

Playing With Others: Depicting Multiplayer Gaming Experiences of People With Visual Impairments

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Games bring people together in immersive and challenging interactions. In this paper, we share multiplayer gaming experiences of people with visual impairments collected from interviews with 10 adults and 10 minors, and 140 responses to an online survey. We include the perspectives of 17 sighted people who play with someone who has a visual impairment, collected in a second online survey. Our focus is on group play, particularly on the problems and opportunities that arise from mixed-visual-ability scenarios. These show that people with visual impairments are playing diverse games, but face limitations in playing with others who have different visual abilities. What stands out is the lack of intersection in gaming opportunities, and consequently, in habits and interests of people with different visual abilities. We highlight barriers associated with these experiences beyond inaccessibility issues and discuss implications and opportunities for the design of mixed-ability gaming.

CCS Concepts: • Human-centered computing → Accessibility; Collaborative and social computing

Additional Key Words and Phrases: game accessibility, visual impairment, mixed-ability, social gaming, inclusion

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1 INTRODUCTION

Recent research characterizes experiences of people with disabilities in playing digital games, their emerged preferences and perspectives [2, 17, 36, 46]. These studies offer important considerations for accessible game design. However, to our knowledge, there is no research work focused on the experience of people with disabilities playing games with others. We argue that this knowledge, especially regarding mixed-ability experiences, is essential to inform game design – particularly multiplayer – and to foster a more inclusive gaming industry.

Accessibility guidelines for digital gaming have been widely disseminated [7, 21, 24, 34]. Game industry often meet some of these guidelines, notably colorblind-friendly palettes, configurable controls and including subtitles [36]. Still, most mainstream debuts still disregard the accommodation of people with disabilities.

The problem does not lie merely in indifference or contempt on the part of mainstream developers. Previous work highlights obstacles to a more accessible industry, from the perspective of developers [17, 36]. Universal game design is not implausible, as it has been instantiated before [20, 22, 35, 44, 49]. However, we cannot ignore the limitations it imposes on the design process and hence on the gameplay and game presentation.

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When it comes to game design, finding techniques that give access to all the information needed is insufficient. Adaptation may disfigure the essence of the game [54]. Also, the game setting and challenge may not be engaging for all players [4, 51]. This may be due to different contexts, preferences, but also to different perceptual, physical and cognitive abilities. Understanding the particular perspectives of people with diverse abilities is essential for the design of games that, beyond accessible, are enjoyable for all.

In this work, we sought to learn more about the experiences of visually impaired people when playing with others. We focus our attention on multiplayer interactions irrespective of visual ability, including family and friends. We conducted individual interviews with 10 blind adults, two group interviews with visually impaired minors, and launched two online questionnaires – one to be answered by people with visual impairments, which received 140 valid responses; and one to be answered by sighted people who play with a person with visual impairments, which received 17 responses. Our findings show that people with visual impairments are often excluded from group play. While there is a considerable variety of accessible games, possibilities to play with others, especially with sighted family and friends are scarce and not ideal. Mixed-visual-ability gaming was often associated with an underwhelming experience for at least one of the players. A recurring issue was that accessible games, particularly audio and text-based games, do not appeal to sighted players. On the other hand, highly-visual games are inaccessible or induce unfair competition. Seemingly, games cater to one set of abilities at a time. This hinders the inclusion of players with disabilities in communities, groups of friends, and even within families. From the participants' perspectives, we discuss implications and opportunities of designing for mixed-ability and inclusive gaming.

2 RELATED WORK

We provide an overview of accessible gaming for people with visual impairments. We discuss games playable, either by design or not, by groups of people with mixed abilities, highlighting commonplaces and design strategies. Also, we look at existing work on the characterization of gaming experiences of people with disabilities, in particular studies involving people with visual impairments.

2.1 Games for people with visual impairments

Accessible digital games are typically associated with one of two trademarks [22]: either a mainstream game that includes accessibility features (e.g. compatibility with screen-readers, enhanced visuals) or a game that is purposely designed for people with disabilities, such as audio games. We emphasize that, despite this distinction, most games accessible to people with severe visual impairments fall under the second designation. Also, most audio games are developed by the indie game industry, usually by solo developers and small companies, or born from academic research. An extensive list of audio games can be found at audiogames.net.

For digital games that target people with visual impairments, the dominant design strategy is to use audio feedback to provide accessible interaction. Audio is used in different ways: speech (mainly through built-in narration or text interfaces compatible with screen readers), audio cues (sounds that represent elements of the game, such as footsteps to represent the player), and sonification (soundscape that allows the players to position themselves in space and locate relevant elements) [54]. Some games also involve haptic interaction [19, 32, 53]. Adjustable visuals, based on scalable interfaces, contrast levels and color schemes are essential for gamers with low vision [54].

Previous work examines accessible gaming and design implications, notably contributing for the establishment of accessibility strategies/guidelines in digital games [4, 34, 47, 50, 54]. The same is happening with tabletop games [13]. There is now a variety of digital games available for people with visual impairments to play [45], thanks to research

and diverse developers dedicated to creating accessible games and software¹². Although this is still a timid growth compared to the one of the digital game industry in general, it is certainly a positive remark and an important step towards inclusive gaming.

2.2 Mixed-ability gaming

Some mainstream multiplayer games unfold to be playable by players with visual impairments, even when these are not fully or purposefully accessible. For example, blind people play fighting games, thanks to the profusion of sound feedback [2, 31], although usually they are not entirely accessible [31]. Interactive fiction (also known as text adventures), text-based MMORPGs and MUDs are also popular among people with visual impairments [2]. Past research shows rhythm/music games to be effective in engaging both visually impaired and sighted players [18, 29, 30, 53]. Other studies aimed to design multiplayer games for groups with mixed visual abilities. WaTa Fight [27] is a competitive fighting game designed for sighted and blind people alike. Players must press two buttons (Wa and Ta) on each side of the smartphone to attack and block the opponent. In Kinaptic [19], one sighted player plays using full-body gestures and one blind player interacts through a multi-modal setup comprising haptic, wind, and surround audio feedback. The main concern in designing the game was to ensure that both players have a fair winning chance. Similarly, Smith and Nayar [37] created the RAD, an auditory display that gives blind people equivalent information in racing games. Inspired by focus groups and workshops with children with mixed visual abilities and special needs educators, Metatla *et al.* designed an activity to support inclusive play experiences [33]. Studies have shown that similar perceptions of narrative and immersion can facilitate shared gaming among people with different visual abilities [14, 52].

We also find important research focusing on other mixed-ability groups. Last Tank Rolling [16] is a motion-based game in which one wheelchair-user and one able-bodied player have to work together to succeed. The wheelchair is embraced as a key element of the game, physically and metaphorically linked to the control of a tank. powerBall [12] takes advantage of augmented-reality to bring together children with mixed motor/learning abilities and encourage social interactions during the experience. Graphics are projected onto a table, and physical pieces are used to affect the trajectory of a ball. Social gaming is stimulated by combining cooperative and competitive dynamics and interactions with both virtual and physical elements. Sobel *et al.* [38] designed Incloodle, a two-player picture-taking tablet application for groups of children with mixed cognitive abilities. By encouraging cooperation among the children, the application is successful in fostering a joint inclusive experience.

Universally playable games are found in research, namely adaptations of traditional games, such as chess [20] and tic-tac-toe [35] as well as games with complex virtual worlds designed to be interacted with and navigated by everyone – PowerUp [44] and Terraformers [49]. These approaches seek to accommodate mixed abilities in the same game, providing redundant feedback and alternative controls. Notably, Access Invaders [22] and its descendant, Terrestrial Invaders, are born from an interesting approach in which the creation and selection of different profiles allows the game to be adapted to the user.

Past research has explored games that accommodate diverse abilities, however it is unclear how and whether this types of games can lead to more inclusive gaming communities. It is necessary to probe what gaming experiences groups with mixed abilities have together, if and what barriers arise, and how we can improve the space for these experiences to happen.

¹Aprone's Accessible Software and Games. <https://www.kaldobsky.com/ssl/audiogames.php> (Last visited on May 7th, 2020)

²Sam Tupy Productions! <http://www.samtupy.com/> (Last visited on May 7th, 2020)

2.3 Characterization of gaming experiences of people with disabilities

Designing for mixed-ability gaming involves understanding the impact that different abilities have on people's experiences, preferences and perceptions regarding gaming. Gerling *et al.* [17] explore the creation of a wheelchair-controlled digital game following a participatory design approach, first with a group of wheelchair-users and then with game design experts. The study shows significant differences in the game concepts suggested by each group.

Porter and Kientz [36] asked people with disabilities to express their habits, preferences, and concerns regarding gaming. Participants seemed to engage in single-player gaming significantly more often than in multiplayer, especially those with visual impairments. The authors highlight this as not expected, given the rising popularity of multiplayer games on the various platforms. Most barriers identified by participants were merely technical, such as the incompatibility with assistive technology (e.g. screen readers). However, some participants with motor impairments expressed their concerns regarding multiplayer experiences, namely the discomfort of failing when competing against able-bodied gamers.

Urbanek and Güldenpfennig [46] approached experienced audio game players and designers, issuing a rich characterization of the audio game genre and experience. Their work offers valuable insights that do not focus on accessibility barriers but on perspectives regarding game design, personal experiences and community. Similarly, Andrade *et al.* [2] published a study focusing on the experiences of a group of blind players. The authors particularly highlight what the group values in games, such as the feeling of agency over the narrative, but also negative aspects, for instance, a perceived lack of complexity in games. Gamers with visual impairments have also reflected on common interaction patterns of audio and text-based digital games [3].

These studies reveal opportunities and concerns shared by a representative sample of people with a disability, which is imperatively important to inform future work on accessible and inclusive gaming. In these, people with visual impairments seemed to prefer to play alone [2, 36]. However, reasons behind this stay unclear. We find a lack of understanding in regard to multiplayer accessible gaming and particularly mixed-ability gaming.

3 CHARACTERIZING MULTIPLAYER EXPERIENCES OF PEOPLE WITH VISUAL IMPAIRMENTS

Our main goal was to learn more about playful experiences of people who have a visual impairment, focusing on experiences shared with other people. We wanted to understand:

- (1) What characterizes the experiences of people with visual impairments when playing games with other people?
- (2) What barriers stand in the way of people with visual impairments when playing and playing with others?
- (3) What opportunities emerge in designing for mixed-ability gaming?

We conducted semi-structured interviews with visually impaired people, including adults and minors. Informed by the first interviews, we launched two online questionnaires, one to be answered by people with visual impairments and the other to be answered by sighted people who play with someone with visual impairments. We then proceeded to data analysis. The study was approved by the Ethics Committee of our school.

3.1 Interviews

We conducted semi-structured interviews with people with visual impairments covering subjects such as playful experiences with family and friends, competition and collaboration both in digital and non-digital games – i.e., board, card and talking games. We adapted interview questions to each group, for example, in the group interviews with younger participants and educators, we asked questions regarding gameful activities at school.

3.2 Online Questionnaires

We built two online questionnaires. One (Q-VI) was to be answered by people with visual impairments, focused on their playing habits, with a particular interest on the barriers that arise when playing alone and with others. The other (Q-S) was to be answered by sighted people that have close contact with at least one individual with visual impairments, focusing on group play experiences with that person.

We advertised questionnaires through mailing lists, social networks and forums, related to communities of people with visual impairments, support networks and audio gaming. We invited people aged 18 or older to participate. To proceed with the questionnaire, all participants verified that they were of this minimum age, also consenting to take part in the study. We collected responses during five months.

The analysis of open ended questions from the surveys allowed us to expand and consolidate the findings of the interviews we were performing locally. Quantitative data collected from multiple-choice questions are related to playing habits and are depicted as an introductory section to our findings. We collected valuable responses from participants who were more experienced gamers and framed their perspectives regarding mixed-visual-ability gaming experiences.

3.3 Participants

We contacted local training institutions for people with visual impairments, where we conducted the first interviews. The group was mainly composed of older visually impaired adults. We decided it would be important to get the perspective of younger people (between 11-18), as age is a factor that influences gaming preferences, motivations and experiences [6]. We proceeded to recruit young participants from public schools with a leading role in the education of blind and low vision minors in our country. In these, for reasons of logistics and minor protection, group interviews were conducted, in which special needs educators also participated. Given their role in schools, and how embedded they become in their students' lives, educators gave an additional lens of the gaming habits, barriers and perceptions of their students, besides the barriers they have faced when procuring accessible gameful material.

We interviewed 10 blind adults (I1-I10), 5M and 5F, aged 34-60 ($M=47.6$, $SD=8.1$); a group of 7 minors, five blind and two with low vision (I11-I17), 5M and 2F, aged 11-18 ($M=13.1$, $SD=2.8$), and two special needs educators, one who was blind; and a group of 3 minors with low vision (I18-I20), 2M and 1F, two aged 13 and one aged 17, joined by two special needs educators. Individual interviews were on average 30 minutes and group interviews took approximately 40 minutes each.

To the first questionnaire (Q-VI), we collected 140 valid responses (R1-R140), 77M and 55F (3 preferred not to say), aged 18-64 ($M=35.1$, $SD=13.7$), from 22 different countries. 67 of the respondents were totally blind (no light perception), 52 of them had severe low vision (visual acuity lower than 6/60), 16 had mild to moderate low vision (visual acuity between 6/12 and 6/60), and 5 preferred not to say.

To the second questionnaire (Q-S), we received 17 valid responses (S1-S17), 2M and 14F (1 preferred not to say), aged 28-61 ($M=43.7$, $SD=8.6$). We asked participants to consider the visually impaired person with whom they have more frequent contact (whom we named Charlie throughout the questionnaire) and to respond regarding multiplayer experiences with that person. We quantified the frequency with which sighted respondents play with visually impaired partners: regarding digital games, 4 respondents play daily with Charlie, 1 plays weekly, 1 plays monthly, 4 play occasionally and 7 never play; regarding tabletop games, 1 plays daily, 2 play monthly, 8 play occasionally and 2 never play. Charlies were 10M and 6F (1 respondent preferred not to say), aged 6-73 ($M=27$, $SD=17.9$) and were identified as a child (8), friend (4), partner (2) and student (3).

Some respondents to the first questionnaire (Q-VI) chose to send e-mails in which they detail their experiences and perspectives regarding gaming. These contacts were mostly due to the sharing of online questionnaires on mailing lists. These responses were also analyzed and contributed to the reinforcement of our findings.

3.4 Data Collection and Analysis

Interviews were audio recorded and transcribed. These transcriptions, open questions to the questionnaires and extra emails received from participants constitute our data. We used inductive thematic analysis (TA) with an experiential orientation under an essentialist theoretical framework [11]. Following the six phases of TA [10], first we familiarized ourselves with the data by reading and re-reading followed by inductively generating an initial set of codes. We continued this phase by refining codes through multiple coding iterations and discussions among the authors. Aiming to promote discussion and to ensure a shared view, we verified inter-rater reliability – two of the authors independently coded 2 individual interviews, 1 group interview and 10% of survey responses, leading to a Cohen's kappa agreement of $k=0.79$. For the next three phases (searching, reviewing and naming themes) we started by close reading codes' excerpts and exploring codes' relationships. The themes were progressively created, iterated, merged and discarded through several iterations of theme summaries with supporting statements and descriptions. Below we present the themes which led our discussions.

3.5 Limitations

Our study provides an in-depth analysis of the perceptions and perspectives of people with visual impairments playing with others. We attempted to recruit sighted people who had experiences playing with visually impaired people, but we were unable to recruit a large number of participants. Therefore, our findings and ensuing discussion reflect the views of participants with visual impairments and are supported by the insights of sighted participants, namely in relation with sighted play.

4 FINDINGS

We introduce a brief characterization of visually impaired participants' playing habits. We then present our findings centered on the themes that reflect our analysis (Table 1). We purposefully use the term 'different' visual abilities, by which we mean any two people with different visual acuity, including both extremes, blind and sighted. We present subjects that may not be exclusively related to multiplayer experiences, but we are careful to frame them in the social context of gaming. Naturally, some barriers we encountered are technical, related to the lack of accessibility in most games. These barriers have already been pointed out by previous studies [4, 21, 34, 36, 54], and are out of the scope of this work. We focus our analysis on the perceptions and concerns that participants had in past experiences that are beyond accessibility issues.

4.1 Gaming habits

Quantitative data collected from the first questionnaire (Q-VI) indicates multiplayer experiences of respondents are infrequent (Figure 1: A and C). 19% of the respondents never play digital games with other people (27) (Figure 1: A). This is congruent with previous studies [2, 36]. Digital multiplayer gaming is overall less frequent for participants with severe low vision. Respondents mainly play digital games with *real-life* friends (65) and online friends (62) (Figure 1: B). On the other hand, they mainly play tabletop games with family (82) and *real-life* friends (78) (Figure 1: D). Participants

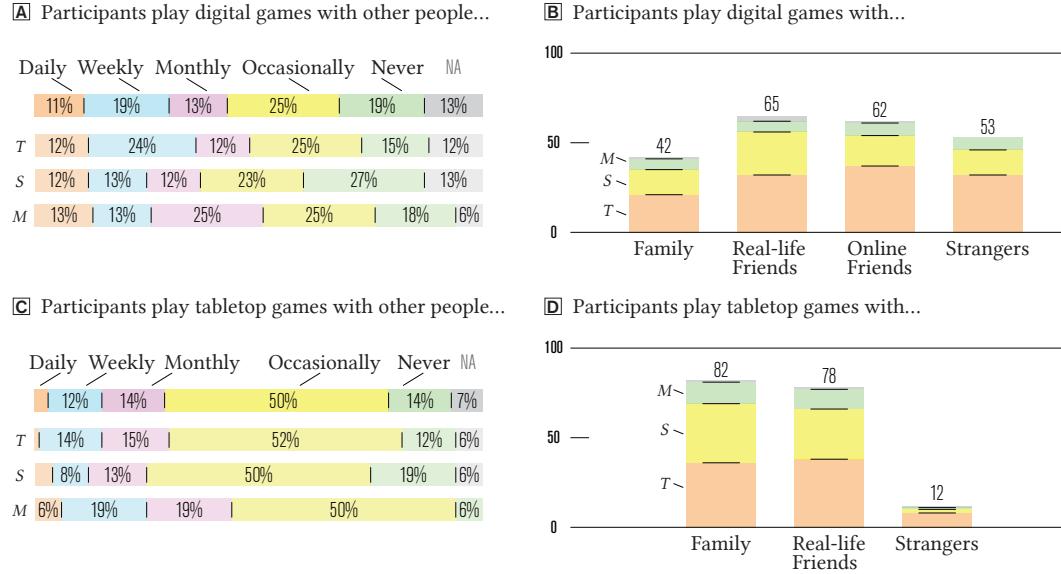


Fig. 1. Gaming habits of respondents to the first survey (Q-VI) particularized by visual impairment of respondents: total blindness (T), severe low vision (S) or mild to moderate low vision (M). A – Frequency with which participants play digital games with other people; B – People with whom participants play digital games; C – Frequency with which participants play tabletop games with other people; D – People with whom participants play tabletop games.

reported experiences with tabletop games as much less frequent than digital gaming. Despite this, fewer respondents marked that they have never played tabletop games with other people compared to digital multiplayer gaming.

Most interviewees stated they mostly play alone, either single-player or competitive games against AI. When playing with others, they mainly play with other visually impaired people. In the first group interview with younger participants, we found that it was unusual for them to play with others with different visual abilities, with the exception of their sighted teacher. We noted that mixed-visual-ability playful experiences were almost always related with mainstream tabletop games (e.g. *Uno*, *Trivial Pursuit*). When playing tabletop games, some participants use assistive software to scan and read printed information, maintain game sheets and roll dice. Moreover, participants often play digital versions of tabletop games, reasoning that pieces, dice and cards are not readable in most physical versions.

Many of the digital games played by participants involve complex worlds and challenges, namely Role-Playing Games (RPG) and simulation games, or imply dexterity, such as shooters and racing games. Among participants, some manage to play highly visual mainstream games. These highlighted the struggle when using emulators or assistive software to play certain games and the effort required in some tasks, in which their impairment makes it more difficult to succeed:

"Many blind people, who have heard about the new accessibility mode in Retroarch, have spent days just trying to configure the software to work, showing me that blind people really want to play great games" – R22.

Other participants pointed out they usually only play games they know in advance are accessible. Some stated they appreciate the variety of accessible games available. However, none of the participants were satisfied with the possibilities to play with others given the lack of enjoyable games to play with people with different visual abilities.

Table 1. Summary of findings and implications for mixed-ability gaming.

Excluded from play
<ul style="list-style-type: none"> • People with visual impairments are limited in playing with family and friends, since mainstream games are vision-dependent and accessible games are unpopular among sighted people. • Some participants avoid getting involved in games that others play, assuming they are not accessible. • Accessible tabletop games are adaptations, are less available and more expensive. • Gaming platforms and habits of people with visual impairments differ from sighted people, baring possibilities of interaction, consequently leading to community segregation and social exclusion.
The accessibility burden
<ul style="list-style-type: none"> • Gamers with visual impairments often adapt non-accessible tabletop games for themselves. • Participants carry their custom adapted versions of tabletop games to be able to play with others. • Groups might agree on working out strategies to make the game more accessible, by tweaking some rules. • Gamers with visual impairments may end up trying to play games that are not accessible to them.
Feedback, fairness and hedonism
<ul style="list-style-type: none"> • Sighted people are not used to audio/text-heavy interfaces and find them complicated and/or tedious to play. • Visual richness of digital games is essential to captivate sighted players' attention. • Visual feedback can be important for more inclusive games, but it may give rise to unfairness. • Unfairness may preclude group play.
The adaptation entrapment
<ul style="list-style-type: none"> • Adaptation is limited when the core gameplay is based on visual engagement. • Adaptation is limited when the gameplay implies synchronous time-restricted gameplay. • <i>A posteriori</i> adaptation may have a negative or unforeseen impact on the experience.
Assistance and playing together
<ul style="list-style-type: none"> • Depending on the game and/or players, assistance may detract from the experience. • Playing a non-accessible game along with a sighted person may be a rewarding experience.
Asymmetric experiences
<ul style="list-style-type: none"> • Taking on different interactions and different challenges for multiplayer gaming can give the opportunity to cater to mixed abilities. • By assuming a strong asymmetric gameplay, each role and challenge can be designed according to the abilities and preferences of each player.

4.2 Excluded from play

For participants with visual impairments, the fact that the vast majority of games are vision-dependent restricts possibilities of playing with sighted family and friends, and inhibits their interest in gaming. Some described experiences where they were excluded from the game or group because other people wanted to play inaccessible games:

"It has happened to me a lot of annoying situations where there is a big group and I had to put myself aside and say I didn't feel like playing. [...] I had to leave because it was not accessible to me. It's annoying because we are a group [...] and in the group everyone sees but me" – I3.

They reported to have tried to engage sighted family and friends with accessible games, but games that are specifically adapted for blind people are ignored by most sighted people:

"Not everyone has Playroom, because Playroom has been adapted for blind people. There's the part of selfishness that is unconscious. Who doesn't need it, doesn't feel it. [...] We continue to be in a world apart. And it's better than nothing but it's not the same thing" – I3

Some participants stated that one of the biggest barriers to an interest in gaming is not knowing what exists and not having someone to guide you through it: "*There are a lot of visually impaired people who end up not even having a clue what it is, because they don't know anyone who would tell them about it*" (I4). One of the teachers in the first group interview explained that some blind children are not interested in games because they are unaware of what exists and assume there are no engaging games for them.

On the other hand, participants with visual impairments described situations in which they avoid getting involved in games that family and friends are playing to avoid the frustration of not being able to play. In the second group interview, one participant reported that he does not even try to play games that sighted friends play, as he assumes they are "*normal games*", in this case games not claimed as accessible or specifically designed for blind people.

Regarding analog games, the problem is attributed mainly to the lack of accessible tabletop games. Participants mentioned that adapted versions of tabletop games are unavailable and typically much more expensive than the standard model. Participants argued that the existence of "custom" versions for blind people is an obstacle to inclusion. Also, it is mentioned that the use of assistive technology may not be well received by some groups and that it may also be an exclusion factor.

From the participants' perceptions, despite the lack of accessible games, what stands out is a lack of intersection of playing habits between people with different visual abilities. One respondent to the first questionnaire (Q-VI) highlights that sighted people often assume that he cannot or would not want to play certain games, thus jeopardizing group play. Some participants frame this exclusion in a broader social dimension, highlighting the disconnectedness that exists between people with different visual abilities:

"Games are a very crucial part of social society. If they were all, or most of them were made accessible, then the blind community would be very appreciative. Games provide a barrier that traps us in a bubble that does not allow us to interact on the same level as our sighted peers" – R79

4.3 The accessibility burden

We realized that, in several situations, the onus of accessibility is pushed upon the gamer with disabilities. Many of the participants with visual impairments adapt analog games that are inaccessible, for example, by adding braille or using materials to give different textures to components:

"When companies produce and manufacture games, they could immediately give a different texture to white and black pieces, for example, in checkers and chess. Because I have to buy a specific chess board for people with visual impairments or else, for example in the case of checkers it has happened many times that I mark pieces myself" – I4

Since most sighted people do not own accessible games, participants with visual impairments have no option but to make sure they have their adapted versions in group play situations: "*I always have to take my own [cards]. [...] I think*

that all the cards, all that are sold out there should be marked [with braille]" (I3). In past experiences of some participants, the group agrees to slightly change some rules of the game so that everyone can be included:

"We modify some games to make them more blind accessible, like making sleeves for cards. For some games, we change the rules slightly by making some private information public. Sometimes we play with teams playing one position so that each team has a sighted player" – R108

However, in many of the cases described, participants with visual impairments end up trying to play games that are not accessible: "*Those who are sighted don't want to play games that are blind accessible so I have to play games that aren't, limiting my ability to actually be a full player" (R109).*

4.4 Feedback, fairness and hedonism

As mentioned, participants with visual impairments repeatedly stated that most sighted people do not care about the games they play. This was corroborated by perspectives of sighted participants: "*Not all games are accessible to those who are visually impaired and those that are often are uninteresting to those who are not.*" (S3). The reason often provided was games specifically designed for people with visual impairments do not have graphics or, when they do, they are not appealing enough. "*I've noticed that, when I talk about Playroom to sighted people, they're not very attracted. Because it really has an audio component, but it has virtually no image at all" (I8).* Moreover, one interviewee expressed her dissatisfaction with a racing audio game which visually is just a black screen, stating she wished other people could perceive the game with their vision:

"Even if we don't see, I think it must be visible. And not being, I don't like it because others are seeing [me playing] and think I'm crazy. [...] People who are sighted, they will not be attracted to it. Like a television... I have a television, I don't see the image but the image has to be there, right?" – I3

Many interviewees came to the conclusion that games could be more inclusive if they provide complementary graphics to an audio-based interaction. On the other hand, participants felt that games designed to be visual first could be unfair: "*With my daughter, I always lose [in chess]. She has a better awareness of the board – more global, right? She could immediately define how to develop the moves" (I8).* This is also pointed out in games where most of the gameplay is accessible, but elements like mini-maps and health-bars are not. Some participants with visual impairments mentioned they are unable to keep up in games involving cooperation: "*Some people don't like to use sound marks to alert me for danger or where to go. [...] The word indicators are small and makes me feel useless" (R43).*

In some cases, unfairness does not detract from the experience. Some participants mention they play some games just for fun with family and friends, even in clear disadvantage:

"When I tried to play table football a few times with my cousins, my nephews and even my daughter - it was just spinning and ... [laughs] When it hit, it went, when it didn't, well... I'm a person, I don't care... I love to play for playing." – I8

Some participants with visual impairments said they end up putting random cards down, just to be included in some tabletop games. However, most participants value an even playing ground to be able to enjoy the game. Sometimes, this is even a factor that hinders multiplayer experiences:

"I don't play much with others because I don't feel it is fair. Most online games are heavily vision-dependent. I used to feel frustrated when playing FIFA with others because I kept missing the ball" – R18

Participants with visual impairments mention the extra cognitive effort of memorizing what happens during the game, constantly being told what is happening or what to do, or just play less adequately compared to everyone else: "*If you can see/memorize what's been played, you know what's left and how to play. I'm a good player, but I know I'm missing things. I just want a game we can be on the same level*" (R25).

Curiously, the opposite was also mentioned, a game with no visual interaction is unfair and even "*not accessible*" to sighted people. Some sighted participants mentioned they are unable to participate or help when Charlie is playing, "*as there is nothing on the screen*". Also, it was stressed that many accessible games have simplistic mechanics, do not stimulate sighted people and even the most complex games are usually based on text-based interaction, which is considered not intuitive and "*just boring*" by those who have no visual impairments.

4.5 Adaptation trade-offs

In the second group interview, one of the young participants, who has low vision, shared his thoughts about one of the most popular games today, Fortnite. He says that even using magnification tools, the gameplay is impractical, as there are too many things happening on the screen and timing is essential. When asked if there would be adaptations that could be made in order to make it more accessible to everyone he stated "*maybe it would lose the essence of the game, if that kind of adaptation... it wouldn't be Fortnite anymore, it would be another game*". (I18)

During individual interviews, we observed participants who became blind as adults enthusiastically spoke of games played before vision loss. Some stated they would like to play accessible versions of these, such as soccer and arcade games. However, participants also expressed the assumption that these could not be adaptable or that vision would be essential for certain games to be enjoyable. I4, for example, says she would love to play *The Sims*, but even if it was accessible, there would be no interest, being that she would not see the actual buildings.

One of the respondents (Q-VI) who contacted us later for further commentaries stated that it is necessary to accept that audio-based gameplay is simply much more limited:

"As soon as the game involves a 2D or 3D map, or tightly timed action, we are completely lost with mainstream games, and I don't see how we can make a game with those elements both enjoyable for sighted people and playable for blind people. The fact is that we are limited with audio compared to what we can represent with graphics." – E-mail from participant

He mentions that gamers with visual impairments will most likely remain limited to specific game genres, namely "*audio games, text games, management games, choice-based or turn-based*". Again, participants highlighted the lack of intersection of games played by people with different visual abilities: "*This is one of the biggest shortcomings. Either the game is fully audio, or the game is visual and often not accessible at all*" (I9). One respondent (Q-VI) pointed out that he would like developers to add alternative ways to complete game challenges:

"It would also be great for developers to include some form of auto navigation so players don't have to see to get around, so the game could automatically walk the character around to the place you want to go" – R129

Several times, regarding both digital and analog games, synchronous time-restricted gameplay was depicted has an obstacle to multiplayer experiences. In many cases, people with visual impairments require more time to access

the same information due to assistive technologies or the inability to process quick visual aids. Participants report how this hinders their multiplayer experiences: "*I used to find when I did this that people didn't want to wait for me to read something, they felt it was too slow*" (R55). This is a factor that can significantly limit the adaptation of multiplayer games to an accessible format.

4.6 Assistance and playing together

Regarding analog games, participants mentioned the assistance provided by sighted players, in reading cards, distinguishing components or moving pieces, and how at times it can be troublesome due to the dynamics of the game:

"Certain games require secrecy, thus meaning I have to work hard to keep cards, sheets, tokens, a secret, despite occasionally requiring assistance in reading/evaluating them" – R29

Participants with visual impairments often rely on someone to play these games, "*which takes time and seems to take away something from the game play*" (R124). In cases where there is the willingness and patience to help, sometimes there is no knowledge or sensibility to assist:

"I love games and believe playing games provides important teaching and bonding opportunities with my children. We have many games in our home, but rely on the children to read directions and often move pieces which is a lot of pressure for them" – R94

In digital games, providing assistance may also be complicated: "*I'm not very good at describing visual scenes when he needs them. Sometimes we play mystery games and the visual hints can be very subtle*" (S1). These scenarios were associated with the trust that has to exist among players: "*It's a trust exercise to play with others, given that the information onscreen could easily be misreported by others to their advantage*" (R29). Some of the respondents (Q-VI) described past experiences in which they play highly visual games "by proxy" — just listening to the game audio and someone sighted is holding the controller. They point out it can be fun and rewarding for both. In some cases, participants play together with sighted people and have the opportunity to influence the direction or some aspect of the game:

"I said that I play a lot of the games listed [answer to a previous question] with other people, but it is mostly them playing with me in the background giving some advice or saying what I want to do or how I want my character to look" – R109

One respondent that later contacted us by e-mail shared his experience with a radio show he followed in the past. In this show, the host would run playthroughs of popular video games, mainly story-driven games with choices. Audience was listening to the game being played and, in parts where there were decisions to be made, they could interact with the host through audio calls and social networks, and vote. The respondent says it was an engaging experience, even though it was someone else actually controlling the game, he had agency in an experience that would otherwise be barred to him.

4.7 Asymmetric experiences

There were those who shared playing experiences or other activities where the interaction or the proposed challenge is not the same for all players:

"I'll be listening to the sound. I won't be seeing. But the person who is with me is seeing. And he might not even be hearing the sounds I'm hearing. [...] There had to be two exits, two channels. [...] I may be listening with audio description, but someone else may be watching the movie and not the audio description. [...] We won't blind anyone, right? The [sighted] person will want to use eyesight to play" – I10

This asymmetry was evidenced mainly at the feedback level, when participants suggested ways to make games captivating for both sighted people and people with visual impairments. One of the respondents (Q-VI) who later contacted us by e-mail referred to past experiences with games in which audio gave information that visuals did not, aiming to create cooperation between people with and without visual impairments. Similarly, another respondent referred to Nyctophobia [42], a board game in which all but one of the players cannot see the board. In this game, the blind/blindfolded players navigate the map through tactile interaction, which is totally vision-independent, while one player is chasing them down, using visual information of the board.

From the perspectives of some interviewees arose the hypothesis that games could be pleasurable for different players, if the game was designed to be challenging in different ways, for different players: *"I think a game is enjoyable and challenging when it fits the kind of activity a person wants to have. The type of interaction the person wants to have with the game" (I9)*. When one interviewee was addressing the difficulty of playing real-time digital games with sighted people, he ended up suggesting that there could be different interactions for each player:

"It's a little difficult, imagining such a scenario. There has to be... there has to be one game interaction for blind people and one for sighted people. There has to be a very big adaptation there" – I1

5 DISCUSSION

Within the concerns, perspectives, and desires of the participants lay design limitations but also opportunities for future work in mixed-ability gaming. While this work focus on mixed-visual-ability multiplayer experiences, some of our findings are likely pertinent to other mixed-ability scenarios. In this section, we discuss these implications and opportunities on game design as well as a better understanding of exclusion factors in gaming that must be addressed.

5.1 Games designed for one stereotype

Gaming is a way of being with others, sharing experiences and interests. However, games are typically designed and developed following a user-centered design. Consciously or not, games are framed to a set of abilities. While this perspective can be highly productive to align design choices with game preferences, it severely impedes cross play of individuals with different preferences and abilities. As such, sharing these experiences is unusual among players with different visual abilities. The reality we perceived during the study was participants with visual impairments play a variety of digital games and are pleased with the growth of accessible games. However, the games they play are often specifically designed for gamers with visual impairments or are not popular among sighted people, namely audio games and text-based games. We suspect the same happens in other mixed-ability scenarios (e.g., one-switch games are specifically designed for motor impaired people).

It was stressed by most participants that accessible games are not designed or captivating to sighted players. Participants report that sighted people are keen to try audio games for the first time but quickly lose interest. The disinterest of sighted players is to be expected as accessible games are typically not designed for them. While it may seem counter-intuitive, we argue that in order to ensure inclusive gaming for people with visual impairments, sighted people stereotypical requirements have to be considered. We are not arguing for Universal Accessibility [41], but rather

considering sets of stereotypical abilities and design for a broader audience, even if not complete. On the other hand, mixed-visual-ability playful experiences we learned about were, in most cases a situation in which people with visual impairments had to adapt to a game that was not entirely accessible to them. These experiences were associated with unfairness or reduced experience on their part. The lack of intersection between games that sighted people play and games that people with visual impairments play is evident. This leads to the emergence of niche communities that revolve around a common interest, in this case gaming, but are bounded around people's abilities.

Previous studies have shown that visual embellishment does not affect performance but improves player experience [26]. Understandably, it was repeatedly mentioned that audio games do not appeal to sighted people because they need visual interaction to be attracted and to be able to play intuitively. Text-based gameplay was considered "*boring*" to and by sighted people. Participants suggested that an appealing visual component could be given to these games. Some audio games include the use of graphical content, but they are the minority. This concern should not go through just avoiding a black screen, but thinking about the experience through a sighted player's perspective. This burden is, evidently, not in the hands of game developers with visual impairments. It is important to promote the collaboration of designers with different visual abilities in the development of more inclusive games. As much as the particular needs of a population are considered when designing a game, the framing of games should not be exclusive.

In this regard, we must consider that the asymmetry of feedback, with equal goals and functions, could incite the situations of unfairness that the participants experience in most mainstream games. Given the relevance many participants give to an even playing ground, we highlight the importance of ensuring that players have access to the same information. This can be difficult to balance, especially considering it can be limiting for game design. Work has been done in this regard, with racing games [37] and fighting games [31]. It is important, in future work, to understand how audio games can have complementary visual feedback without offering supplementary information. On the other hand, it is necessary to explore how visual information that is typically inaccessible in mainstream games, such as health bars and mini maps, can be mapped to auditory interaction without overwhelming the user.

5.2 Technology in analog games

In the case of analog games, it is not only a lack of intersection of habits, but actually a lack of accessible games. Participants repeatedly pointed out that adapted versions of tabletop games are scarce and expensive. They emphasize that, being dependent on others to access information and move components, the experience is often diminished and time-consuming. And, again, assistance depends on goodwill, sensibility, and largely on the patience of the person who assists and the one being assisted. For hands-on interaction, many participants say it is frustrating to be constantly knocking the pieces to be able to perceive the game. They often have to trust their memory and, again, other players to know what happened and what is happening.

There are associations dedicated to the adaptation and accessibility review of tabletop games³⁴⁵, as well as games designed with blind players in mind [23, 42]. However, there is limited research on how to adapt and design accessible tabletop games. Participants believed that not all games can be adapted, since components can have a lot of text and cannot be efficiently brailled. One respondent suggested that a reasonable solution could be to use QR codes. Some participants reported experiences in which the group excluded them because they do not conform to the use of technology in tabletop games. However, several board games currently make use of applications to enhance the

³64 Oz. Games. <http://www.64ouncegames.com/> (Last visited on May 7th, 2020)

⁴Meeple Like Us. <https://www.meeplelikeus.co.uk/about-us/> (Last visited on May 7th, 2020)

⁵Accessijeux - Jeux de société accessibles aux déficients visuels. <https://www.accessijeux.com/> (Last visited on May 7th, 2020)

experience [43]. These games, designed from the ground up to accommodate the use of technology, could be an asset for the evolution of mixed-ability gaming. Notably, Johnson and Kane [28] proposed a system to convert board games into more accessible experiences, by augmenting them with on-demand audio descriptions and tactile landmarks. A set of practices for assistive technology in board games has been suggested [13]. Yet, to our knowledge, there is a lack of research work that focuses on exploring different uses of technology in board games and the potential benefits for the inclusion of people with visual impairments.

5.3 Unawareness and availability

We noticed some interviewees had difficulty finding accessible games to play, in some cases because they lacked digital literacy or trust to search and install games. Especially in the case of the group interviews with younger participants, we realized there was an atmosphere of unawareness leading to a lack of interest in games. The fact that platforms such as *Steam* and console systems are depicted as inaccessible by participants, may contribute to this problem. If people are limited in ways to access and learn about new games, they are being excluded right from the start. The interviewees who played a greater variety of games mentioned websites through which they kept abreast of new audio games, namely *audiogames.net* and *blindgamers.com*. An important step may be the adaptation of mainstream platforms and the creation of new digital platforms that facilitate access to games by people with visual impairments.

5.4 Untangling synchrony

Synchronous multiplayer gameplay is a challenge in mixed-visual-ability multiplayer experiences. In digital games, participants with visual impairments are unable to keep up with the game when there are many elements on the screen to navigate with assistive technology or to read with low vision. Therefore, among the most realistic perspectives of some participants, there is a desire to see more asynchronous digital games being accessible. Participants say that turn-based and choice-based games can be ideal to be adapted to an accessible format. Given that some games with these characteristics are popular among sighted people [1, 15], this could be a viable way to open doors to the entanglement of gaming experiences between sighted and visually impaired people. One of the respondents demonstrated his desire to play popular Collectible Card Games (CCG), saying that only a few changes would be needed to make them accessible. This facet may also prove relevant in the context of other groups with differing reaction times. As such, novel design strategies are needed to unravel the problem of concurrency in mixed-ability gaming.

5.5 Embracing mixed abilities

An issue that is often discussed is the generated tension between ensuring accessibility and adding complexity to a game [2, 37, 54]. Accessibility, in the absence of clever design, may eventually limit gameplay. Some interviewees report that many games they try out are too easy or repetitive. This is a problem already pointed out in previous studies [2]. Participants mentioned some highly-visual games that they would like to play, but were concerned they would be very difficult to adapt. The approach of adapting games, simply by converting non-accessible information to accessible information is tempting, but it has consequences on the experience [54] — especially, when done *a posteriori* it may have negative consequences. Accessibility guidelines are essential to guide game design, however it is inconceivable a set of actionable guidelines that guarantee accessible gameplay, inclusion, and equity in the experience. Thus we believe this tension can only be relieved through clever design and new approaches. It is imperative to create gaming experiences that can be equally enjoyable for groups with mixed abilities.

Related work examines mixed-visual-ability collaborative routines in home settings [9] and the office [8]. Similarly, in this study, we learned about practices of sighted and visually impaired people in co-creating accessible gaming. Participants with visual impairments told us about experiences in which they play games indirectly and a sighted player is using the controller (i.e. playing by proxy). In none of these, the perspective is negative, on the contrary, these scenarios are valued as a way of experiencing something that would otherwise be barred. They refer to experiences in which the sighted person controls the game and they make meaningful gameplay or narrative decisions. The feeling of indirect agency could be central in these scenarios, since the ability to affect the game narrative is a critical factor that attract blind people to gaming [2]. Participants point out that these experiences can be enriching for both. Creating game scenarios in which players are interdependent may “*challenge traditional hierarchies of abilities*”, emphasizing contributions from people with diverse abilities [5]. While there are no current features that are advertised to support this practice in mainstream games and platforms, there are examples of how features can facilitate this type of gaming experience. For example, the Xbox One Co-Pilot ease of access feature⁶ links two controllers to act as one, enabling both players to have an active role. Also, we can envision a service where proxy players serve as a way to interact with the game without actively intervening.

We believe there is room to explore alternative ways of experiencing the games in which, for example, some interaction is reduced to enable the experience. Some participants consider that world-navigation often precludes their participation in many of the mainstream games. It was previously established that in-game navigation is not perceived in the same way by people with different visual abilities and that it is necessary to consider these differences in game design [3, 39]. One of the respondents suggests that it would be innovative if there were alternative mechanics allowing to complete challenges that are not accessible, giving the example of auto-navigation. We argue that adjusting or reducing interaction in a case like this may not necessarily mean reducing the experience. In some cases, it can open up opportunities for other ways to experience the game, for example auto-navigation combined with audio description. Some games offer an alternative gameplay mode in which the player navigates the world with an audio commentary [48]. Evidently, in a scenario where the gameplay is converted into a more static version, the game might come near a cinematic experience. However, it can open doors for people with different abilities to have closer habits and interests. It will be relevant, in future work, to explore alternative ways of experiencing gameplay in designing for inclusive gaming and perceiving the impact on the experience and perceptions of people with disabilities.

5.6 Embracing asymmetry

Our findings highlight a tension that emerges from mixed-visual-ability group play: maintaining fairness may limit enjoyment and vice versa. It was spontaneously suggested by some participants that this tension may be relieved if the game provides asymmetric interaction. We argue that acknowledging different abilities may allow us to create experiences that challenge and engage each player. The concept of asymmetry has been previously explored in games designed for mixed-ability groups, markedly used in the conception of different roles for different players [16, 19], and influential to the point of using different game profiles adapted to each player [22]. However, we have no conclusive answers as how we can go about designing this type of experiences in this context.

Asymmetry has been shown before to increase social presence and connectedness [25]. Games with asymmetric roles have been successful in mainstream gaming, with players often entangled in a collaborative dynamic through a variety of game mechanisms. For example, in *Keep Talking and Nobody Explodes* [40], one player is the “Defuser”,

⁶Copilot on Xbox One. <https://beta.support.xbox.com/help/account-profile/accessibility/copilot> (Last visited on May 7th, 2020)

responsible for disarming a bomb with no instructions and the other players are the “Experts”, who have access to the bomb manual. Each role implies a specific interaction and challenge and players depend on each other in order to succeed in the game — the interdependence is purposely designed. In strong asymmetric gameplay, each role can be designed according to the abilities of each player and more than one stereotype may become an intrinsic part of the game design process.

We believe research on the subject must be aware of unintended consequences that occur in other contexts where there is a separation of technologies and/or experiences. On the other hand, we recognize the limitations to game design by seeking for symmetric experiences in mixed-ability gaming. We see the opportunity to alleviate these limitations and cater for different abilities, by assuming a strong asymmetry on the gameplay with entwining mechanics. In this discussion, we draw attention to “asymmetry” and other design spaces that have potential for mixed-ability gaming. It is necessary to explore these different design spaces to create experiences that, even if not equal, may be fair, enjoyable and challenging to everyone.

5.7 Future Work

We emphasize the space that exists to be explored towards more inclusive gaming, more specifically in group gaming experiences with mixed visual abilities. These spaces are born from 1) the need to consider a broader targeting in the design of accessible games and even in games specifically designed for people with disabilities; 2) the potential of using technology in analog games and benefits for people with visual impairments; 3) the inaccessibility of gaming platforms and lack of accessibility information on games available in these platforms; 4) the opportunity in designing games with asynchronous gameplay for mixed-ability gaming, in the sense of designing games that can be enjoyed at the pace of each player; 5) the opportunity to explore alternative ways of experiencing a game and enabling game mechanics, such as auto-navigation in digital games; 6) the opportunity to explore strong asymmetric gameplay in the sense of designing and entwining different interactions and challengers fitting the needs and preferences of each player. Research work in these spaces may lead to a larger intersection of gaming habits and interests of people with different visual abilities.

6 CONCLUSION

In this study, we present a characterization of mixed-visual-ability multiplayer experiences, based on the perspectives of people with visual impairments. While substantial work has been conducted on the topic of game accessibility, this study suggests that there is a lack of intersection in gaming habits of people with different visual abilities. This causes situations of exclusion in group play and gives rise to isolated communities. Most games are designed from a perspective of binary targeting, either targeting sighted people or people with impairments. We suggest opportunities in designing games that can simultaneously cater to different abilities. We highlight points that must be addressed so that mixed-ability gaming is no longer associated with diminished and precluding experiences and that, on the contrary, may reduce stigmas and make room for a more inclusive society.

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