon Go players, (2) requirements of mobility impaired LBG players from the game summarised through two different personas, and (3) a set of design implications for extending inclusion across LBGs.

## 2 LITERATURE REVIEW

### 2.1 Location-Based Games

Location Based Games (LBGs) emerged from the increasing use of geospatial and mobile technologies which afforded individuals the opportunity to engage in gaming on the move [2]. An early example of an LBG is Pac-Manhattan, a large-scale urban game utilising the street grid of New York City to recreate the 1980s video game sensation Pacman [31]. Ahlqvist [2] has identified five key dimensions which characterise LBGs: Location (i.e., how

much the real-world location of the player determines the game system dynamics), Spatial expansion (i.e., the game environment is larger than traditional game locations such as a rugby pitch or a Monopoly Board), Temporal Expansion (i.e., how time functions within an LBG – it can be kept the same, sped up or slowed down, so a day in real life may equate to five within a game), Representation (i.e., how LBGs digitally represent real space and time often building on cartographic maps by overlaying a digital world with different items and waypoints), and Pervasiveness (i.e., how effectively the LBG immerses the user within its game world).

The most successful LBG that can be characterized using these [2] five dimensions is Pokémon Go, a game that was regarded as a social phenomenon when released in 2016 and which continues to be played today [4]. In this augmented reality (AR) mobile game, players explore their real-world surroundings with the aim of catching Pokémon (i.e., many types of virtual monsters). Caught Pokémon become part of the players' collection. Eventually, collected Pokémon can evolve into more powerful forms, and players can use their collected Pokémon to compete with others. Pokémon Go encourages exploration and gameplay (such as collections of Pokémon and other items) in real-world locations known as PokéStops and Gyms which are located at pre-defined landmarks [23]. Sometimes users need to team up with other players to attempt to defeat and catch rare Pokémon. These attempts are called raids and take place at core sites referred to as Gyms, enabling social interaction within Pokémon Go [27]. The game's capacity to facilitate social interaction has been attributed to this feature [12, 30]. For example, having surveyed predominantly non-disabled players on their motivation for gameplay, Evans et al. [12] found that users were motivated by friendship maintenance and relationship initiation.

Similar to other digital games, LBGs leverage digital avatars to represent players in-game. Studies have consistently shown that individuals tend to create digital avatars that reflect important aspects of their perceived identity [20, 36]. Depending on individual preferences, this might result in users choosing not to disclose their disability in the digital world [7]. Ultimately, having the option available gives disabled users the agency to decide their desired representation. Regardless of disability identity, users of Pokémon Go regarded the current features offered by the game's avatar to be stereotypical of the average person and felt limited in their ability to represent their identity. [21]

## 2.2 LBGS, Movement-Based Games and Disability

Despite numerous papers on mainstream LBGs and mobility, understanding disabled users' experiences when playing these games has received limited attention. This may be indicative of ableist assumptions such as believing that individuals with mobility issues have no interest in mainstream LBGs or that their needs do not differ from non-disabled users. However, social media sites have a plethora of active forums and groups (e.g. Reddit and Facebook) where individuals with mobility issues routinely share their experiences of Pokémon Go [32]. Furthermore, recent research has shown that disabled users actively engage in video games, such as LBGs and use a variety of assistive technologies such as key remapping and subtitles [3].

Seaborn et al and Eadey et al [11, 34] agree that studies in mixed reality have focused on the "ideal" average user which has excluded the rich diversity of real human populations such as those who are physically disabled. As such, they developed a social, mobile mixed reality capture-the-flag (CTF) game for adults who use powered chairs. Through observational

studies and self-report data, they found that participants indicated a high level of engagement with the game and found it to be both social and accessible. Furthermore, participants craved a more challenging gaming experience than the one provided such as having a gaming space that contains pylons, shrubbery, and other physical landscape features that may impede data shown on the mobile devices. This research suggests that LBGs are desired by those with physical disabilities as their challenges often require users to navigate physically challenging environments to receive in game rewards such as lucrative Pokémon in Pokémon Go.

Although the research by Seaborn et al and Eadey et al [11, 34] was conducted in an artificial gaming environment which could have impacted participants' experiences, the more recent work of Graf et al. [17] implemented within a traditional sport setting, yielded similar results. Using an interactive floor projection system, iGYM, they found that people with mobility disabilities were able to compete on par with and in the same physical environment as their peers without disabilities. This begs the question of whether current LBGs, as they currently stand, enable users with mobility issues to play the games on the same level as users without disabilities and, if they do not, then work is needed to be done to create a more equal playing field.

The work by Gerling et al. [15, 26] shows that being able to share playing experiences with others is also essential to facilitate physical activity and to make gaming experiences more enjoyable for wheelchair users. This is extremely relevant in the wake of the COVID-19 pandemic as many LBG players who previously played enjoyed mixed reality games with their friends in public were suddenly forced to play these games from the safety of their own homes and with limited ability to interact with others. The relationship between COVID-19, LBGs and disability will be discussed in the following section.

### **2.3 COVID-19, LBGs and Disability**

The COVID-19 lockdowns forced drastic changes on Pokémon Go and other LBGs as they had to adhere to the social distancing rules implemented by governments across the globe [5]. These included the introduction of features such as remote raid passes, which allowed users to battle for the chance to catch rare Pokémon from their own home, whereas previously users had to physically travel to a Gym to battle in raids. For instance, Bhattacharya et al. [5] observed how the pandemic disrupted the three foundations of LBGs – exercise, exploration and social engagement – and believed it to be a unique opportunity to reimagine the design of LBGs to mitigate the negative impacts of the pandemic on the three foundations and to improve overall gameplay. They initially conducted a diary study using a varied sample including individuals with severe depression, ADHD, social anxiety and chronic illness. Over a 2-week period, participants completed seven diary entries on the days they played one or more LBGs pertaining to participants' negative and positive experiences of playing. The results from this study informed online design sessions where the researchers asked participants their reasoning for playing LBGs during the pandemic. When asked to imagine how LBGs could offer opportunities for new benefits, participants recommended improvements including enhancing home play options, enabling remote access to in-game features (such as Gyms and PokéStops) and more virtual events. This recommendation resulted in the researchers suggesting design speculations such as adding personal messages to gift items to enhance users' mental health.

Despite the novel insights, the work of Bhattacharya et al. [5] was constrained by the COVID-19 lockdowns. Namely, the creativity of participants was inspired by quarantine and social distancing which does not reflect post-pandemic life where the changes made to accommodate social distancing and restrictions on movement are being rolled back. This suggests that users may have different needs leading to different designs. Additionally, in the current paper, we focused on individuals with mobility issues as they represent a diverse set of users with different needs across different contexts, differently from [5].

### **3 STUDY 1: BARRIERS, NEEDS AND MOTIVATIONS OF DISABLED USERS WHEN PLAYING POKÉMON GO**

The first study of this research aimed to explore the needs, barriers and motivations of disabled users playing Pokémon Go. This was achieved using a qualitative survey that recorded experiences and provided participants with the opportunity to describe their ideal Pokémon Go. Qualitative surveys were chosen due to their potential to offer rich and focused data [9]. Our research questions for this study were (i) *What motivates individuals with mobility issues to play Pokémon Go?* and (ii) *Do the specific features within Pokémon Go, meet the needs of individuals with mobility issues or create barriers?*

Inclusion criteria for the study were: age over 18 years, ability to provide informed consent, self-identifying as having a mobility-related disability, plays Pokémon Go at least once a week.

#### **3.1 Method**

**3.1.1 Materials.** The qualitative survey was built using Qualtrics Software and asked participants to state their experiences, needs, barriers, and motivations for playing Pokémon Go and to describe their ideal version of Pokémon Go. Example features shown to participants to encourage reflection can be seen in Figure 1 (Left).

An initial version of the survey was piloted on 3 individuals who did not meet the inclusion criteria but provided feedback on the structure and general presentation. As a result of their evaluation, text boxes were added below multiple-choice questions to enable participants to elaborate on their chosen responses.

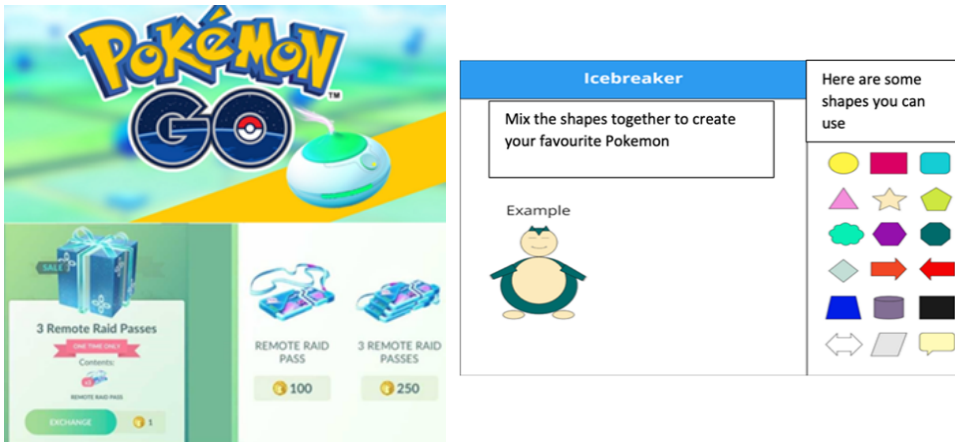


Fig 1: (Left) Two features in Pokémon Go, shown to participants during the survey, called incense and remote raid passes. (Right) Icebreaker activity in workshops. This enabled users to relax themselves into the workshops and encouraged divergent thinking.

**3.1.2 Ethical Considerations.** This research received ethical clearance from the UCL Interaction Centre (UCLIC) Research Department's Ethics Committee. The approval ID number was: **UCLIC\_1920\_005\_Staff\_Barbareschi**. When clicking the link for the survey, participants were informed about the research aims with clearly stated inclusion criteria. The survey only collected anonymous data. By clicking the button to access the survey, participants confirmed that they consented to the use of the anonymous information they provided for the research and that they met the inclusion criteria.

**3.1.3 Recruitment and Study Procedure.** Participants were initially recruited via convenience sampling through advertisements on different social media sites, predominantly Facebook and Reddit Forums. Upon completion, participants were invited to email the first author with screenshots that they believed captured their experience of the Pokémon Go game. During these interactions, snowball sampling was utilised. All participants accessed the survey via a link auto-generated by Qualtrics. The survey took 10-15 minutes to complete.

**3.1.4 Data Analysis.** The first author imported survey findings from Qualtrics to a word processing software. None of the responses were excluded from the analysis. Quantitative questions, including demographic data, were analysed using basic descriptive statistics and visualized using bar graphs. The qualitative questions were analysed using a bottom-up thematic analysis with key data being clustered using both latent and semantic coding [8]. Codes that shared similar meanings were mapped together by the first author using affinity mapping which resulted in the formation of themes. These were iterated upon and reviewed by all authors on three occasions over a three-week period during the month of June 2022. Doing so ensured the themes best represented the data provided by participants.

**3.1.5 Participants.** Here we chose to present demographic data in a narrative format, as opposed to a table format as it keeps the participants of the research better anonymized. Sixty participants completed the survey (18 men, 36 women, 5 non-binary and 1 self-description - Genderqueer). All participants met the following inclusion criteria: (1) aged 18+, (2) identified as having a mobility disability or multiple mobility disabilities, (3) played

Pokémon Go at least once a week, (4) able to communicate effectively in English and (5) able to give informed consent. Their ages varied, with 8 (13.33%) aged 18-24, 17 (28.33%) aged 25-34, 13 (21.67%) aged 35-44, 17 (28.33%) aged 45-54, 4 (6.67%) aged 55-64 and 1 (1.67%) aged 65+. The majority identified as white (49 – 81.67%) with the rest identifying as mixed/multiple ethnic groups, Black, Asian, Other and one chose not to specify. The majority of respondents used Pokémon Go regularly, with 35 (59.32%) playing the game every day. Furthermore, most users stated they have played the game since its release in 2016 (n=47 – 79.66%).

Participants stated they play Pokémon Go in a variety of different countries. Namely, 27 (45.76%) in the USA, 25 (42.37%) in the UK, 2 (3.39%) in Canada, 2 (3.39%) in Australia, 1 (1.69%) in New Zealand, 1 (1.69%) in Spain, 1 (1.69%) in Belgium and 1 did not specify. Twenty-eight (36.84%) participants reported using Pokémon Go in a city, 20 (26.32%) reported using it in a suburban area, 20 (26.32%) reported using it in the countryside and 8 (10.53%) stated other (including in a 'town' and 'in the hospital/clinic'). Thirty-three (46.48%) reported playing the game on their own, whereas 38 (53.52%) played with others. The respondent's company included spouses, children, friends, siblings, parents, and carers.

## 3.2 Results

Four themes were identified from the qualitative analysis of the survey and are discussed here: (i) escape from reality, (ii) inaccessible features, (iii) identity and representation, and (iv) sense of community.

**3.2.1 'Escape from Reality'.** Participants stated they enjoyed playing Pokémon Go as it offered an escape from the frustrations and pain often associated with their physical disabilities. The game offered relief from boredom and entertainment even when one was unable to leave the house. P51 said, *"It provides me [with] an escape from reality and the boredom of being stuck at home most of the time."* For some, the positive impact of the game acted as a coping mechanism when facing traumatic events and mental health issues. This was often coupled with the 'cuteness' of Pokémon and being a general fan of the franchise. Responses indicated the prominence of a nostalgic feeling, which encouraged so many users to play the game in the first place. P50 explained, *"I started playing after my husband was killed in 2016. This left me with PTSD. I play to escape reality for a bit, also have been a huge Pokémon fan since I was a kid"*.

For others, this escapism manifested as a *"symbol of hope"* (P43) where participants positioned the game as a reason to overcome the challenges associated with their disabilities. P43 said, *"When I became ill, it gave me [the] motivation to walk more which doctors told me would help my illness. I still play Go because I hope to recover one day. It's a symbol of hope for me"*. This is also an example of where the specific dynamics of the location-based nature of the game were highlighted as beneficial by one of the participants. Overall, participants leveraged the game to cope with the boredom that arose from the distressful feelings and situations they associated with their disabilities. The game reduced the drudgery of daily life by providing unique moments of fun. P32 said, *"It's entertaining and fun. I love Pokémon and the shinies are pockets of dopamine. It helps my weeks not all blend together and connects me to community"*.

**3.2.2 Inaccessible Features.** Despite their enjoyment, participants identified several aspects of the game, that made it inaccessible or challenging for them. Participants saw these

inaccessible features as the product of a bias toward non-disabled users. This led to feeling marginalised and frustrated: “I think most importantly my dream PoGo would be as accessible as I could possibly make it, taking into account all people, and not just able-bodied ones”. (P53). Some of the inaccessible features listed by users included:

**Walking Tasks for Rewards:** Many of Pokémon Go’s in-game tasks require users to walk certain distances to receive rewards. Environmental barriers and physical difficulties made this task impossible for many participants, generating frustration and leaving participants thinking either they could not continue to play the game or would have to accept a gaming experience with limited access. For example, P19 felt unable to walk fast enough to reap the benefits of increased incense effectiveness which results in more Pokémon spawning. For others, it hindered the ability to achieve specific in-game challenges. P23 reflected, *“The walk x distance for rewards tasks, that featured heavily this past explorer week get me down over the’ week. I’ll maybe hit the first distance which is fine and usually an achievement for me, but there’s no way to hide those. I don’t like to be reminded I can’t go that far compared to normal folks every time I open the section of the game”*.

**Timed Tasks:** The inability to complete tasks that required walking was further compounded by a common need to complete these within a certain time frame, which many participants felt unable to accomplish. P40 summarised, *“There’s a lot I could say about Niantic’s recent changes [...] I’ll keep it brief: returning to narrow time windows (3 hours) and implementing timed limited research (over the course of a day or a few days), especially that requires walking, is not only ableist, but very presumptive about how much free time people have to play this game”*.

**Sharing Location Data Outside of Gameplay:** To complete tasks requiring significant walking, some participants felt obliged to make their location data constantly known, even when not using the app. This raises potential ethical concerns as users who do not have mobility issues may feel less inclined to share their data in this way. Thus participants felt they were being penalized for their inability to walk large distances. P46 said, *“I eventually ‘walked’ 151 km for the mew task but it took me almost a year, and that’s with Pokémon go tracking my activity in the background from Apple”*.

**Significance of User Location:** Location was an issue commonly raised by participants. For instance, participants described the game as being more inaccessible for both disabled and non-disabled individuals living in less densely populated areas. P26 explained, *“spinning stops is harder because most discs are in towns or cities and hardly any in communities when there should be Gyms and PokéStops in our neighborhood”*. However, they argued that individuals with mobility issues were more severely impacted by this due to often being home-bound subsequently making it difficult to travel to more built-up areas where the PokéStops and Gyms are present enabling players to collect rarer Pokémon or play with others: *“Improving rural and suburban Pokémon and stops would be helpful for days I cannot leave my house”*. (P46)

**Impact of Covid-19:** When asked about the impact of the COVID-19 pandemic, participants highlighted how the removal of initial features introduced when social distancing rules were still in place resulted in a more inaccessible gaming experience. For instance, they showed disappointment about reduced incense effectiveness – a tool used to increase the number of Pokémon that appear on a user’s screen – as this limited the amount of Pokémon they could catch when stuck at home. *“Incense used to be a huge part of my play style because I find it hard to get around. I feel like I have to accept that the game isn’t aimed at people like myself. It’s quite sad because disabled gamers already have a hard enough time finding games that we can play...”* (P11). Moreover, the introduction of remote raid passes provided users with the opportunity to capture exclusive legendary Pokémon that normally cannot be caught by any other means. Some survey participants shared that this change enabled them to participate



in raids for the very first time as previously they had to physically travel to the raid's location and were unable to do so. *"Remote raids are awesome I can't complete my Pokedex without them."* (P42)

**3.2.3 Identity and Representation.** Several participants wanted to be able to express their identity within Pokémon Go through the app's customisable avatar. However, they felt limited in their ability to do so due to a lack of representative features of disability to choose from, such as a wheelchair or a cane. Participants regarded their disability as an important part of their identity and wanted to share this with others. P16 said, *"Being able to make an avatar with a visible disability or a mobility aid such as a cane or wheelchair or hearing aid. I have been able to do this in other games and expressing this part of my identity is important to me."*

To address this lack of representation, participants suggested ways of making the game more suited for disabled users. For instance, being able to let game developers know you are disabled and receiving a more accessible experience in response, indicates a willingness to disclose personal information if it could positively affect their gaming experience.

*"Maybe a survey when joining the game where you can select things like disability so the game and [avatar] could be altered to a more accessible version for those who're physically challenged".* (P12)

Participants were also conscious of the potential impact of the game on their health and were keen to avoid any risk of exacerbating the debilitating effects of their conditions. As such, they suggested potential ways of ensuring the game was safe to play: *"More options to track disabled people's activities — maybe include heart rate data from activity trackers like Fitbit and Apple Watch or something as activity. Getting dressed and out the door are big tasks for me and my heart rate gets to an active level."* (P15)

**3.2.4 Sense of Community.** Participants described Pokémon Go as a facilitator of friendship and as a tool that fosters a sense of community. Thanks to the location-based dynamic that pushed people to explore their surroundings, the game acted as a bridge between the home and the local community, allowing participants who identified as confined to their homes to connect with people they otherwise would not be able to connect with. P40 reflected, *"When I went away to college and was struggling with depression, Pokémon helped me stay active and allowed me to meet new people in my community. Now, I still play Pokémon in part because I've been at it for so long it would be hard to stop, and in part because it's one of the few things I'm still able to participate in with my disability."* (P40)

For some participants, the game has resulted in the formation of close friendships made possible and maintained via social media channels such as Discord and WhatsApp. The game didn't just represent a point of connection, but a world in which everyone could interact at an equal level. P54 said, *"I also met one of my closest friends when I invited her into to discord group after helping her win a raid. We are very competitive; she's not disabled but there are much fewer Pokémon spawning at her house so it evens out."* (P54)

Friendships were seen as mutually beneficial for progress within the game. Namely, participants described coordinating in-game activities which gave them access to certain features. For example, P35 mentioned, *"I can keep in touch with friends who play too and via messenger we plan meets to raid, so that every player in our group can get high tier Pokémon."* (P35). This implies that success in the game is better achieved when playing the game with others.

Some individuals stated that the game gave them the motivation to leave their homes despite the difficulties of their mobility disabilities. This enabled them to explore their

communities, see friends and feel a stronger sense of identity. P19 explained, *"I've made some good friends and we do social things together as a result of the game. It encourages me to leave the house (pre-COVID more so) and I started playing to help me do more walking."* To further enhance the sense of community, participants suggested incorporating some form of messenger service within the app to allow players to communicate with others during play. This was especially desired during the height of the COVID-19 pandemic, as participants were no longer able to plan in-game activities face-to-face. *"[I'd like] some form of messaging in the game to find local people playing instead of relying on 3rd party apps."* (P22)

## 4 STUDY 2: DESIGN RECOMMENDATIONS FOR LBGs SUCH AS POKÉMON GO

The qualitative surveys effectively identified the needs, barriers and motivations of disabled users. However, we wanted to explore in more depth the recommendations for ways to make LBGs more accessible. Therefore, we conducted a study to investigate how LBGs can be made more inclusive toward disabled users. Based on insights gained, we created a topic guide delivered via two separate co-design workshops where we encouraged users to think about inclusive design ideas for LBGs. The co-design workshops aimed to provide a creative space that enabled users to share their ideas. Being conducted within a group environment permitted users to discuss ideas with one another which enabled real-time iteration. Each workshop consisted of three participants and one researcher and was conducted via Microsoft Teams.

Our key research questions for this study were (i) *How can Pokémon Go and other LBGs be made more accessible to disabled users?* and (ii) *What would more accessible features within LBGs look like?*

### 4.1 Method

**4.1.1 Participants.** Six people participated in this study (2 men and 4 women). All identified themselves as disabled and played Pokémon Go and other LBGs regularly. Five participants were aged between 35-44 years and one between 45-54. Five participants identified as white and the other identified as Mexican American. Five of the participants were recruited after expressing interest to participate in further research after completing the Study 1 survey. The last participant was recruited via Reddit.

**4.1.2 Materials.** Participants were sent a meeting invitation on Microsoft Teams ahead of their scheduled workshop. The workshop's activities were carried out using a Miro Board with the first author sharing their screen and taking notes as the participants completed each activity. Participants were required to have access to pens and paper to complete the 'Crazy 8 sketches' and storyboarding.

**4.1.3 Ethical Considerations.** This study was carried out under the same ethics as Study 1 and noted many of the same ethical considerations. Participants were provided with an information sheet that outlined the purpose of the study and provided informed consent before participating in the online workshops. The online workshops were audio- and video-recorded and recordings were deleted once fully transcribed.

**4.1.4 Procedure.** At the start of the workshop, the first author explained the purpose of the workshop and the participants introduced themselves to one another. Following this, participants were guided through the instructions for each activity and were given the

opportunity to ask questions. The design workshop consisted of four main activities with the first being an Icebreaker. This involved each participant creating a Pokémon character either using digital shapes on Miro or using pen/pencil and paper, as seen in Figure 1 (right). After creating their design, participants displayed them to other group members who then guessed the Pokémon they were attempting to depict. The aim of this task was to encourage communication and creative thinking.

For the second activity, participants identified Problem statements and accompanying “How Might We” statements. This encouraged participants to reflect on their own frustrations with Pokémon Go and LBGs in general as well as empathise with others' frustrations. The third activity involved ‘Crazy 8 sketching’ where participants were given eight minutes to sketch eight ideas based on their previous statements. The goal of Crazy Eights is to push a participant/user beyond their first idea and to generate a wide variety of solutions to the design challenge at hand [16]. Upon completion, participants presented their drawings to the rest of the group for discussion. The final activity involved participants sketching storyboards of either their features from their Crazy 8s or another dream feature of their choice. This task involved creating multiple images representing how an individual would use their newly created feature and presenting the images to the group.

*4.1.5 Data Analysis.* The recordings of the workshops were re-watched by the first author to gain a deeper understanding of the data, transcribe the data and make notes of any key insights. A framework analysis was utilised, whereby the themes from Study 1 informed the analysis of the transcripts. Using a bottom-up Thematic Analysis [8], the transcripts were then read multiple times to identify both semantic and latent codes, which were then put into affinity diagrams to allow for the identification of themes/design recommendations. These then informed the discussions between authors who met remotely four times on a weekly basis during the months of July and August 2022. These conversations resulted in the creation of primary and secondary personas, see Figure 4, which guided the design recommendations outlined in the discussion. As good practice, the first author emailed design recommendations and visualizations to participants of the co-design workshops. This acted as a form of member checking as participants were able to confirm if the recommendations aligned with their design ideas.

## 4.2 Results

During the co-design sessions, participants highlighted their desire to continue playing LBGs but felt limited in their ability to do so as a result of a lack of variation in the playing experiences offered. To maximise their enjoyment of LBGs they suggested a variety of ways of making these games more accessible and representative of disabled users' needs. These are outlined in the following section. A summary of the Problem and How Might We statements can be seen in Figure 2.

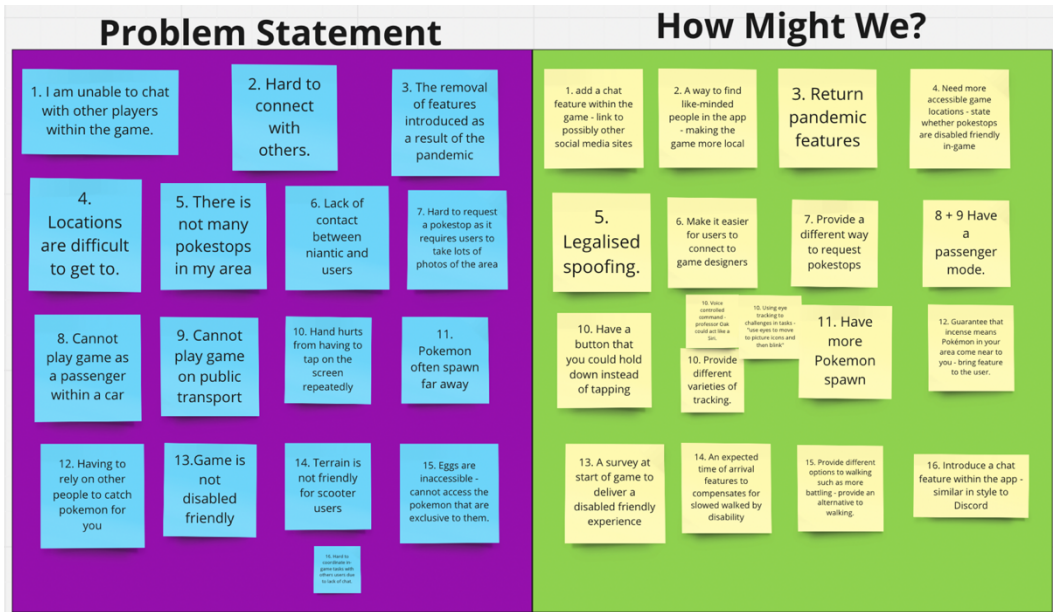


Fig 2: Example of Problem statement and How Might We activity from Workshop 2. This activity allowed users to identify ways of overcoming limiting factors in LBGs such as making hard to reach places more accessible.

4.2.1 *Better representation of disabled characteristics through LBGs avatars.* Participants discussed how LBGs are ineffective in capturing the way they represent themselves in physical space. Namely, they highlighted the lack of variety in the features offered for LBG avatars. As such, players wanted games such as Pokémon Go to incorporate wearable features such as prosthetic legs and hearing aids. In co-design session 1, P1 acknowledged that some users may not want to show their disabilities through digital games but personally craved better representation, *“I would like to see a wheelchair or hearing aids or different things [such as] sticks and prosthetic legs.”*

In response, P2 highlighted how Pokémon Go introduced the ability to wear masks as a result of the COVID-19 pandemic so could therefore quite as easily do the same for disabled features: *“They brought in masks for the pandemic. At the moment my avatar is holding a bunch of flowers. So I do not think introducing a walking stick would be that difficult to achieve.”* During the crazy 8s and storyboarding activity, P2 visualised what these disabled features may look like within Pokémon Go, as seen in Figure 3.

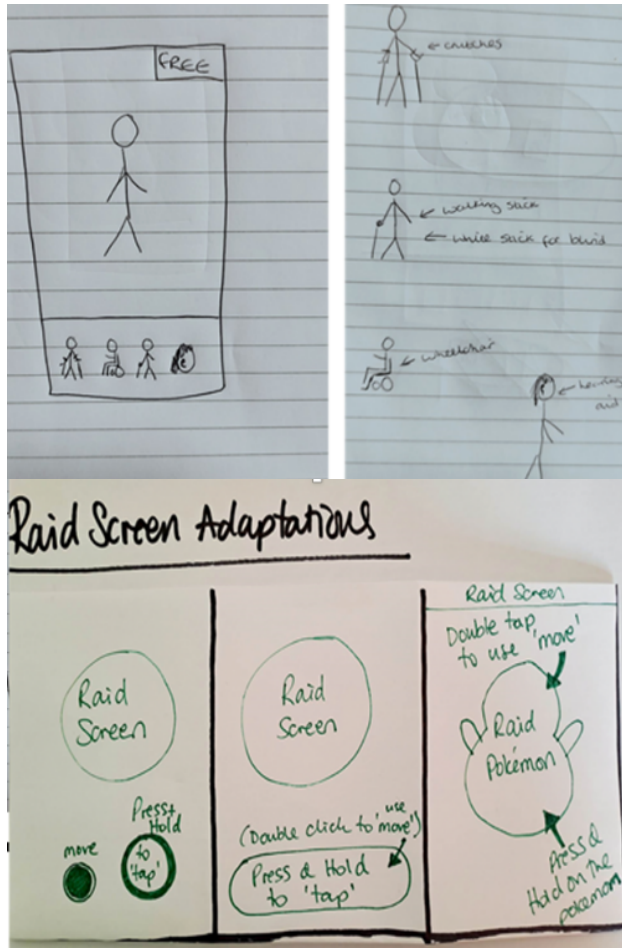


Figure 3: (Top) Crazy 8s and storyboarding drawings drawn by P2 to show potential disabled avatar accessories. These include a wheelchair and a walking stick. (Bottom) Having different input options when Raiding in Pokémon Go, such as holding attack buttons instead of repeatedly pressing them.

**4.2.2 Interactions with phone screens are physically demanding.** The six participants stated they had experienced physical difficulty when interacting with LBGs. Pokémon Go requires users to repeatedly tap a specific location on their screen to complete raid battles which many users found impossible to complete. Players stated they attempted different ways of getting around this but often ended up unable to complete the task or experiencing severe pain. P1 explained, *“The thing I have the biggest problem with, apart from the walking, is the tapping of the screen during raids. I have a lot of problems with muscle weakness in my hands. [...] I end up having such a problem because I end up having to hold one of my hands with my other hand while I am doing it, just because I can’t support [myself] doing it.”* (P1) In response to this inaccessible feature, participants suggested offering an alternative that allows the user to hold the button as opposed to repeatedly pressing it, as seen in Figure 3. *“If it could hold down the button instead of tapping it that would be perfect.”* (P4)

Participants also stated how throwing Pokéballs to catch Pokémon was physically taxing, requiring movements that they feel unable to do especially for long periods of time. P1 said, *“Some of the [throwing] tasks I cannot hit because I haven’t got the hand control because they require certain types of throws and I just cannot do them”*. (P1)

Participants explored potential alternatives such as the use of eye-tracking technology, which would allow other disabled people to play LBGs. P6 said, *“They have technology where you can move your eyes to make a curveball coordinate where you want to throw the ball or do other things”*. P4 added, *“Quadriplegic people could then play it too [...] that would really open it up”*. (P4)

**4.2.3 Providing a self-identifiable disabled account.** Players envisioned the possibility of LBGs offering disabled-friendly accounts that would provide alternatives to walking-based challenges which many felt unable to complete. All participants highlighted how the current singular account framework shared amongst all users is not accessible for disabled users. For example, hatching eggs in Pokémon Go was highlighted as difficult for disabled users, as they can require users to walk long distances, such as 10 and 12kms. *“It was having the time pressure of the Cherubi one [walking task], all in one day and that’s 5km in a day – yeah...no, that is just not possible”*. (P2)

Disabled-friendly accounts could allow users to inform LBGs that they are disabled and receive a more accessible experience as a result. For instance, P6 supported the idea of filling out a survey when first downloading these games.

*“It [a survey to receive a more catered disabled experience] would make it easier. Especially, I know like with what P5 was saying, with my [mobility] scooter, when I have to use it, there is certain terrain where I can’t use it. Heavy traffic areas also pose a safety concern”*. (P5)

In workshop 1, P2 highlighted how Niantic already offer a child-friendly version of Pokémon Go that makes the physical requirements of the game easier. P2 elaborated, *“With the child account, it seems that things like the walking distance requirements, different tasks and things are made easier. So, I was like well if they can do that for a child account, why can’t they do a disabled account.”* Thus, some users felt that the technology already existed within the game, making it easy for Niantic to adapt this toward a disabled access account.

P1 agreed with P2 but made the counterpoint that it would be difficult for a disabled account to successfully address the variability across different disabilities: *“Thinking about the Paralympics for example, where you have people with all kinds of different levels and types of disabilities and there are all kinds of different kinds of classifications. So, I can see that when you have something like a LBG that it is quite difficult to think [...] how Niantic may come at it [addressing disabled player’s needs] given the huge variation that comes with people’s disabilities.”*

**4.2.4 Make it easier to communicate with users through LBGs.** Participants imagined LBGs that offered a way of communicating with other users. They discussed the methods they currently used and attempted to incorporate these into LBGs. For example, P2 discussed how they currently use Discord to organize raids with other players and suggested that Pokémon Go could incorporate a chat design where it would be possible to create channels for different conversation topics. P2 explained, *“In my local area, me and a friend run a Discord – the advantage of this is that you get a channel for every raid that comes up, so rather than it all being in one long text and trying to keep track of everything, you just go onto the raid that you want, and you put whether or not you need an invite. [...] Having something like this in Pokémon Go would be helpful as then you would not have to swap between apps.”*

P1 shared the same sentiment, however, they highlighted the potential risks this may create such as the threat of children chatting to adults with ill intentions. *"I think it's [having a chat feature] something that keeps coming up as a discussion that I have noticed in chats anyway. People are really keen to have this feature in the game [Pokémon Go] but also there are a lot of people also saying that let their kids go on Pokémon Go because there is no chat feature and it's safe as they cannot talk to other adults. I think it's a difficult balancing act that one."* (P1) Participants further discussed the possibility of monitoring a potential chat feature to prevent children from being lured to dangerous locations or to prevent other forms of abuse. *"I think it would be easy enough to have it monitored because there is no information on there apart from your username. They do not know your age range."* (P3)

## 5 DISCUSSION

In this work, we focused on answering the following research questions: 1). What are the barriers and needs of disabled LBGs players? 2). How can LBGs be made more inclusive and accessible? To address these, we conducted two studies in the form of a qualitative questionnaire and a series of co-design workshops. Here we discuss the insights gained from both studies and the design recommendations created as a result of these insights.

### 5.1 Study 1: Insights from the Qualitative Surveys

Results of Study 1 identified four key themes that represented the playing experiences of disabled users: 1) 'Escape from reality', which referred to the ability of Pokémon Go to allow users to forget about the pains and frustrations they associated with their disabilities, 2) Inaccessible features, which pertained to game features that users felt were out of reach for disabled users, 3) Identity and Representation, describing how Pokémon Go did not effectively permit disabled users to express their identity nor captured all of the needs of disabled users, and 4) Sense of community, highlighting how Pokémon Go facilitated friendship resulting in a sense of community. These findings demonstrate the positive impact of Pokémon Go for disabled users but also highlight a need to introduce features that make the game and other LBGs more accessible [5].

Results from Study 1 highlighted the dramatic impact that social distancing rules, implemented as a result of the COVID-19 pandemic, had on disabled users' lives, such as juggling remote work with increased childcare as a result of school closures, which matches findings by Bhattacharya et al. [5]. Regarding Pokémon Go, [5] participants, who had a variety of health conditions ranging from chronic pain to cancer, highlighted their disappointment that many public events, such as 'GO Fest', were cancelled. This aligns with the work of Gerling et al [26] as they emphasized the importance of being able to play digital games with other people in order to encourage engagement. In contrast, our study participants reflected on how the pandemic also had a positive influence on their gaming experiences. This is because it resulted in the game becoming more accessible as Niantic for the first time designed a game for users who were meant to stay in their homes, which for many participants was a lived reality before the pandemic. However, participants were also quick to highlight how the gradual removal of social distancing rules has resulted in Niantic removing changes made, such as a now-reduced effectiveness of incenses. The inaccessibility this has caused mirrors the petitions created, and frustration raised, across many social media platforms across mainstream media [35]. When complementing this with previous research that highlighted the desire of disabled users for challenging gaming experiences [11, 34] it emphasizes the need for nuanced approaches where the challenges

offered by the game matches players capabilities, without generating frustrations as a result of accessibility barriers.

Study 1 also suggests that participants want to express their identity through Pokémon Go but feel limited in what is currently available. This applies to LBGs more widely as they also do not offer avatar features that represent disabled characteristics, such as HPWU, and is consistent with the work of Kim et al. [20].

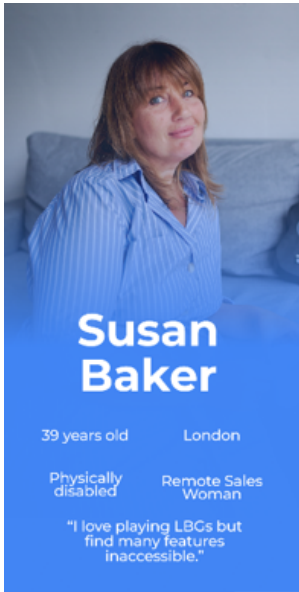
## 5.2 Study 2: Insights from the Co-Design Workshops

The results from the co-design workshops show that disabled players identified novel and insightful ways of making LBGs more accessible. Many of these recommendations align with those identified by Bhattacharya et al. [5] with both studies highlighting the need for a means to chat with other users through LBGs to increase social connectedness. However, this study produced novel insights such as a need to account for variations amongst disabled LBGs users. Namely, participants highlighted that games such as Pokémon Go and Jurassic World Alive only offer singular inputs to complete in-game tasks meaning that some disabled users feel unable to complete tasks that would be possible if they had different input options for completing them.

The qualitative insights from Study 2, demonstrate that adjustments made to LBGs have the potential to improve the playing experience of both disabled and non-disabled users as supported by Cairns et al. [10]. Modifications don't necessarily need to be complex and extensive, features as simple as signposting can be an effective tool to make LBGs more accessible. This is because making it clear to users where certain features are should prevent the likelihood of a user thinking a game is inaccessible when it might be in fact accessible. This relates back to the work of Graf et al [17] who demonstrated that when a game is designed with inclusivity in mind, disabled users are able to compete with non-disabled users at the same skill level.

As a result of the participant's insights, a primary and secondary persona were created to summarise the motivations, needs, barriers and frustrations of disabled users of LBGs. The primary persona (figure 4) represents a long-term and frequent player and captures the more salient needs of participants from both studies, such as a need for greater representation of disabled characteristics across LBG avatars. The secondary persona (figure 4) represents a newer and less frequent player and depicts additional, less salient needs found across users such as reintroducing accessible game features that have been removed since the easing of social distancing. Based on these personas we drafted the following recommendations and design visualisations.





**Susan Baker**

39 years old London

Physically disabled Remote Sales Woman

"I love playing LBGs but find many features inaccessible."

**About Me**

Susan is a mother of two children who works from home as a remote Sales Woman. She lives in London and suffers from muscle atrophy which limits her mobility. In her spare time, Susan enjoys playing Location-Based Games (LBGs) with her children and has been a lover of gaming ever since she was a child.

**Goals & Motivations**

She has a genuine passion for LBGs and would like to meet more like-minded mothers within her community through playing these games.

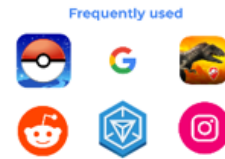
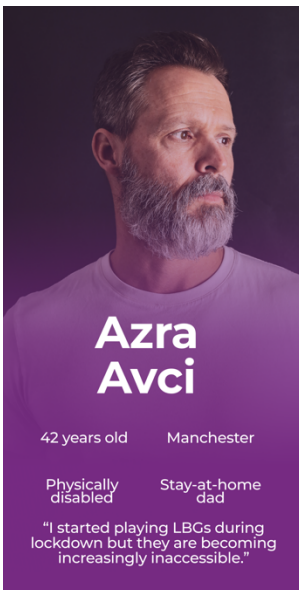
Her muscle atrophy has resulted in mental health issues, so plays LBGs to escape the pains and frustrations that arise from her disability.

**Painpoints & Frustrations**

She gets frustrated when LBGs, such as Pokémon Go, require users to walk long distances to receive exclusive rewards.

Susan believes LBGs do not effectively represent disabled users and is frustrated by a lack of disabled accessories across LBG avatars.

She struggles to complete LBG tasks that require lots of intricate finger movements and would like to see greater variety across input options.

**Azra Avci**

42 years old Manchester

Physically disabled Stay-at-home dad

"I started playing LBGs during lockdown but they are becoming increasingly inaccessible."

**About Me**

Azra is a stay-at-home dad for his three young daughters. He lives in London and was diagnosed with multiple sclerosis which limits his mobility and causes fatigue. Azra has recently started playing LBGs during the COVID-19 pandemic with his children but has noticed that as social distancing eases, these games are becoming less accessible.

**Goals & Motivations**

Azra wants to use LBGs as a means to bond with his children, especially his youngest who is obsessed with Pokémon.

As a disabled rights activist, he wants to see LBGs and other types of games become more accessible.

**Painpoints & Frustrations**

He is frustrated with companies, such as Niantic, for removing and reducing the effectiveness of in-game features since the easing of social distancing.

As a novice in the gaming community, Azra already believes LBGs are catered towards the needs of non-disabled users more than disabled users.

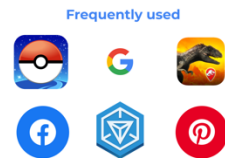
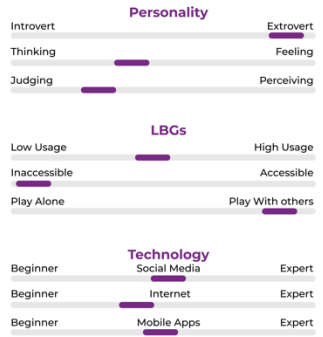
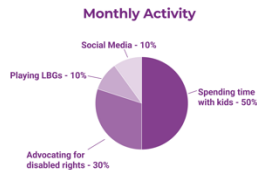


Fig 4: Primary and Secondary Persona. The former represents a long-term and frequent player and captures the more salient needs of participants from both studies, such as a need for greater representation of disabled characteristics across LBG avatars. The latter represents a newer and less frequent player and depicts additional, less salient needs found across users such as reintroducing accessible game features that have been removed since the easing of social distancing.

### 5.3 Design Recommendations

**5.3.1 Greater disabled representation for LBGs Avatars.** We suggest providing users of LBGs with greater options for avatar customisation. This will enable disabled users to select items that they may use in their day-to-day lives, such as walking sticks and wheelchairs. Over time, and based on disabled user feedback, these accessories could be refined to provide variation in their characteristics. Based on the findings of this paper and the work of Kim et al. [20], we argue that this should result in a stronger sense of identity and representation when playing.

In alignment with Bloustein and Wood [7], we recommend that these accessories should not be a requirement for disabled users, but rather facilitate choice, with disabled users being able to choose whether or not they identify as disabled within LBGs, instead of LBGs creators making assumptions around disabled identification. Some visual mock-ups can be seen in Figure 5. Participants of the design workshops gave positive feedback on these designs stating that they always wanted to see greater disabled representation in avatar customization.

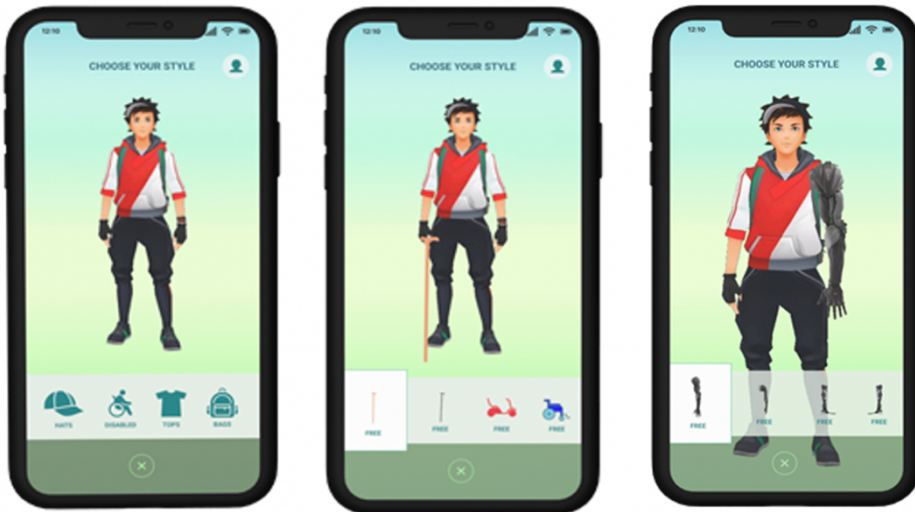


Fig 5: Incorporating physically disabled characteristics such as walking sticks (middle figure), and prosthetic arms (right figure) in LBG avatar display.

**5.3.2 Provide different input options for phone interaction.** Many tasks within LBGs require users to repeatedly tap their phone screen, such as raiding in Pokémon Go. This can cause pain to disabled users, especially those with muscle weakness. As an alternative, we suggest providing alternative inputs such as holding for 1 second, releasing and then repeating or providing users with the option to hold for the entirety of a task. An example of this can be seen in Figure 6. Additionally, given that phone screens are relatively small, LBGs require users to make precise finger movements, such as intricately spinning and throwing a Pokéball to get an excellent throw. We argue that different forms of input such as shaking your phone as seen in Figure 6, could be more accessible. This would be coupled with haptic feedback and should create a more equal playing field for disabled users [17].

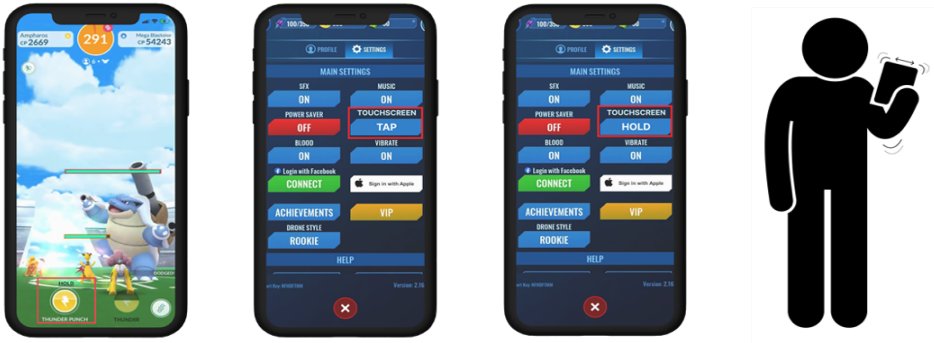


Fig 6: Providing different physical input options within the settings areas of LBGs, allowing for different in-game interactions.

**5.3.3 Creating disabled profiles for LBGs.** We suggest putting a 'disabled access' icon within the settings area of LBGs (seen in Figure 7) that would permit disabled users to state their disability and would also be an opportunity for these users to express requirements for disabled specific accounts, as seen in Figure 7. This may lead to the anticipation of positive experiences which according to [26] will lead to greater engagement. Having completed this form, users will be given access to a more disabled-friendly gaming experience. For instance, users could be allowed to change their location in-game without having to walk to allow them to experience the full benefits of LBGs, irrespective of their disabilities. It should be noted that choosing a disabled account should be optional as many may not want to disclose their disability. Furthermore, moderating these accounts may pose gatekeeping issues and needs to be explored further in future research.



Fig 7: Submission form for gaining access to disabled account, located within settings of LBGs.

5.3.4 *Provide instant messaging within LBGs.* At present, LBGs do not offer a messaging service within their platforms meaning users are required to navigate between other apps to communicate with other users. This can be particularly frustrating for disabled users as it can be physically taxing navigating between different apps. As such, we recommend locating a message icon within the home screen of LBGs for easy access, as seen in Figure 8. During the workshops, participants were keen to incorporate a messenger system within LBGs. However, upon reflection and having seen the design mock-ups some participants were hesitant about this feature and felt that it might be too intrusive. Despite messenger systems not yet being implemented within LBGs and the uncertainty of workshop participants, other types of digital gaming platforms have successfully utilised messenger systems which have fostered social connectedness and helped in the coordination of tasks amongst users [37]. For example, the Massive Multiplayer Online game World of Warcraft [6] allows users to effectively coordinate tasks when playing the game. Figure 8 shows a Discord Style messenger system, where users can toggle between different channels such as PVP battling and research tasks. This specificity will make it easier for moderators to block individuals who appear to be using the service with malleolus intent, a concern that was mentioned amongst participants in the co-design workshops.

Collectively, these recommendations seek to make LBGs easier to use for disabled and non-disabled players. Based on the feedback of workshop participants and the literature these recommendations need to be iterated upon to better represent the needs of a larger sample of disabled users.

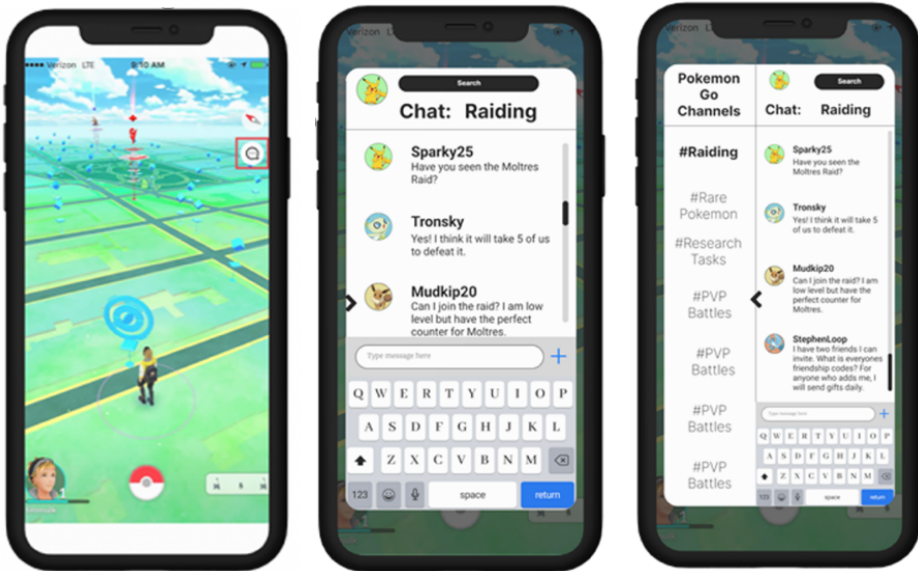


Fig 8: A messenger feature, accessible via LBGs home screens and similar in style to Discord.

#### 5.4 Limitations

This research had various limitations. For instance, whilst the qualitative survey had a relatively large sample of 60 participants for such a specific demographic, both the survey and co-design workshops only consisted of participants who all identified and grew up in the Western hemisphere at the time of this research. As such, the recommendations and insights of users are likely to reflect a Western-centric understanding of LBGs. Future research should strive to focus on recruitment and increase the number of participants, especially for co-design workshops, to gain insights from disabled users from different cultural backgrounds.

In relation to Study 1, the results of the qualitative surveys were understood and analysed through the lens of LBGs generally, despite participants only stating they played Pokémon Go and being asked questions specific to Pokémon Go. This decision was made as Pokémon Go is the most popular LBG and therefore easier to recruit for and shares game mechanics with other LBGs. However, Pokémon Go also differs from other LBGs. For instance, Jurassic World Alive's user interface (UI) looks significantly different from the UI of Pokémon Go, which may have resulted in respondents providing different feedback if specifically asked to talk about other LBGs. Therefore, future research on disabled users' experiences of LBGs should look at users of different LBGs and generate broader implications.

With regards to the procedure of Study 2, all but one of the 6 participants from the co-design workshops were unable to access and use the shared Miro Board due to connectivity issues

and inaccessibility. This meant that participants were unable to complete the icebreaker challenge and could not type their Problem and How Might We statements during the workshop. As an alternative to the original icebreaker, participants drew their favourite Pokémon using pen and paper and presented this to their groups via their cameras. This still encouraged participants to think creatively and collaborate with their peers but presenting through their camera screens could make it hard for users to see what it is they had drawn. As an alternative to the use of virtual sticky notes for the Problem and *How Might We* statements, the participants were encouraged to provide their responses but the first author wrote down what was being said. While the limitations of the online format made the co-design workshops challenging in some respects, we believe that these can inform further studies at the planning stage, as online workshops can reach participants who would not be able to participate otherwise. Despite the limitations of the procedure of the co-design workshops, they led to rich insights from participants.

## 6 CONCLUSION

Our research aimed to identify the barriers, needs and motivations of disabled LBGs players to inform more inclusive LBGs design guidelines. To achieve this, two studies were conducted as part of this dissertation project. First, an online qualitative survey explored 60 disabled users' experiences and motivations for using Pokémon Go, the most widely used LBG at present. Second, two co-design workshops were orchestrated to allow a total of 6 participants to discuss and identify ways of making LBGs more accessible and inclusive for both disabled and non-disabled players. Design visualisations were made as a result of these studies and were member checked with participants to see if they aligned with their ideas. Results of the survey identified four key themes that demonstrate that LBGs offer an escape from reality and facilitate friendship formation for disabled users but also showed that these users believed LBGs to have many features that were inaccessible and geared more towards non-disabled users. As such, participants alluded to ways of making LBGs more accessible and this informed the structure of the second study of this research which consisted of two co-design workshops. Results of the workshops identified four design recommendations: 1) Having greater disabled representation across digital LBG avatars, 2) Providing more variation in the physical inputs on mobile devices when using LBGs, 3) Creating disabled access accounts that provide disabled users with a more accessible experience across different LBGs and 4) Provide instant messaging within LBGs that allow users to coordinate group in-game tasks more effectively. Participants provided positive feedback for the design visualizations but stated the designs needed more refining and clarity. Further research is needed to explore whether these recommendations are supported by both disabled and non-disabled users more widely. Furthermore, physically prototyping these ideas will allow users to better understand how these features will function in a naturalistic context. The findings of this research could change the way in which LBG features are designed. We believe that this paper will be the catalyst for further work into disabled experiences of LBGs and games more widely.

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