Perspectives on Mixed-Ability Competition

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Abstract

Competition is typically centered on balance, fairness, and symmetric play. However, in mixed-ability competition, symmetric play is often not possible or desirable. Currently, it is not clear what can or should be done in the pursuit of the design of inclusive competitive experiences (in sports and games). In this paper, we interview 15 people with motor or visual disabilities who actively engage in competitive activities (e.g., Paralympics, competitive gaming). We focus on understanding engagement and fairness perspectives within mixed-ability competitive scenarios, highlighting the obstacles and opportunities these interactions present. We relied on thematic analysis to examine the motivations to compete, team structures and roles, perspectives on ability disclosure and rankings, and a reflection on the role of technology in mediating competition. We contribute with an understanding of (1) how competition is experienced, (2) key factors influencing inclusive and fair competition, and (3) reflections for the design of inclusive competitive experiences.

CCS Concepts

• **Social and professional topics** → **People with disabilities**; • **Human-centered computing** → **Empirical studies in accessibility**; • **Applied computing** → *Computer games.*

Keywords

mixed-ability, competition, disabilities, competitive gaming, sports, accessibility

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1 Introduction

Competition is an inherent aspect of human interaction, influencing development and social dynamics across diverse life stages and environments [13, 14, 21, 47]. From childhood to professional careers, competitive experiences shape skill development, motivation, and social dynamics [17, 47].

Traditional sports, as exemplified by the Olympics and Paralympics, divide athletes based on their abilities[1], adapting events to different impairments, resulting in disability disclosure enforced by design. Through explicit disability disclosure, these divisions recognize the diversity of abilities and strive to minimize any inherent advantages or disadvantages. This approach aims to ensure fairness by having athletes compete with others who are categorized as having comparable abilities. Furthermore, players often compete in adapted sports that were specifically designed with their abilities in mind (e.g., boccia). However, while these methods aim to ensure fairness within segregated groups, it does not enable competition across diverse abilities.

In contrast, most competitive games do not implement such structured divisions and do not require participants to disclose their disabilities. As a result, games, in principle, do not segregate players based on abilities. However, the ability to participate effectively can vary widely, depending heavily on the accessibility features and inclusive design of the game. These adaptations include customizable controls, alternative input methods, and game mechanics designed for various abilities [12]. Without thoughtful design, games can create barriers for players with disabilities, resulting in an uneven playing field (e.g., hindering a player's ability to contribute effectively to team efforts). Games tailored for specific abilities, like audiogames for visually impaired players, also exist, mirroring the concept of adapted sports by providing alternative experiences designed for particular disabilities. However, these specialized games can lead to community segregation, where players with disabilities may be confined to separate spaces rather than integrating into the broader gaming community. This can reinforce the divide between mainstream and adapted gaming experiences, limiting opportunities for shared experiences. Despite these challenges, gaming holds a unique opportunity to foster inclusive mixed-ability competition. The adaptability of digital games enables individuals with diverse abilities to compete more equitably than might be possible in traditional sports settings. In recent years, accessibility in games has seen notable advancements, particularly in single-player [20] and cooperative experiences where mixed-ability design has made significant strides [27, 31].

However, when it comes to mixed-ability competition, the challenge is exacerbated from just requiring equality in the play experience (regardless of differences in gameplay), to how to design for a perceived fair competitive experience. Still, ensuring fairness becomes a challenge in mixed-ability contexts due to the impracticability of uniformly applying rules [36] as not all challenges can be accessible without significant changes. Questions related to disability disclosure also arise, as the lack of structured divisions—common

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[1]Paralympic Classification URL: https://www.paralympic.org/classification (visited on 09/02/25)

in traditional sports—means that players' abilities and impairments may not be immediately visible or known. This can lead to challenges in ensuring fair play, as differences in abilities may affect the gameplay experience in ways that are not immediately apparent. Addressing these concerns demands a holistic approach that goes beyond technical accessibility features. It involves designing game systems and competitive structures that consider the diverse needs of players and how these needs intersect with perceptions of fairness.

Recent developments in the world of competitive gaming, notably the announcement of the Olympic Esports Games set to debut in 2027 in Saudi Arabia[2], underscore the growing importance of considering inclusivity in competitive environments. The International Olympic Committee (IOC) has taken a significant step by creating a new platform that reflects the digital age and broadens the scope of competitive activities. This evolution presents a timely opportunity to reexamine how competitive experiences, both in sports and gaming, can be designed to be engaging, fair, and accessible for all.

In this paper, we explore the perspectives of 15 individuals—10 with visual impairments and 5 with motor impairments—through semi-structured interviews, focusing on their experiences and perspectives on competitive activities, including engagement, social inclusion, and fairness. Participants had diverse competitive experiences, from paralympic athletes and expert gamers to athletes in local sports and casual gamers. Our research examines how individuals experience competition based on functional classification and mixed competitive scenarios, with an emphasis on identifying opportunities for designing inclusive competitive gaming environments. Specifically, our research questions are:

(1) How are people with disabilities experiencing competition with others?
(2) How do people with disabilities envision mixed-ability competition being designed to be inclusive and equitable?
(3) How does ability disclosure impact ranking, sorting, and player classification in mixed-ability competitions?

Our work reflects on the perspectives of people with motor or visual impairments on mixed-ability competition. Throughout the work, we will refer to people with disabilities and mixed-ability gaming referring to these specific groups, and while we believe they are informative to any mixed-ability competition scenario, the perspectives of other communities might unveil additional considerations. Our results detail the current structures of competition (when in teams and individually) for people with disabilities in sports. We reflect on the interplay between access, fairness, technology, and the specificities brought forward by the interaction with the rules of different sports and games. We discuss the key decisions implicitly or explicitly made when creating sports events or games (e.g., disability disclosure, matchmaking policies) and their impact on players. Lastly, we draw attention to the potential seen in mixed-ability competition in games and discuss the implications for fairness and balancing when accommodating any kind of asymmetric play.

[2]International Olympic Committee. Inaugural Olympic Esports Games to be held in Riyadh in 2027 – Road to the Games to start this year URL: https://www.olympics.com/ioc/news/inaugural-olympic-esports-games-to-be-held-in-riyadh-in-2027-road-to-the-games-to-start-this-year (visited on 11/02/25)

2 Related Work

In this section, we explore existing research on concepts of competition and fairness, competition in sports and gaming, and mixed-ability gaming.

2.1 Concepts of Competition and Fairness

Competition between individuals or teams is a central aspect of most sports and of many other life activities in our modern culture. People engage in competition for various reasons. Some aim to develop mastery and achieve excellence, while others find excitement in the act of winning itself [69, 83]. Additionally, some competitors are motivated by external rewards, such as symbolic or monetary incentives tied to victory [83].

Shields et al. [69] consider that true competition involves two or more opponents jointly seeking excellence. The purpose of contests is to promote an enjoyable quest for improvement, whether in sports, academics, politics, or economics. For instance, sports contests aim to showcase and develop physical prowess, while academic competitions seek to foster intellectual curiosity and academic growth. True competition requires both an external contest and an internal mindset that views the contest as an opportunity to strive for excellence and find enjoyment in the pursuit of meaningful goals, rather than merely seeking victory. This interpretation of competition encourages maximum effort and supports both personal and collective growth. However, it's important to recognize the dual nature of competitive environments, as they also harbor the potential for negative or toxic interactions among participants/supporters [48, 50, 69, 77], which may vary in severity [25]. These interactions underscore the challenges associated with sportsmanship and fair play within competitive settings, where tensions and conflicts can arise amid the pursuit of victory. Additionally, engaging in competitive scenarios carries the risk of losing, which can diminish overall enjoyment [66, 85].

Fairness plays a pivotal role in competition by ensuring players perceive they have an equal opportunity to succeed. In sports, it extends beyond adherence to rules and encompasses the broader principles of ethical conduct and equal opportunity. Fair play is central to this concept, advocating for respect towards opponents, adherence to regulations, and maintaining dignity regardless of the outcome [57, 67]. It represents a commitment to ensuring that competition remains equitable and that all participants have an equal chance to succeed [57]. This perspective highlights that fair play involves not just following the rules but upholding justice and integrity in the competitive process, emphasizing equal opportunities for all participants, and maintaining respect and ethical considerations throughout the contest [28, 56]. While fair play is often associated with positive values and proper conduct, its essence lies in justice and equal opportunity within competitive contexts [68, 76].

2.2 Competition in Sports and Gaming

Competition is a fundamental aspect of sports and most multiplayer games. In traditional sports, classification systems (e.g., weight classes, disability classifications in the Paralympics), and regulation

on technological advancements (e.g., LZR Racer swimming suits[3]), aim to level the playing field so that the outcome of the competition is determined by skill, training, and effort, rather than external advantages [78, 80]. In gaming, mechanisms such as matchmaking algorithms and ranking systems aim to ensure equity by pairing players of similar skill levels, while also offering players a tangible representation of their progress and skill [6]. The balancing of game mechanics is also a key aspect, calibrating resource and power dynamics to prevent undue advantages and maintain skill-based competition; for instance, live-service games continuously adjust rules to ensure fairness and keep players engaged [88]. Unlike traditional sports, gaming operates within a different landscape due to the absence of established classification systems and the evolving nature of accessibility features (e.g., customizable controllers for players with disabilities), creating dynamics for fair competition that are yet to be explored. This section examines how competition is structured and experienced, focusing on the categorization of athletes in the Olympics and Paralympics, the landscape of esports, and the impact of technology and accessibility in both fields.

2.2.1 Olympic and Paralympic Model: Categorizing Athletes. In mainstream sports, competitors are often categorized based on social factors like age and gender, as well as physical attributes like weight. This classification system is designed to ensure fair competition and recognize participants' different physical and developmental stages [87]. Opportunities for participation in sports for people with disabilities are significantly influenced by sports classification and perceptions of their athletic abilities.

Experts in disability sports consider classification to be a central issue, and it is identified as a key area requiring further research [78, 80]. In sports, classification systems are designed to encourage participation by individuals with disabilities while balancing the impact of impairments on competition outcomes, aiming for fairness [79]. Some categorize athletes based on observable properties through medical diagnosis, which may prove unjust due to the subjectiveness of these methods, and others categorize athletes based on an objective and functional level [81]. For Paralympic sports, the International Classification of Functioning, Disability, and Health[4] [44] provides a standardized framework for categorizing impairments and activity limitations, seeking to balance the impact of impairment on competition outcomes [80]. To achieve this balance, the system separates athletes with different abilities, preventing them from facing each other in the same event (e.g., a blind athlete competing with a sighted athlete).

Classification systems vary across sports, reflecting their unique demands. For instance, Boccia[5], a Paralympic sport without an Olympic counterpart, was originally designed for individuals with coordination impairments but now includes athletes with various impairments. Its classification system groups players based on the severity of their physical impairments and their impact on performance. Players compete in wheelchairs and are classified into four discrete categories (e.g., BC2 can throw without assistance; BC3, who have more severe impairments, use a ramp and pointer to direct the ball with support from a ramp operator). Another example is Paralympic swimming[6] which uses multiple sports classes for athletes with physical, visual, and intellectual impairments. It employs a functional classification system, which groups athletes based on how their impairments impact their ability to perform in the sport. For instance, athletes with physical impairments are classified into 10 classes based on their mobility level, while athletes with vision impairments are classified into 3 classes depending on their residual vision. The differences between sports classification assessments highlight the complexities of establishing a fair inclusive competition.

The barriers to participation in sports for individuals with disabilities extend beyond classification. Engaging in sports and physical activities has been linked to numerous personal and societal benefits, prompting the establishment of policies and initiatives to promote sports participation [2, 4]. However, literature on disability sports highlights several barriers to participation, such as lack of time, finances, and stigmatization [18, 86]. Inclusive sports aim to address some of these barriers, promoting full participation and social inclusion, which benefits both individuals with disabilities and the broader community [18, 24, 63, 74, 82]. Research indicates that social inclusion initiatives in sports have broader benefits beyond individuals with disabilities [51, 52, 70]. A study on Mixed-Ability Rugby [16], an inclusive sport where disabled and non-disabled players play alongside one another, revealed a potential for achieving inclusive outcomes, leading to enhanced social networks, increased social capital, personal development, and fundamental perception shifts among participants, regardless of ability.

2.2.2 Esports. Global esports organizations, such as the International e-Sports Federation[7], advocate for the recognition of esports as professional sports. However, consensus on its classification remains an ongoing discussion [39]. Research reveals parallels between esports and traditional sports regarding consumption motives [40]. Moreover, esports is gaining acceptance within the sports community, as evidenced by sports organizations' investment[8] in esports teams. With attributes akin to traditional sports, such as intense competition, participation, sponsorship, and rigorous training [45, 75], esports has evolved into a significant leisure and professional activity, shaping contemporary consumer culture.

While classification systems are integral to traditional sports, they are largely absent in competitive gaming. Unlike traditional sports, where structured divisions are used to balance competition, the digital nature of gaming allows for adaptable and innovative solutions for fair competition across people with diverse abilities. In games where perceived difference between players (e.g., skill) exists, prior works have explored creating asymmetries in game mechanics (e.g., aim assist, asymmetry of information) to balance the experience and promote engagement [7, 84]. While these works

[3]NASA (2008). Space Age swimsuit Reduces Drag, Breaks Records URL: https://ntrs.nasa.gov/api/citations/20090002494/downloads/20090002494.pdf (visited on 11/09/24)
[4]World Health Organization. International Classification of Functioning, Disability and Health (ICF) URL: https://www.who.int/standards/classifications/international-classification-of-functioning-disability-and-health (visited on 12/09/24)
[5]Boccia in Paralympic Games, Paris 2024 URL: https://www.paralympic.org/paris-2024/video/sport-explainers-paris-2024-boccia (visited on 09/02/25)
[6]Para Swimming in Paralympic Games, Paris 2024 URL: https://www.paralympic.org/paris-2024/video/sport-explainers-paris-2024-para-swimming (visited on 09/02/25)
[7]International e-Sports Federation URL: https://iesf.org/ (visited on 10/12/24)
[8]Iarfhlaith Dempsey (14/12/23). Beyond the field — how sports clubs are opening up new horizons through esports. Esports Charts URL: https://escharts.com/news/sports-clubs-in-esports (visited on 25/08/24)

reflect on the impact on perceived fairness, players are mostly playing symmetric games and have equal modalities of play. Furthermore, balancing efforts in game design lack a comprehensive definition, with symmetry often associated with fairness [9, 60, 65]. Consequently, the concept of fairness in game design frequently revolves around symmetry, leaving a gap in addressing fairness within mixed-ability contexts where asymmetric play is often necessary. In mixed-ability scenarios, inherent asymmetries—whether in gameplay, interface, or required adaptations—pose unique challenges for applying traditional fairness principles. This oversight underscores the need for more research into creating fair competitive environments in games that accommodate diverse abilities.

2.2.3 Technology and Accessibility. Technological advancements have significantly transformed the competitive landscape for non-disabled athletes. Innovations such as the LZR Racer[9] swimming tech suits have enhanced performance by reducing drag and improving buoyancy, leading to remarkable achievements in swimming competitions. Similarly, in ski jumping, technology helps manage factors like start position, K-point, and wind conditions to ensure fairness and optimize performance. In bowling, professional athletes use custom-designed balls tailored to their grip, weight, and dynamics preferences, showcasing how personalized equipment enhances performance. For athletes with disabilities, adaptive technologies such as advanced prosthetics and specialized training equipment have enabled participation at higher competitive levels [8]. However, concerns about access, affordability and fairness arise, as disparities potentially created by these technologies increase. Furthermore, technology use in adaptability/improvement is a contention topic, with unclear boundaries. While some technology is embraced in the olympics (e.g., pole vault materials[10]), others have been prohibited (e.g., running-prostheses) and only accepted under specific categories, resulting in works seeking to understand the effects of these devices' advantages [22]. These advancements illustrate how technology can push the boundaries of human capability and redefine competitive standards in sports, yet it remains unclear how disability and technology intersect.

Baldwin et al. [5] present a participatory design in the context of assistive technology for canoeing, emphasizing mixed-ability collaborative design from the outset. In their work, sighted and visually impaired individuals directly collaborated with researchers to co-create assistive devices, ensuring that the design process was inclusive and representative of the needs of all participants. This approach recognizes people with disabilities not just as end-users but as co-creators, promoting equity and agency throughout the design process. Baldwin et al.'s model stands in contrast to traditional universal design approaches by emphasizing active involvement and co-creation. By fostering a sense of ownership and agency, their approach promotes innovation and accessibility, ensuring that solutions are both functional and empowering. This methodology highlights the potential for game design to follow similar principles of inclusivity, where players with different abilities can contribute meaningfully to the design and gameplay experience, rather than being positioned as passive participants.

2.3 Mixed-Ability Gaming

Various initiatives aim to make games accessible for individuals with disabilities, and often led by communities of disabled gamers (e.g., AbleGamers - Accessible Player Experiences (APX)[11]). Research has also contributed investigating accessibility in games for people with visual [31, 32, 71], motor [11, 27, 42], hearing [54], and cognitive [61] impairments. While research and industry commonly advocate for accessibility to broaden gaming accessibility for all, games are often designed with a particular user in mind and are, therefore, framed for a set of abilities. This diminishes the potential for inclusive gameplay experiences, where individuals collectively engage with games. Below, we first discuss how players with disabilities adapt to games, followed by an overview of two design approaches for mixed-ability play: universal game design and asymmetric game design.

2.3.1 Adaptation Strategies in Mixed-Ability Play. Players with disabilities often adapt their expectations and playstyles to engage with games that are not explicitly accessible. Two of the four main strategies participants employed during adaptation, as identified by Martinez et al. [53], are adapting expectations and adapting play. **Adapting expectations** involves either "powering through" barriers—enduring frustration or discomfort—or ceasing play when accessibility challenges make a game unplayable. **Adapting play** enables players to creatively modify their interaction with a game, favoring mechanics that better suit their abilities (e.g., ranged combat), or redefine their objectives, treating games as spaces for exploration or social connection rather than competition. Gonçalves et al. [29] document similar approaches among blind players, who creatively repurpose game elements—such as using audio cues or spatial markers—to navigate otherwise inaccessible environments. Social reframing is also common; for instance, Mario Kart [23] might be viewed as a casual social activity rather than a competitive race, or in GTA RP [59], using the game's open-world environment for live storytelling and role-playing, which makes it more accessible to some players by shifting focus away from traditional gameplay. These player-driven strategies highlight the adaptability and ingenuity of gamers in overcoming barriers but also expose a critical gap: accessibility should not rely solely on improvisation but must be an integral part of design. By understanding these adaptation strategies, game designers can uncover opportunities to build games that inherently support diverse playstyles.

2.3.2 Universal Game Design. Universally accessible games [33–36], consist of games that are designed to be adaptable to players with diverse abilities, enabling them to play together. Work by Grammenos et al. [36] introduces Parallel Game Universes, where each player plays a unique instance of the same game, and input and output are adapted to their needs. This paradigm was applied when designing universally accessible versions of chess [35], tic-tac-toe [62], and Space Invaders [34]. The feasibility of applying this approach to more complex games remains uncertain, as it may

[9] 3

[10] Olympics. See how the evolution of carbon fiber poles changed the pole vault world. The Tech Race URL: https://olympics.com/en/original-series/episode/see-how-the-evolution-of-carbon-fiber-poles-changed-the-pole-vault-world (visited on 12/02/25)

[11] AbleGamers - Accessible Player Experiences (APX) URL: https://accessible.games/accessible-player-experiences/ (visited on 12/02/2025)

require significant simplification and may not be scalable to all gaming contexts. In this model, customized profiles are utilized to modify the game interface and difficulty levels for individual players, creating distinct "game universes". However, by assigning identical roles and tasks to all players, the proposed solution is to decrease the game's difficulty for those unable to keep pace with the challenge. This strategy may inadvertently reinforce negative stereotypes by portraying players with disabilities as less competent and diminishing the value of their contributions.

2.3.3 Asymmetric and Role-based Play. Ensuring fairness becomes a challenge in mixed-ability contexts, due to the impracticability of uniformly applying rules [36] as not all challenges can be accessible without significant changes. Asymmetric play is gameplay where different players have access to different sets of mechanics [26, 41]. Asymmetry in games can manifest in several forms [41], such as asymmetry of ability (players have unique traits, unavailable to other players), challenge (differences in challenges/obstacles the player faces), interface (how players engage with the game, i.e. input and output), information (differences in player's knowledge), investment (differences in time investment), and goal/responsibility (players seek different outcomes).

Asymmetric design was used before to create multiplayer cooperative experiences for mixed-ability groups. Last Tank Rolling [27] is a collaborative two-player motion-based game where one user in a wheelchair controls a tank while one able-bodied player plays as a foot soldier, avoiding obstacles and fighting enemies to reach their goal. Similarly, Gonçalves et al. [30] explored asymmetric roles in games for pairs with mixed-visual-abilities, emphasizing collaboration and creating an engaging and inclusive experience for both sighted and blind players. Asymmetric design was previously explored in competitive mixed-visual-ability gaming, focusing on exploring alternative modalities. Grabski et al. [32] designed Kinaptic, a tag-like game for both blind and sighted players. The game featured an asymmetric setup where sighted players interacted using a Kinect camera and TV for visual feedback, while blind players relied on a haptic device, wind simulation, and 3D sound. The study evaluated the environmental awareness of the alternative interface created with mixed results. Similarly, VR Showdown [1] was developed to allow visually impaired and sighted (blindfolded) players to engage in competitive gameplay together. The game is a virtual reality adaptation of the fast-paced, air-hockey-like sport, originally designed for individuals with visual impairments. It incorporates 3D spatial audio and haptic feedback, enabling visually impaired users to detect and interact with a fast-moving ball in real-time based on sound cues and vibrations. In its multiplayer Player vs. Player (PvP) mode, visually impaired and sighted players can compete remotely in real-time. The study demonstrated that visually impaired players could enjoy well-matched gameplay against both AI agents and sighted participants, showing that players with visual impairments can compete equally with sighted players. Still, we have yet to understand how players experience and envision mixed-ability competition, in particular the complexities around fairness, transparency and potentially asymmetric gameplay.

In many asymmetric competitive games, team imbalances often arise due to one team possessing strong abilities, requiring the larger team to communicate effectively to contend, as seen in Dead by Daylight [43] and Evolve [73]. Round-based gameplay is another common approach. This involves players switching roles after each round, maintaining balance throughout the game. Exploring dependency among asymmetric players, Torchless [19] investigated shared-screen competition. In this game, a player's actions may allow the opposing player to use a more powerful set of skills that can tip the game's balance against them. In VR asymmetric play, where roles are expected to be reversed, works have embraced an imbalance between the two players, as highlighted in several studies. Gugenheimer et al. [37, 38] emphasized the significance of power and skill imbalances in asymmetric VR gameplay, while Kerure and Freeman [46] and Zhou et al. [89] also explored similar themes. Gugenheimer et al. noted that the difference in "power level", manifested through asymmetry in information, ability, and interface, drove enjoyment and need not necessarily be equally balanced, as players restrained themselves, knowing they would switch roles. This imbalance is inherent in asymmetric VR games, where players typically take on different roles with varying degrees of power and agency. In mixed-ability scenarios, roles cannot be reversed when designed based on ability, as some may be inaccessible to players with disabilities. Leveraging asymmetric game design for competitive mixed-ability games introduces a unique set of challenges and opportunities.

3 Methodology

We conducted semi-structured interviews with 10 visually impaired and 5 motor-impaired individuals, some of whom are currently active in competitive activities (i.e., sports and/or gaming) while others have participated in the past. Of the total participants, 13 interviews were conducted in-person at our Faculty, or at local institutions for people with visual impairments and 2 were conducted online. The sessions lasted on average 39 min (SD=17) and were audio recorded. Participants received compensation in the form of a €5 voucher or equivalent for their time. This study was approved by the Ethics Committee of our school.

After a brief demographic questionnaire, we initiated the semi-structured interview organizing around the following topics. We explored participants' **current and past engagement in competitive activities**, focusing on their participation frequency, types of activities, and experiences with different competitive settings, including casual and professional contexts. Next, we investigated **motivation for competition**, examining what drives them and how they select partners/opponents. We examined perspectives on **mixed-ability competition**, gathering views on integrating individuals with different abilities versus maintaining separate categories (e.g., Paralympics), and the pros and cons of each approach. In the context of **digital and non-digital games**, we gathered insights on both video games and traditional games (e.g., card and board games), addressing accessibility challenges and differences from traditional sports. We prompted participants to reflect on: 1) **disability disclosure**, 2) **matchmaking, classification, and ranking** players based on abilities/disabilities, and 3) **the role/potential of technology**. Lastly, we addressed inclusivity challenges and perspectives on fairness in competitive environments. The interview script is available in the supplemental material.

3.1 Participants

To reach volunteers, we shared the study through our networks and contacted local institutions and associations for educational and/or recreational activities for people with impairments. During the interview participants filled in a form providing demographic information (i.e., age, self-identified gender, disability, competitiveness, and gaming frequency). We interviewed 10 people with visual impairments, 6M and 4F, aged 20-48 (M=34.3, SD=8.2), and 5 people with motor impairments, 3M and 2F, aged 27-52 (M=40, SD=9.3), two described having cerebral palsy, one has only one lower limb with mobility, all were at times wheelchair users, and one used a rollator occasionally. Among the participants 1 participated in Paralympic competitions, 3 participated in world competitions, and 7 participated in international competitions. In addition, 2 were also coaches, 1 is president of an association for inclusive sport, and 3 expert gamers, one of which is a game accessibility consultant [72].

Table 1: Demographics Questionnaire.

ID	Gender	Age	Disability
B1	F	36	Low Vision
B2	M	24	Light Perception
B3	M	48	Light Perception
B4	M	28	Low Vision
B5	M	39	Low Vision
B6	F	35	Blind
B7	M	37	Blind
B8	F	20	Blind
B9	F	39	Low Vision
B10	M	37	Blind
M1	M	42	Motor-Impairments
M2	M	39	Motor-Impairments
M3	M	52	Motor-Impairments
M4	F	45	Motor-Impairments
M5	F	27	Motor-Impairments

3.2 Data Analysis

Interviews were manually transcribed by the first author. We performed a mixed deductive-inductive codebook thematic analysis [10] over all open-ended questions of the interview. We familiarized ourselves with the data by iterative reading, then the first author developed codes based on research questions, data familiarity, and study observation. The team discussed interpretations and developed a preliminary codebook. The first author coded all interviews, adding new codes as needed. Themes were outlined, named, and discussed over multiple sessions with all members of the research team. The team is composed by non-disabled male members, one junior and two senior researchers with past work on accessibility and inclusive gaming.

4 Findings

Participants had a wide variety of competitive experiences and played a variety of sports and games (table 2). Participants were asked to describe how competitive they consider themselves, with most self-identifying as highly competitive, with the remaining three describing how it's about pushing their boundaries or being social and active with others. Four had previous experience with mixed-ability competition in sports (i.e., three with rowing, one with blind football), and eleven had played games with mixed-ability groups. All participants were actively involved in or had previously participated in either individual or team-based competitive activities. Below, we present our themes divided into: 1) Reasons to Compete, 2) Understanding Competition Structures, 3) Key Decisions when Designing Competitions, 4) Barriers to Adapted Sports, and 5) Mixed-Ability Gaming and Sports.

4.1 Reasons To Compete

Participants identified several motivations for engaging in competitive activities, highlighting both personal and social factors. Common reasons included striving for self-improvement, the intrinsic joy of participation, the thrill of competition, the dynamics of group or team play, and exercise. Many participants saw these activities as an opportunity to forge friendships and experience a sense of belonging. These motivations align with findings from existing research [69, 83].

For instance, B2 emphasized the importance of personal growth, "*It's the fact that I can improve through training and also help others as much as I can. It's the desire to get better that drives me*". M2 emphasized the need for different types of competition to cater to various experience/skill levels: "*Some people play for fun, not for competition. Offering different competitions gives everyone a choice*". The excitement of competition and sense of belonging were evident in the experiences shared by B5, who noted, "*I love the adrenaline, the joy, the emotion, the unity within the group. I enjoy being part of a team, knowing that when everyone does their part well, the team achieves its goals*".

In addition to these personal and social motivations, participants viewed competitive environments as platforms for raising disability awareness, challenging stereotypes, and demonstrating that people with disabilities are fully capable of excelling in high-level competitions.

> "*The main thing that motivates me is to showcase skill rather than focusing on a disability. I've always been an advocate of competing at the highest level, even with a disability, to make sure people focus on abilities rather than limitations*" (B10)

4.2 Understanding Competition Structures

When discussing competitive environments, it's important to reflect on how individuals/groups are categorized, and when in teams, how they are composed. We need to distinguish between competition where teams/individuals are formed and matched based on their characteristics (i.e., abilities, age, gender, weight) and only compete within the same categories and **Mixed Competition**. Throughout this work, we will use the term **Single-Ability Competition** to refer to competition in which functional characteristics of the individual attribute them to a specific group. Additionally, in team-based competitions, we discuss two types of team composition: **Homogeneous** (different teams have the same set of abilities)

and **Heterogeneous** (different teams do not have the same set of abilities).

4.2.1 Single-Ability Competition. The Paralympics exemplify how **Single-Ability Competition** is structured so that participants compete against others within the same functional classification. This format attempts to ensure that all competitors are on a level playing field, with categories designed to match participants as closely as possible based on specific traits.

Table 2: Competitive Activities. Sports and Games played by the participants. * - played against other people, P - paralympic, W - worlds, I - International, L - Locals/Casual, S - School. Some participants' activities are divided into 'Prev' (previous) and 'Curr' (current) to differentiate activities before and after the onset of impairment.

ID	Sports	Games
B1	Rowing* (I), Swimming	Monopoly*
B2	Goalball*, Running*, Showdown*	Online Soccer Manager*, Cards*, UNO*, Checkers*
B3	Prev: Basketball* (I); Curr: Bodybuilding*, Athletics*, Goalball*, Hiking, Cycling	Chess*
B4	Rowing (N)*, Indoor Cycling	-
B5	Prev: Voleyball* (S), Futsal* (S), Handball* (S), Basketball* (L,S), Football* (L); Curr: Goalball* (L)	Prev: Cards*; Curr: Chess*
B6	Goalball*	-
B7	Prev: Capoeira* (coach), Running*; Curr: Blind Football*, Goalball*, Rowing*, Running*, Showdown*, Capoeira	Prev: FIFA
B8	Running*, Goalball* (L,S), Hiking	-
B9	Prev: Football*; Curr: Swimming*, Bowling*, Orienteering*, Cycling, Running	Prev: Super Mario; Curr: Cards*, Battleship*, UNO*, QuentinC's Playroom
B10	-	Mortal Kombat 1* (W), Street Fighter 6* (W)
M1	Powerchair Football* (I), Swimming, Adaptive Surfing, Running	Cards*, Checkers*, Dominoes*
M2	Powerchair Football* (I) (coach and player)	PES*, Football Manager*, America's Army*
M3	Boccia* (W)	Doom, Formula 1, Snooker
M4	Swimming* (P,W), Powerchair Football*, Inclusive Dance	Board Games*, Wii Fit, Wii Sports
M5	Powerchair Football*	Cards*, Dominoes*

M4 noted that in non-disabled competitions, athletes progress through structured age categories, whereas in disability sports, the path is less predictable due to **varying levels of disability**. "*In normal competition, a child enters a sport and follows a linear progression based on age. But with disabilities, there are many nuances. You might have congenital disabilities where the person has always played sports, or acquired disabilities where someone starts sports in their 20s. It varies by the level of disability, and you never quite know who will appear in what category or event*". However, for teams at a local level, it is often not possible to have enough players to separate based on both ability and age, leading to large age gaps that negatively affect the experience for some.

"*At the moment, with fewer participants, different ages compete together, but in the future, I'd prefer age divisions. It's a bit frustrating seeing older participants being less active, while teenagers give it their all*" (M5)

Others had contrasting opinions valuing the differences between players: "*I saw a 12-year-old and a 70-year-old on the same team. That's what makes this sport phenomenal*" (M2). When it comes to competition in sports where the disability of a player has a significant impact on the performance, participants favored separate categories as is the status quo. B1 stressed that individuals with motor impairments should compete against others with similar impairments: "*A paraplegic should compete with paraplegics and quadriplegics... because we're talking about physical sports. When there are such limitations, we shouldn't place people without any limitations in the same competition*".

Importantly, for the competition to be perceived as fair by some, it is not only about the current ability of players/competitors during play. For example, in Showdown[12], B7 argued it would not be fair to compete against sighted participants even if they were completely blindfolded, as sighted competitors still have inherent advantages due to their **prior visual experiences**.

"*Even with their eyes covered, a sighted person already has a sense of spatial awareness—they know the dynamics of the game and can move more fluidly. For someone who's been blind since birth, the learning curve is steeper*" (B7)

This raises questions about the role of progressing and/or acquired disabilities and the functional categories attributed to participants who do not consider the history of each competitor in its evaluation. Every attempt at symmetric and equality between participants by further categorization inevitably results in limiting the pool of locally close available teammates and competitors.

4.2.2 Mixed-Ability Competition. In contrast, **Mixed-Ability (MA) competition** refers to environments where participants may differ across a range of characteristics. This approach to competition offers a more inclusive framework, where diverse participants can compete together, though it also presents its challenges regarding fairness and team dynamics.

The potential of MA competition **depends on the sport** and the specific limitations of participants: "*It always depends on the limitations of the people and what can be adapted. Mixed teams with mixed teams, and non-mixed teams with non-mixed teams, because*

[12]International Blind Sports Federation. Showdown. URL: https://ibsasport.org/sports/showdown/overview/ (visited on 12/02/25)

otherwise, the criteria would be... well, it depends on the sport … When it comes to physical sports that demand a lot from the body, mixed-ability competitions might not work well, especially if some athletes have significant physical limitations compared to others" (B1). B9 pointed out that in certain cases, athletes with disabilities can compete alongside able-bodied participants with minimal adjustments:

"*A person with visual impairment can still compete with a sighted person... with some adjustments, like a coach providing signals, it wouldn't affect my performance in the pool*"

However, B9 believed that **not all sports lend themselves to mixed-ability formats**, particularly for athletes with significant physical impairments.

Another important aspect of fairness in MA competitions is the **rules and regulations** governing these competitions. Clear rules are essential to ensuring that players with differing abilities can compete on a level playing field. Through our interviews, it became evident that **clearly defined roles within teams are essential for maximizing the strengths of each member**. Participants with disabilities emphasized the importance of structured teamwork where each member's unique abilities are leveraged. Role-based teams allow individuals with different abilities to contribute meaningfully, fostering a sense of inclusion and teamwork. In the context of rowing in a team, the stroke second position in the boat is responsible for setting the rowing rhythm while having no impact on the navigation. B1 highlights how this position is unaffected by her visual disability "*people, despite their disabilities, are capable of practicing sports like rowing or others, as long as they (the role) fit that person*". In blind football, the sport is purposefully mixed-ability with sight required to be a goalkeeper.

For some sports, like goalball, B2 argued that sighted and blind players can compete without issues, as long as everyone follows the same rules (i.e., both players are blindfolded) as it creates an environment where there is true equality between competitors, as the same limitations are applied to all, and external advantages like vision are neutralized. However, in sports like judo, (assuming sighted athletes train and/or compete with vision) B3 expressed that the disparities that come from understanding human motion beyond proprioception and the associated techniques would make the competition unfair.

However, under certain conditions, disparity in performance may also be positive. M1 described the benefits of mixed-ability sports, noting that competing against a range of participants with **different levels of ability can be highly motivating**:

"*The more diversity in age and ability, the better we feel. I have colleagues who are better than me, which pushes me to improve. I think we shouldn't only compete against those with similar problems. For example, if you walk normally, and I use a walker, I'll try to keep up with you within my limits*".

4.2.3 Homogeneous Teams Competition. We consider homogeneous teams to be when each member of a team has a corresponding member on the opposing team who shares the same key characteristics (such as age, gender, or abilities) relevant to the competition. Depending on the competition, the specific characteristic that matters may vary — for example, in one competition, age may be the only consideration, while in another, both age and gender are important. Homogeneous teams were seen as a fair way to have mixed-ability competition, but are limited to the sports where it is possible. In blind football, all players are blind with the exception of the goalkeeper, who is required to be fully-sighted. Similarly, for rowing, having at least one blind rower per boat could contribute to fairness: "*If the team is mixed, with two blind people or at least one blind person per boat, it's fairer. In rowing, the blind person usually sets the pace because it's much easier to lead than to follow when you're visually impaired*" (B1).

4.2.4 Heterogeneous Teams Competition. Heterogeneous teams are formed without requiring matching players with competitors, as the competition is designed to balance a wide range of abilities and characteristics.

When discussing heterogeneous teams participants highlighted two approaches: one where we assume asymmetry and different demands, and another where the demands of the sport/game do not interact with an individual's disability.

Leveraging asymmetry, one could adapt current sports making players interdependent and complementary to each other: "*When the only limitations are vision or hearing, we can compete similarly with different adaptations. For instance, one person can guide the other—forming a team where someone who sees helps someone who doesn't, and they integrate seamlessly*" (B1). A concrete example is how in powerchair football, M2 believed it could be adapted to support heterogeneous teams: "*Non-disabled people wouldn't use the same equipment as disabled people, who use frames because they don't play with their feet. We could even have a league where powerchair football is played by both disabled and non-disabled participants*".

In digital gaming, B9 explained that **accessibility measures** can make heterogeneous teams more viable, especially when well-implemented (i.e., creating a space where the demands of the game do not interact with one's disability):

"*In videogames, if accessibility is ensured, I don't see any issue with having mixed teams, where both disabled and non-disabled people can compete together*"

Similarly, B9 noted that in card game tournaments they've participated in, mixed teams do not lead to feelings of exclusion, even when they are the only participant with a disability.

4.3 Key Decisions when Designing Competitions

In addition to competition structure, one must carefully consider **Disability Disclosure**, **Matchmaking Policies**, **Ranking/Sorting of Competitors** and the associated **Events and Spectator experience** when designing for inclusive competition.

4.3.1 Ability Disclosure in Sports and Games. In traditional sports, the requirement to disclose one's abilities or disabilities aims to support fair competition and create equivalent matchups by categorizing athletes (e.g., Paralympics). In contrast, most online games do not require such disclosure, leading to varied opinions among participants about how, when, and with whom this information should be shared.

Participants generally felt that disclosure should be optional when possible, in both sports and games. Some, like B1, argued

that disclosure is a personal choice, reflecting that "*it should be optional because it is always subjective. Some people prefer to disclose their limitations right away*". B1 also noted that keeping such information private might be important, explaining that allowing individuals to choose whether to disclose their disability respects personal boundaries. M9 shared a similar perspective, arguing that mandatory disclosure is not necessary, and suggesting that information about disabilities could be optional rather than required. They emphasized that accessibility features can level the playing field, making it unnecessary to always reveal one's disability, comparing it to other personal characteristics that are not typically disclosed.

In addition to the general preference for optional disclosure, participants differentiated between disclosing disabilities to teammates versus opponents. For intra-team disclosure, B1 pointed out that sharing information within the team could facilitate better understanding and support, noting, "*I think it should be internal because it gets resolved there… A coach will manage and understand what is safe and what is not (in the case of rowing)*". Some participants supported disclosing disabilities to opponents. B4, for instance, argued that informing opponents can enhance awareness and safety, based on past negative experiences where opponents lacked understanding. They stated, "*Once you know I am visually impaired… people will automatically be more cautious with me*". B7 also endorsed full disclosure in all situations, using personal examples to emphasize how informing others can ensure proper awareness.

M1 argued against the necessity of ability disclosure in virtual environments suggesting that there should not be ability disclosure in games. They believed that online platforms should strive for inclusivity, asserting, "*In a machine-based competition, we should aim for equality. There should not be discrimination based on disability, especially when adaptations can be made*". M2 expressed concerns about ability disclosure in games, suggesting that it might lead to unfair assumptions or excuses for losses. They advocated for disclosing disabilities only in person, after online competitions, to ensure that performance evaluations remain unbiased during online play.

Furthermore, the necessity for disclosure may vary depending on the context of play. B10 highlighted the importance of understanding one's needs by disclosing relevant information, saying, "*I think it's important because sometimes you need to disclose your disability to help others understand your needs. If you don't, how will people know what you need?*". They emphasized that while disclosure can be beneficial, it is not always necessary.

4.3.2 Matchmaking Policies. In mixed-ability competitions, matchmaking becomes more complex due to the variety of characteristics that could be relevant for ensuring fairness. These characteristics can include physical abilities, accessibility options in online games, influenced by disability disclosure which affects the ability to determine Team Composition types (i.e., homogeneous/heterogeneous) and apply matchmaking policies accordingly. The challenge lies in determining which of these are relevant to the competition and should be factored into the matchmaking system. The process needs to account for different ability levels and adjustments while still allowing the competition to feel balanced and engaging for all participants.

B5 offered a different perspective, suggesting that experience and training should be the primary factors in matchmaking. They emphasized that competitors should be grouped according to their level of preparation and the time they've invested in training: "*My perspective on rowing or any competition is about preparation. If someone has been training, then they should be separated by category based on their training and effort. The more experienced should compete with the more experienced*" (B5).

Finally, B9 pointed out that the **context of the competition** matters, particularly in determining how seriously fairness and matchmaking need to be considered. In more casual competitions, the need for strict matchmaking may not be as significant, while in more competitive or high-stakes environments, ensuring fairness becomes a top priority.

4.3.3 Ranking and Sorting Competitors. Regarding leaderboards and ranking systems in mixed-ability competitions, participants were presented with two main approaches: a joint leaderboard, where all players are ranked together in a unified system, and separate leaderboards that account for players' abilities.

B5 advocated for a ranking system that focuses on the nature of the competition itself, rather than on the athletes' disabilities. They stressed that rankings should be determined by the specific demands and rules of the event, rather than by the participants' abilities. As B5 put it, "*The competition should be categorized based on its requirements, not the athletes' disabilities. The classification should reflect the nature of the competition itself, ensuring fairness and avoiding the reinforcement of disability stereotypes*".

M2 echoed this sentiment and exemplified it with gaming. They stressed the importance of equity over mere equality, suggesting that if **players compete under equitable conditions**—such as using adapted controllers that allow them to perform at the same level—a single, unified leaderboard is appropriate. M2 explained, "*It's not about equality... If everyone has equity, then yes, the same classification should apply to all. Whether someone is using a standard controller or an adapted one, if they're playing at the same level, they should be ranked the same*".

Has seen in heterogeneous teams discussion, the matter of fairness comes down to if the game demands are of a nature that, in principle, do not interact (i.e., create higher demand) for any player with, without or of different disability. B3 discussed the idea of a unified ranking system in adapted chess, where players with and without visual impairments compete under the same rules. As B3 put it, "*The ranking table can be unified because it's two players following the same rules. Whether someone is sighted or visually impaired, the game's rules don't change. The board might need adjustments to accommodate the visually impaired player, but the rankings should be the same*".

However, the idea of a joint leaderboard was not unanimously supported. B7 believed that while inclusive competition is important, rankings should still reflect the distinct challenges faced by different groups. Drawing from their experience in a marathon, B7 pointed out that although participants with and without disabilities started the race together, "*the classification was different*" at the finish line, with separate rankings for each group. In their view, this ensured fairness by acknowledging the unique challenges faced by each participant. Interestingly, the perceptions on how ranking and

leaderboards should be done, clash with the current practices in sports.

4.3.4 Events and the Spectator Experience. The organization and spectator experiences of competitive events also play a role in shaping inclusive environments for people with disabilities. B10, an active participant (e.g., Evo 2024[13]) and organizer in competitive gaming, shared insights from their experience. They pointed out a significant shift over recent years, noting an increased presence of individuals with disabilities at competitive events since they first started attending in 2013. In their role as an organizer, B10 has focused on organizing tournaments specifically for blind and low-vision players, aiming to create fair competitive environments. Despite these efforts, they noted that mixed-ability competitions are still developing.

B10 also highlighted both progress and ongoing challenges in accessibility for competitive events. They observed that while there have been improvements, such as providing headsets and allowing personal audio setups, issues remain. For example, navigating venues with layouts that often change daily can be difficult for blind participants: "*if I'm blind it is very challenging to navigate the different stations or different booths and everything when every day, they sort of change the layout*". Additionally, B10 noted that some venues lack essential adaptations, such as ramps for stage access: "*we had people who (...) have to play on the main stage. They have no ramps for people to go into the stage*". They also shared previous experiences where the absence of sound in venues negatively impacted the spectator experience, leading them to watch a stream of an event they were attending to spectate: "*if you're playing a fighting game, but if you have no sound in the venue, then how is the blind player going to enjoy the gameplay like other people who are spectating the matches or the gameplay?*".

B10 noted that while they have organized tournaments for blind and low-vision players, they have not yet managed mixed-ability events, explaining, "*We created a tournament specifically for blind and low-vision players to compete in a fair environment, separate from others*". Similarly, B8 shared concerns regarding goalball venues, highlighting the importance of silence during play: "*While the ball is passing, there must be a lot of silence, otherwise no one can hear the ball*". This silence is essential for players to accurately track the ball's movement and direction.

Competition, whether in games or sports often results in events. While it is crucial to ensure accessibility in the playing of sports and games, one cannot neglect the impact of when these venues and events are not designed to support players with disabilities between the act of playing and spectating.

4.4 Barriers to Adapted Sports

The **availability** of adapted sports, typically single-ability and homogeneous teams, is a significant barrier, often limited by both geographic and infrastructural constraints. M2 highlighted that individuals with severe disabilities frequently have very few options, noting, "*People with more severe disabilities often only have options like boccia available to them*". This limitation is compounded by the lack of teams and facilities, particularly outside major urban areas. **Financial barriers** are a major impediment in adapted sports, affecting both the cost of specialized equipment and overall participation. For instance, the high cost of official powerchair football chairs—at least 10,000 EUR each—forces many players to use less suitable personal chairs. M2 explained, "*We play with our own chairs, which means the rotation and acceleration are not the same. We use tactics to compensate for the differences*". This financial strain extends beyond equipment to include other expenses, which limits the growth of teams and the sport's accessibility. M2 noted that securing funding for adapted sports is often more challenging than for virtual sports. They explained that in virtual sports, it's easier to attract sponsorships because athletes demonstrate their skills through a controller, which is less costly and more straightforward compared to the requirements of adapted sports, which need significant investments in equipment and facilities, making it harder to secure financial support. Often these adapted sports rely on highly specialized technology with low demand and high costs which directly impact the opportunities for competition. **Effective support structures** and disability awareness are essential for the success and inclusion of athletes with disabilities, yet they are often lacking in adapted sports. One significant challenge is the insufficient accessibility training for coaches and sports professionals, which impacts their ability to provide adequate support. B9 highlighted this issue, noting that without specialized knowledge, coaches and educators struggle to meet the needs of athletes with disabilities. This lack of understanding can result in less effective programs and limited opportunities for these athletes. The at times lack of knowledge, is felt in the absence of adaptations in traditional sports resulting in frustration and exclusion. B6 shared their experience of being unable to compete in school sports due to a lack of appropriate adaptations, highlighting the broader issue: "*There are many traditional sports that are not inclusive. Even if we wanted to or really liked them, we can't participate because they are not (made) accessible to us*".

For athletes with disabilities, adaptive technologies such as advanced prosthetics and specialized training equipment have enabled participation and at times increased performance limits. However, concerns about access and affordability persist, as disparities in the availability of these technologies can create inequities. When sports or games require adapted specialized technology it often comes at the cost of accessibility to a wider audience. In powerchair football, M1 discussed how technology can enhance safety by suggesting that "*technology could include devices to reduce impacts or slow down the chair upon collision*". Such technological advancements could help mitigate risks associated with the sport's high speed and physical nature. Additionally, B4 raised concerns about the safety of swimming for individuals with visual impairments. They pointed out that challenges like navigation in the water can pose significant risks, noting that "*awareness of one's surroundings in the water is crucial to avoid accidents*".

In addition most existing technology and practices, particularly in sports, were designed thinking of players and coaches with stereotypical abilities. This leads to challenges at all levels within each sport. For example, it is challenging for coaches with motor-impairments to convey tactics and position to their electric

[13]Evo - The Ultimate Fighting Game Tournament URL: https://www.evo.gg/ (visited on 10/12/24)

wheelchair players when the tools available to them are whiteboards with magnets.

4.5 Mixed-Ability Gaming and Sports

Adaptations and accessibility features are key in making sports and gaming more inclusive for individuals with disabilities. In sports, participants mostly saw technology as either a vehicle to improve access or safety and often as an alternative to having to rely on others' assistance (e.g., guidance when swimming). The consensus among participants was that there were **more opportunities for fair mixed-ability competition in games**, as they perceived them as having the possibility of the game demand to not interact with their disability, or be achievable to adapt in such a way.

> "*In a game that's more of a mental exercise, I believe that, as long as the person understands the game well, there isn't much of an advantage for someone who is sighted. I believe the chances of winning are equal*" (B5) on analog chess

The experiences shared by participants reveal both advancements in game design and ongoing challenges. In gaming, the inclusion of accessibility features has been noted in some fighting games. B10, who has consulted on accessibility for games like Mortal Kombat 1 [72], emphasized the positive impact of these features, noting, "*A few fighting games have added accessibility features so that you're able to have a better chance of playing*". B10's involvement highlights the gaming industry's increasing awareness of accessibility needs and the incorporation of these considerations into game design.

However, despite the support to the mixed-ability play model, B10 believes that in certain cases the differences in abilities/disabilities will always have an impact. "*No matter how many accessibility features you can add into a game, you know, it's that sighted players will always have that advantage no matter what. You know, that is hard to admit, but that is something that can happen. Like, that's literally an advantage. They have a visual advantage in terms of, you know, fighting and things like that*".

The gaming industry has made strides in inclusivity, with studios now actively seeking input from consultants to improve accessibility. B10 observed, "*Studios are reaching out to consultants to ask, 'What can work? Can you come to our studios and give us examples of what works and what doesn't?'*". This proactive approach indicates a growing commitment to addressing accessibility from the outset of game development. For example, Street Fighter 6 [15] offers both "*classic*" and "*modern*" control schemes. The modern controls provide shortcuts for players to execute actions diminishing the requirement on fine-motor skills to be proficient. M2, who has no arms or legs and plays using one foot, shared the difficulties in finding suitable gaming equipment, emphasizing that most consoles are designed for hand use. Even with specialized controllers, playing can be "*complicated*". Despite these obstacles, they play games like Pro Evolution Soccer [49] and America's Army [3]. Still, in games, unlike sports, accessibility is only realistically achievable by the developers' involvement as any changes require their implementation.

For analog card games, accessibility adaptations like braille cards allow for inclusion. B3 and B2 shared their experiences with braille and tactile adaptations. B3 mentioned, "*I play chess with a braille board and card games with braille cards. While not all card games are accessible, braille adaptations allow me to participate fully*". B2 echoed this, emphasizing that the presence of braille enables participation, arguing, "*If things are organized properly, mixed tournaments of sighted and blind players can be held. The only barrier is prejudice, not the disability itself*".

Interestingly, while in sports the discussion centered, for the most part, on single-ability competition and categorizations, all participants discussed games from a position of inclusivity and mixed-ability play.

5 Discussion

Our findings contextualize how people with visual and motor disabilities are competing in sports and games. We detail how people perceive competition in mixed-ability scenarios, both as it happens today, and how they should be designed. We reflect on the complexities around team structures, disability disclosure, rankings, matchmaking, and how technology is perceived. In this section, we explore our findings within the context of our research questions and reflect on the avenues for future research in the design of more inclusive competitions.

5.1 (RQ1) How are people with disabilities experiencing competition with others?

The experience of competition for individuals with disabilities is often shaped by the limitations and opportunities presented by existing sporting structures. While traditional single-ability homogeneous teams can provide a sense of fairness, they can also result in smaller player pools, limited infrastructure, and a restricted range of sports options. Due to smaller participant pools, mixed-gender or mixed-age play is common, and seen by some as a benefit for sociality, and by others as hindering fair and high-performance competition. Many sports are not inherently accessible to individuals with disabilities which leads to people choosing primarily from a small pool of available activities. In most, disability disclosure is necessary and seen as a way to ensure fair competition based on functional classification. Conversely, in games, disabilities are expected to be invisible and assumed to not influence ability to compete, leveling the playfield. Participants expected and viewed games as promising avenues for mixed-ability competition given the flexibility and perceived lower cost. In some cases, specialized hardware or adaptations (e.g., braille cards) are required for individuals with disabilities. However, it is mostly uniquely up to developers to build accessible features that enable individuals with disabilities to find suitable challenges and compete on equal terms.

In sports, while single-ability play is in principle easier to be fair, it is also harder to have enough athletes, especially in team-based games. The more we separate in the pursuit of fairness through equal competition, the harder it is to be a sustainable practice. In some cases, like rowing or blind football, group dynamics can offer opportunities for equitable participation. When the competition context allows for adaptations that are meaningful and well-integrated, participants often report positive experiences; however, when the adjustments are insufficient or poorly implemented, they may feel disadvantaged or patronized.

During our interviews, it was clear that with the exception of digital games, technology was not part of the conversation. While

many sports do not require any assistive technology to be accessible, often people have to rely on guides or assistants (e.g., guide running). In addition, the techniques applied and the learning process often have to be adapted (e.g., conveying tactics in powerchair football). Prior work has tackled independent swimming with wearable trackers for blind swimmers [58], and enabled remote training with GoalBall desktop application [55], to name a few. However, we argue there are still many open challenges and opportunities (e.g., enabling solo rowing between blind people) for enhancing autonomy and training in sports for people with disabilities. We found few instances where technology has been leveraged in the pursuit of more inclusive play. For the most part, sports and play are looking at people as solely players/athletes ignoring all other roles (e.g., coach) they take and transition between during competitions. Furthermore, people do not seem to have much choice in their roles but rather often, it is the sport that determines it. Technology in sports for inclusive competition remains largely unexplored. We posit that all inaccessible sports (and roles) represent open challenges that the community has yet to prioritize. As an example, while navigation systems for people with visual impairments have decades of research for autonomous navigation, we have yet to see work on autonomous cycling or rowing which potentially necessitates entirely new solutions, particularly when we consider the high performance demands for competition. We believe that the uniqueness of each challenge might not only contribute to innovations in sports/games but potentially create new ways for people to engage in entertainment and collaborative activities.

5.2 (RQ2) How do people with disabilities envision mixed-ability competition to be designed to be inclusive and equitable?

Depending on whether we are asking about sports or games people view mixed-ability competition differently. In sports, there seems to exist a pre-established rigidity in the structure of the competitions that people assume as the primary and correct model. In it, people expect symmetry in the competition and separation as much as possible under the assumption that it is the only way to ensure a fair competition, and that is what is desirable. This also means that mixed-ability competition in sports is only viewed when there are roles where one's disability has potentially no impact (e.g., rowing) or when teams are homogeneous even if mixed-ability. There is an intrinsic desire shared by most to have new roles and sports accessible with the goal of competing on equal ground with current practitioners. One approach is designing specific roles or adaptations that allow participants of varying abilities to contribute meaningfully. However, when reflecting upon their own sports they view mixed-ability competition as a way to raise awareness (when competitions are not mixed), or see it as a necessity given the limitations imposed by other roles (being the navigator in a boat).

While one should not shy away from the challenges in adapted sports, esports and games are uniquely positioned to create more affordable, accessible and equitable spaces for mixed-ability competition. All participants expected games to be a place for equally matched play regardless of ability. For some these spaces already exist in games (i.e., analog and digital) such as chess and card games, where they perceive the challenge to be unaffected by their disability. In addition, players envision games as having open structures where adaptations can be made to reduce the differences between players. Unlike sports where differences are perceived as creating unfair competition, for games and the changes necessary to make them accessible, seem to be associated with the pursuit of fairness and inclusivity. However, all are also clear on making the assumption that this inevitably means that game designers, researchers, and developers are responsible for accurately determining what is a fair competition when providing asymmetric gameplay/hardware. We argue that the pursuit of fairness for mixed-ability games seems no different than the complexities of balancing in any game with asymmetries. This means that for the design of inclusive mixed-ability competition one should leverage existing knowledge on balancing, and assume like all others, that balancing is by its very nature controversial, requires continuous adjustment of play, based on game data and informed by players perspectives [64], especially assuming that these games follow most of the popular recent models of live service games with regular updates in content. The only difference is these games must be able to create roles/accessibility features that enable players with disabilities to compete and are able to track their performance in relation to the expectation. However, it will be up to each designer (as it already is for any feature/content/role) to determine how the play data from each game influences its future design decisions.

A distinction between competitive games and traditional sports hinges on intellectual property (IP) ownership. In traditional sports, such as soccer and basketball, governance is decentralized and distributed among entities like national federations, international governing bodies (e.g., FIFA), local clubs, and community organizations. This structure enables widespread participation and competition without centralized ownership or control over the sport itself. For instance, FIFA oversees global soccer standards, while individual countries manage their federations, and local clubs organize leagues and tournaments. In contrast, video games are primarily developed, owned, and controlled by companies or publishers who set the rules, manage distribution, and determine game updates and balance patches. Unlike traditional sports, the medium for esports tournaments is protected by copyright and license agreements, with most publishers requiring organizers to follow a community tournament license to host competitions in their games. This centralized control over games can bring forward new challenges not present in sports in the pursuit of inclusive competitions.

5.3 (RQ3) How does ability disclosure impact ranking, sorting, and player classification in mixed-ability competitions?

Ability disclosure plays a complex role in mixed-ability competitions, as it directly affects how players are ranked, sorted, and classified. In sports, as previously discussed, there is an expectation of disclosure and separation based on functional classification and other differences (i.e., age, weight, gender). Participants did not believe disclosure should be enforced but argued that fair competition requires them to be ranked only amongst those with similar abilities. Within teams (and in sports) people believed disclosure to be positive in order for the team to react accordingly when needed.

However, if the competition did not require it, and if the disability did not affect the competition, people argued that the opponents might not necessarily be made aware. The interplay in the decisions of disclosure are complex and heavily influenced by both sport, disability, and individual, and we believe no single static recommendation is possible to be made. On one hand, revealing a player's impairment or the use of accessibility tools can help create fairer matchups by ensuring that rankings reflect not only skill but also functional ability. However, mandatory disclosure can lead to stigmatization or discomfort, potentially discouraging some participants from fully engaging in the competition.

Conversely, in digital gaming, there is the expectation of anonymity and the perceived lack of need for disclosure. This results in players recommending matchmaking and ranking systems in which disclosure is optional. As long as players *compete under equitable conditions* and abide by the *same game rules and objectives* rankings should be shared. However, similarly to sports, if that is not the case (i.e., as asymmetries in competition might creep in) so it appears the need to recognize the different challenges that are posed to competitors. This is especially timely to consider given the rise of Esports. We believe we should start to consider by design how we can create mixed-ability competitive games that create a space where it becomes possible for heterogeneous teams to compete and disabilities are only part of the conversation on peoples' will to disclosure. This means we must look for ways to integrate performance metrics, accessibility features, and potentially even player perceptions into how matchmaking algorithms determine opponents or even attribute scores during/after gameplay. While in sports adaptations and asymmetries are unwelcome given the rigidity associated with existing sports, games are recognizable as ever-evolving play spaces which we believe create unique opportunities for inclusive play.

6 Limitations

It is important to contextualize that the sample, while diverse in terms of competitive experiences, was primarily composed of individuals with motor and visual impairments. This represents a subset of disabilities, and the findings may not fully capture all perspectives of individuals with other types of impairments.

Moreover, the perspectives of the participants were heavily influenced by the specific sports or games in which they participated. This could have limited the range of experiences and viewpoints represented in the study. Additionally, the sample included a mixture of highly competitive athletes and relatively few expert gamers, which may have influenced the perspectives on the feasibility of equality and fairness in different types of competitions.

7 Conclusion

We believe the findings presented in this study offer valuable insights into the experiences of individuals with disabilities in competitive settings. We conducted an interview study with 15 participants including Paralympic athletes and game accessibility consultants, highlighting the complexities of disability disclosure, the opportunities for mixed-ability competition in gaming, and the expected rigidity within sports in maintaining segregated categories in the pursuit of fairness.

We believe technology can play a crucial role in enabling new roles, and research is needed to understand how to create ethical and just matchmaking and ranking systems that conform to the expectations of players with and without disability. We argue that, unlike sports, there is a unique possibility in games to assume balance is and will be a continuous adjustment based on player performance, accessibility features, and players' perceptions.

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