RESEARCH-ARTICLE

Exploring The Role of Technology for Accessible Stadium Experiences for People With Limited Mobility

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Abstract

Attending public sports events is a popular leisure activity that has yet to become more accessible for people with limited mobility. In our work, we address the role that technology, and especially, digital ticketing infrastructures play in the individual preparation for attending football matches and the experiences that disabled fans have at football stadia. Building on autoethnographic work on attending large public events with a disability, we report findings from semi-structured interviews with people with limited mobility (N=12). We apply Reflexive Thematic Analysis to craft four main themes, (1) showcasing the importance of familiarity with the processes, (2) illustrating the (in)voluntary separation of disabled and non-disabled people in current (ticketing) infrastructures, (3) highlighting social contacts as key contributor but dependency on other people also as obstruction of accessibility, and (4) contextualising the role of interactive seat plans for ticketing. Building upon these findings, we contribute an account on the experiences of people with limited mobility and the examination of current and prospective technology for this purpose with a focus on ticketing and seat plans, thereby also appraising previous findings from autoethnography.

CCS Concepts

• **Human-centered computing** → **Accessibility**.

Keywords

Disability, attending public events, interactive seat plans, limited mobility

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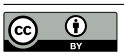

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1 Introduction

Sports events, such as football[1] matches, attract many people, making it a popular leisure activity that can also enhance spectators' well-being [5, 17]. Despite the benefits for disabled[2] people [27] and the legal obligation to make leisure activities accessible, (as stated by the Convention on the Rights of Persons with Disabilities [28, Article 30]) lacking accessibility at these venues limits the participation on an equal basis [19, 33]. To address this, football clubs often implement accessibility guidelines and establish dedicated infrastructures for accessible ticketing [32].

Still, accessibility is multi-faceted, and to participate in these events equitably, further efforts are required. Particularly, the insufficient provision of accessibility information (online) may reinforce the exclusion of disabled people since unknown barriers can enhance concerns [33]. For instance, missing information on transportation or accessible seats and paths in the stadium creates uncertainties that make it challenging to assess the overall accessibility, thus limiting the motivation to buy tickets and go to the stadium [40]. This presents an opportunity for clubs to leverage technology to inform about barriers and accessible alternatives through online visualisation in improved or novel ticketing interfaces, and reduce necessary efforts when planning journeys but also concerns of disabled visitors.

Here, research concerning the accessibility of public events has primarily focused on how the built environment can accommodate disabled people, while focusing on wheelchair users (e.g., [24, 32]). In turn, preparation, information extraction, the social implication, and especially, the potential of technology as a key facet of accessibility remain under-addressed. Only recently, research has started to showcase the prospect of interactive seat plans that are frequently used in the acquisition of seating tickets (see Figure 1 for examples). While such visualisations could be used to purchase accessible seats and to prepare for potential barriers on the path to these seats, Strobel et al. [40] demonstrated that current implementations fail to provide sufficient information for such complex processes. This, in turn, can reinforce uncertainties that the accessibility needs are met.

Thus, we expand on their autoethnographical research by exploring the role of such technologies and interaction design in this

[1] American and Canadian English: soccer.
[2] We use mostly characteristic-first language, because we want to underline that people are disabled by the environment.

context more broadly, and provide additional perspectives from people with limited mobility. In our work, we focus on the case of football matches as an example of highly popular sports events that are regularly attended by a broad range of people and which are of general societal relevance [12]. Further, they offer a framework to study these perspectives within established infrastructures. Against this backdrop, we raise the following research questions (RQs):

RQ1: How do people with limited mobility plan, carry out, and experience the attendance of football matches, and what role does technology play?

RQ2: What role does the interactive seat plan play in the ticket purchasing process, and how does it (fail to) address information needs of people with limited mobility?

To synthesise the experiences and requirements of people with disabilities regarding technology in the preparation for attending public events, we conducted semi-structured interviews with 12 participants with a range of disabilities that affected their mobility. Through Reflexive Thematic Analysis [4], we crafted four themes: (1) Familiarity greatly benefits accessible experiences but getting to this point is difficult, (2) To include is to separate, (3) Questioning dependencies on other people while respecting the importance of social contacts, and (4) Improved interactive seat plans need to account for context and individual requirements. Illustrated through these themes, our results show that familiarity with (digital) infrastructures contributes to stadium accessibility, and that current best practices to include disabled people in spectating football matches rely on physical and technological separation of disabled and non-disabled attendees, thereby prioritising wheelchairs over other mobility aids. Further, we highlight the social implications of such technology, mainly that social contacts play an important role in facilitating accessible experiences, but that these compromise the agency of disabled fans in all instances. Finally, our findings demonstrate that interactive seat plans are one pathway towards improving the preparation for stadia visits, but that providing accessibility information requires a thorough contextualisation of people's lived realities, which is not sufficiently supported by technology yet.

Our work makes the following contributions:

- We provide an account of the accessibility experiences of people with limited mobility when attending football matches and the role of technology therein.
- We explicitly focus on the role of interactive seat plans and analyse their potential to prepare for accessible experiences at football matches, showcasing how existing digital infrastructures can be expanded to cater to fully inclusive experiences.
- We appraise findings from previous work that addressed interactive seat plans through autoethnography [40], and show how results from first-person methods can be contextualised via broader qualitative methodology.

2 Related Work

Despite relevance of accessible leisure [27], there only exists limited related work that explicitly discusses the role of technology in the role of gaining access to sports spectating, with existing work strongly focusing on the experiences of people who are blind or have low vision (e.g., see [14, 29]). Shifting the focus to real-world sports spectating and people with limited mobility, this section revisits general considerations for accessible stadia, and discusses related work on the provision of accessibility information online. Focussing on interactive seat plans, we also describe Strobel et al. [40]'s autoethnography as well as state-of-the-art implementations as basis for our work.

2.1 Stadia and the Role of Accessibility Information

The accessibility of stadia and arenas has been discussed in sports management research with a focus on the European game of football [10, 30] as well as North American sports [24, 36]. Such work primarily discusses the implementation of guidelines for wheelchair accessibility particularly for the built environment, for instance, the compliance of stadium infrastructures with the Americans with Disabilities Act (ADA) [36, 42], but also references other disabilities or addresses older people [31].

Research on ADA compliance for spectating in wheelchairs mainly concerns the built environment, including accessible parking spots, unobtrusive views when seating, the integration of companions, or catering and toilets [36, 37]. Other disabled spectators may not require this kind of separated space in the built environment, and discussion here may rather shift towards effective inclusion in regular stands. Addressing attendees beyond wheelchair users, Yazigi et al. [43] discuss signage at these venues that addresses people with reduced mobility in general, and Paramio-Salcines et al. [31] involve older spectators as people who share requirements with disabled people.

Adopting a structured lens, Koželj et al. [20] present a standardised framework for evaluating disability support communication in football organisations, focusing on the organisers' perspectives. They developed a scoring system to quantify disability support, for instance, regarding the categories dedicated personnel, infrastructure, and ticketing. Further, Paramio-Salcines et al. [33] introduce a framework for accessibility considerations concerning stadia. Their model comprises different stages of the spectator journey, including (1) the motivation to travel, (2) actual travel to the venue, (3) participation in the experience, (4) travel home, and (5) sharing the experiences. Here, we note that while the preparation for accessible experiences may be settled within the first stage, it affects others: For example, the motivation to travel inherently depends on the provision of accessibility information [26] such as that made available through seat plans [40]. However, links between this online provision of accessibility information and the other stages remain to be discussed, which is a gap relevant for our work presented here.

2.2 The Online Provision of Accessibility Information About the Built Environment

Online provision of well-designed accessibility information plays an important role in planning trips [26]. For example, HCI research presented tactile maps that can help people who are blind or have low vision navigate unfamiliar buildings [16] and embodied virtual reality (VR) explorations that can be used to remotely assess wheelchair accessibility [34]. Further, Li et al. [21] investigated the integration of pavement barriers in maps, and demonstrated that

users of various mobility aids perceive barriers differently, showcasing that considerations on the individual arrangement and context need to be included.

Regarding football stadia, research has discussed the preparation for different cases. Mestayer et al. [24] examined the availability and discoverability of tickets for disabled people, and Sanford and Connell [37] question the restriction to one companion ticket per wheelchair user. Dickson et al. [9] also discuss the research and booking step that disabled fans require when preparing their trip to fan zones, with a focus on travel planning and parking. In preparation of public events, disability liaison officers[3] play an essential role as they assume responsibility for accessible experiences, bridging the gap between the inaccessible reality and the needs of disabled spectators [33], thus, compensating for lacking provision of accessibility information online.

Finally, the provision of information does not only affect online sources, but also extends to on-site signage [43]. This presents a critical part of the experience at the time of travel or attendance, and underlines the importance of providing compatible sources of (online) information.

2.3 Interactive Seat Plans

Seat plans are a state-of-the-art tool to communicate information during the ticket booking process, and they are used for a variety of venues, ranging from transportation (e.g., planes and trains) to cultural events (e.g., theatres) and sports. There currently exist various representations of interactive seat plans for football stadia. Usually, they contain a stadium view (see Figure 1a) and a section view (see Figure 1c), which will be displayed upon clicking on the section in the stadium view. Alternatively, zooming in and out can enable a more continuous transition between both views (see Figure 1b). While some representations display more fine-grained models of the seating area (see Figure 1c) that, for instance, contain stairs and entrances, more abstract representations show less detail (see Figure 1b).

This state-of-the-art has received little attention in recent research. HCI has only touched upon the topic of technology for preparing accessible stadium experiences. Strobel et al. [40] present an autoethnography of a person with limited mobility attending public events, providing a subjective but in-depth account of the matter. In comparison to wheelchair users who visit public events in stadia or arenas in dedicated accessible sections, the first author uses crutches and sits in regular sections, where they find that accessibility in the booking process is not appropriately represented. Their perspective concentrates on the role of interactive seat plans when searching for accessible seats and includes three main aspects: The lacking compatibility of seat plans in relation to their disability, the personal adaptation strategies, and the inherent social component.

The autoethnography should, however, be further discussed in broader contexts: Including other disabilities and lived experiences, our research extends their work to broadly reflect the information needs of people with limited mobility, which includes seat plans as one component of a more complex process to prepare for accessible stadium experiences.

[3]In the following, we also use the term "fan representative for disabilities" to highlight that this may not always be a professional occupation.

3 Method

Expanding the autoethnographic account on interactive seat plans and their role for the accessibility of large public events [40], we examine football stadium accessibility as one subset of public events with a broader group of people with limited mobility. We conducted semi-structured interviews with people who currently spectate matches, have spectated them in the past, and would like to do so in the future. The following section describes our method, including the interview procedure, a description of the participants, analysis approach, and positionality.

3.1 Interview Guide

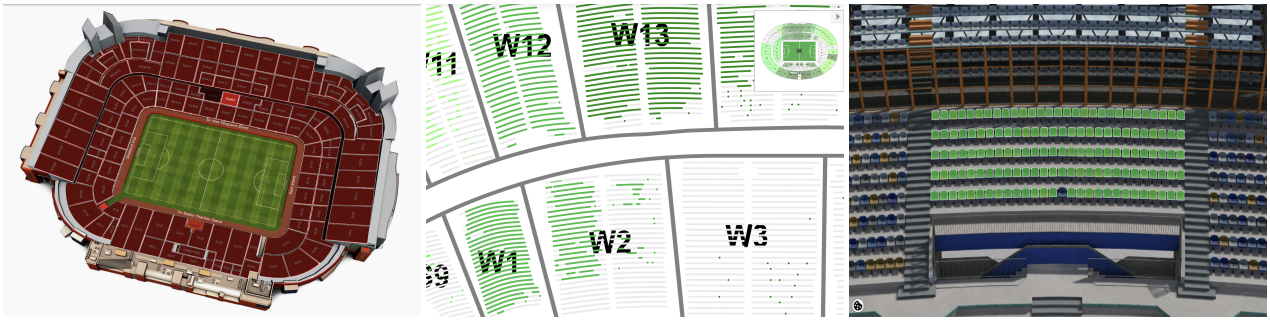
We developed an interview guideline through multiple steps of iteration, building upon recent research [40]. The first part of the interviews focused on demographic information. Then, interviews addressed participants' experiences attending football matches, thereby also addressing facilitators and barriers (e.g., *What were positive and negative experiences you have had at the stadium?* and *What are the reasons you have decided against attending a football match?*). We also explicitly focused on the acquisition of accessibility information when purchasing tickets for accessible seats at football matches (e.g., *Which information about the stadium would you like to receive before attending a football match?* and *How do you purchase tickets for football matches online? Please describe your procedure.*). Afterwards, interviews explicitly addressed the role of technology, including seat plans for accessibility. Here, we included a presentation of selected seat plans (of German 1st-3rd division clubs) as a conversation starter. We discussed their current as well as their potential future role in this process. For the full interview guide, please refer to the supplementary material.

3.2 Procedure

Participants were recruited via contacts at football clubs, social media, and word of mouth. The first and the second author conducted 12 interviews. The interviews took 71 minutes on average. Before starting the interview, we obtained informed consent from participants, and it was clarified that the interviews would be audio-recorded. At the beginning of the interview, the procedure was explained, and participants were given room to ask questions. Then, we proceeded with the interview guideline (see Section 3.1). At the end of the interviews, participants were given the opportunity to ask questions and to address points that they felt relevant but had not been covered by our questions. Participants received a compensation of 20 euros for their time. The study protocol was approved by the Karlsruhe Institute of Technology ethics board.

3.3 Participants

Overall, 12 people with mobility disabilities participated in our interview study (see Table 1). P4 brought his non-disabled stadium companion to the interview, who also contributed his perspective (C4). Among the 12 participants, most were men (2 women, 10 men, 0 non-binary), which reflects the demographic of fans, driven by the inherent dominance of men in football [6]. They were aged between



(a) A stadium view of the seat plan [22]. (b) A zoomed-in stadium view to select specific seats [15]. (c) A detailed section view with seats [39].

Figure 1: Three examples that show the state-of-the-art of interactive seat plans.

ID	Gender	Age	**Disability** (functional) and assistive devices used (at the stadium)
P1	male	35	Walks short distances, uses wheelchair at stadium
P2	male	56	Walks with trouble lifting his legs and walking stairs, uses wheelchair at stadium
P3	male	65	Uses wheelchair permanently
P4	male	25	Describes it as complex, uses wheelchair, but did not disclose amount of use
P5	female	48	Paralysed legs and arms, uses wheelchair permanently
P6	male	60	One-sided spasms, walks short distances using electrical stimulation of foot flexor
P7	male	62	Uses wheelchair permanently
P8	male	37	Uses wheelchair permanently
P9	male	29	Walks short distances, uses wheelchair at stadium
P10	male	34	Has spasms mostly in legs, uses wheelchair at stadium, additional vision impairment
P11	female	27	Trouble with walking and balance, uses foot orthosis
P12	male	27	One-sided lower extremity disability, uses crutches or wheelchair at stadium

Table 1: Key characteristics of the participants.

25 and 65 (M=42.1, SD=14.5). All of them had been football fans for more than ten years. They regularly attend football matches, ranging from around one match per season to all home and away matches of the club they support. To provide an overview of how the participants might experience barriers in stadia, we asked them to report on the assistive devices they usually utilise (at the stadium). While some participants use their wheelchair permanently, the majority use various mobility aids and alternate between them, e.g., between crutches and a wheelchair. However, these participants mostly did not use alternatives to the wheelchair at the stadium. Among the wheelchair users, some also contributed perspectives from past experiences when they used crutches or had no disability. Additionally, two participants reported on using electrical stimulation of the foot flexor as well as a foot orthoses to assist with lower limb disabilities.

3.4 Analysis

To analyse the transcribed interviews and synthesise findings, we applied Reflexive Thematic Analysis (TA) [4] and crafted themes inductively, i.e., not informed by prior research. Reflexive TA centres the researcher in the qualitative analysis, and acknowledges their inherent subjectivity as an essential part of the method. We followed the procedure outlined by Braun and Clarke [3] that describes the stages of data familiarisation, coding, and theme development. Codes we used are, for example, *random assignment of seats* and *seats close to entrance*. This procedure was led by the first author, who regularly initiated discussions among the research team to question their assumptions and interpretation of the data, i.e., to reassure quality and robustness of the thematic synthesis. We provide our results organised into four main themes that we present in the next section.

In addition, we provide preferences for the design of interactive seat plans with an initial set of items that participants suggested to include in these representations (see Section 4.4.4). This collection was distilled from the list of codes, i.e., we additionally grouped codes around suggestions and requirements for interactive seat plans, deduced the suggestion or requirement, and removed duplicates.

3.5 Positionality

To help readers understand our individual background that may have influenced the interpretation of results, in the following, we give a research team positionality statement: All authors have experienced public events, but not all attend them regularly. If attending these, football matches are usually the preferred events, followed by events of the performing arts. Demographically, we are a team of physically disabled and non-disabled people with additional neurodivergent perspectives. We are all of Western cultural background, and currently live in Germany. Academically, our background lies within Computer Science, Media Studies, and Cognitive Science, and we are currently at different stages of our careers, ranging from Master student to full professor.

4 Results

We present the results of our Thematic Analysis around four main themes, (1) Familiarity greatly benefits accessible experiences but getting to this point is difficult, (2) To include is to separate, (3) Questioning dependencies on other people while respecting the importance of social contacts, and (4) Improved interactive seat plans need to account for context and individual requirements. Here, we also provide details on the role of technology, and outline the potential and limitations of interactive seat plans. The presentation of results contains participants' quotes to illustrate their lived experiences.

4.1 Familiarity Greatly Benefits Accessible Experiences but Getting to This Point Is Difficult

Familiarity with the venue and the ticket purchasing process was a key factor when planning accessible stadia experiences, especially for home matches. In unfamiliar environments, such as away games, the lack of information on accessibility is a key factor that prevents disabled people from attending football matches.

4.1.1 Disabled People Develop Routines and Gain Knowledge when Visiting a Stadium Regularly. Our results show that getting familiar with a stadium, its accessibility, and the ticket purchasing policies is a process. Regarding home matches at the corresponding stadia, most participants have already completed this process and developed routines. For example, one fan who visits the stadium with a wheelchair shared that "The more routine there is, the more relaxed it becomes. And because of the routines I have [developed] due to the regular visits to the stadium […] I am immensely advantaged" (P10). This translated to better on-site experiences: Participants who benefit from established structures reported good accessibility at the home stadia of their favourite clubs. For instance, P4 attests the stadium he regularly visits "good accessibility" (P4) , while other participants mentioned a "mental inner peace if you know where to go" (P2) and "a state of flow" (P9) when describing their routines. These experiences then give disabled people confidence that "in the end, everything work[s] out fine" (P1).

Developed routines are also relevant regarding the ticketing infrastructure and the inclusion in processes to distribute tickets among disabled people. Tickets for wheelchair users are often available via separate channels (also see Section 4.2.1). A club membership or direct contact with the fan representative (for disabilities), with whom contact needs to be initiated first, can improve chances to get a ticket or may even be a requirement. For instance, P10 pointed out, "You can only apply for away tickets if you are a member of the fan community and a member of [the local club]" (P10). Regarding the contact to representatives for disabilities, another participant explained that "if you regularly come, she [the representative] knows you and you can contact her via WhatsApp […] and say that you need a ticket again" (P3). Alternatively, if disabled fans are committed to very regular attendances and if available, they can benefit from "the comfort of a season ticket" (P2) for an accessible seat and do not need to worry about getting accessible tickets any more. Participants also developed routines involving their companions. For instance, P11 said about her partner, "[h]e knows me and my situation […] and, of course, pays attention to where and how we sit and checks it" (P11).

However, the examples above are cases where participants were highly familiar with the surroundings. In consequence, there is no need for extensive preparation for on-site barriers, and the corresponding information needs are low. For example, P12 expressed, "[W]hen I go to [the local club's matches], I know all the circumstances at the stadium" (P12). We want to note that routines naturally require regular visits, suggesting that the lack thereof can prevent disabled people from enjoying the benefits of stadium visits. Here, participants saw potential in technology that provides extensive accessibility information for first-time or low-frequency visitors. For instance, one participant suggested that technology could supply "these details which I acquired through going to the stadium for many years and asking people about […] [so] that they are available beforehand" (P10). This may reduce the discrepancy between routine and first-time or low-frequency visitors, i.e., lowers the threshold to develop routines, and thus, makes visits to unfamiliar environments more accessible and comfortable.

4.1.2 Unfamiliar Environments Showcase How Missing Information Thwarts Accessible Experiences. Contrasting regular visits, there seems to be an information deficit for occasional visits to unfamiliar stadia, e.g., for away matches, as the "information extraction is often very difficult" (P3). There are two main issues that participants mentioned.

First, travelling to away matches requires additional planning, and creates additional accessibility barriers: Access to trains needs to be organised in advance, and lifts at the station regularly do not function. For instance, C4 reported on their experience that train trips need planning, because "[w]ithout a registration, a wheelchair transport cannot be requested" (C4). If travelling by car, participants requested information about parking before arriving at the venue, "It would be convenient to know […] [where] people with handicaps can park, and so on" (P11). While parking may be granted, it is often unclear how far the distance from the car to the seat in the stadium will be, for example, "that I can estimate, hey, is it worth it that I can visit the match as a pedestrian[4], or do I need to get a wheelchair ticket, because I cannot walk this distance" (P12).

[4]The participant refers to himself as pedestrian when he uses crutches.

Second, while ticketing can often be organised via the home club and its infrastructure, wheelchair users reported that it was often unclear whether they had to "sit in […] the opposing section" (P2), or whether they could sit together with the other (non-disabled) away fans. Even though P8 underlined the general low tendency to engage in violence among disabled fans, he recalled one occasion where he was attacked by a wheelchair user who supported the other team, "He […] attacked me on the arm when I was just celebrating a goal" (P8), highlighting the seat he was provided may have been accessible, but did not afford him the safety as granted to non-disabled fans at away matches.

Consequently, many disabled people avoid away matches, as illustrated by one participant, who explained that "Yes, as a wheelchair user, I do not visit away matches any more […] because I do not know most of the stadia, which barriers there are […]" (P7). Such a lack of information can induce stress, as P10 stated, "Encountering information needs […] because no one responds [to a request], for example, at the away trip, […] Disabled people do not want to take this risk, because they do not want to be confronted with that stress" (P1). This underlines the need for a better provision of accessibility information, especially for unfamiliar venues..

4.2 To Include Is to Separate

Our data highlights that current infrastructures to facilitate inclusion of disabled people in stadia strongly rely on separation in the built environment and within the ticket purchasing processes. We first outline the assets and drawbacks of this separation. Then, we focus on one critical drawback of such separation – the freedom to choose the individually preferred mobility aid.

4.2.1 (In)Voluntary Separation Within the Built and Ticketing Infrastructures . Whether separation is appreciated depends on individual characteristics and preferences. Separating disabled fans from non-disabled fans in the built environment demonstrates both advantages and disadvantages. However, separation in the ticketing infrastructure was not appraised positively.

Safe spaces that provide voluntary isolation from crowds were a major request. For instance, P5 criticised the situation with other fans, "Simply the crowds that do not pay attention, even though one obviously has a physical or visual impairment" (P5). P12 further suggested "a safe and secure path" (P12) for disabled people. Despite this benefit of separation, participants also articulated their desire to experience football matches together with non-disabled people. For instance, P7 criticised that "only one person is allowed to accompany [him]" (P7) instead of allowing him to bring his wife and daughters, and P12 would prefer "wheelchair users and pedestrians to all sit together" (P12).

Separated ticket infrastructures were commented on less controversially. Ticketing requests are routed separately for disabled persons, and currently either rely on personal contact with the fan representatives (for disabilities) or can be processed automatically. Having to make purchases via human contact represents a major barrier as it introduces additional effort and does not allow for spontaneous ticket purchases together with non-disabled peers. Describing their experience, one companion commented, "One has to explicitly contact the fan representative for disabilities and at [their club] it is usually two weeks in advance" (C4). Additionally, most of the participants criticised the small capacities of accessible tickets, as P3 stated, "Even with a membership, it only works with an ordering list, and if there are too many orders, [tickets] will be drawn" (P3). Here, existing infrastructures and processes seem to impede the potential of software systems that could, in principle, provide disabled people a similar ticket purchasing procedure as offered to non-disabled people.

4.2.2 Enforced Separation Takes Away Freedom to Choose the Preferred (Mobility) Aid. Separate stadium infrastructures and seating arrangements had implications for participants' choice of mobility aids when attending a football match. Even though several participants in our sample could use crutches, adapting to the current infrastructures, they often (involuntarily) chose a wheelchair for going to the stadium. For example, P2 explained why he chose this mobility aid, "I need to sit in a wheelchair, so I can carry out the stadium visit. [Alternatively], it would be sufficient for me if there were handrails everywhere in the stadium" (P2). Others, such as P1, mentioned long distances as a reason, "I cannot walk such long distances, and I would depend on an accessible or wheelchair space" (P1).

These issues resulting from separation in the built infrastructure also translate to ticketing and information systems. For instance, P12, who alternates between crutches and a wheelchair in daily life, described wheelchair tickets as a "compromise" (P12), and elaborated, "that I can estimate, is it worth it to visit the football match as pedestrian or do I need to book a wheelchair ticket, because I cannot walk these distances" (P12), suggesting that there do not exist tickets that address requirements in-between wheelchair and non-disabled seating. Additionally, if these tickets would exist, detailed information must be provided online and on-site. For instance, P1 stated, "And then, the security personnel did not know it either, whether to go left or right around the stadium, and it was annoying, and very exhausting" (P1), explaining that uncertainties induced by the lack of information further prevent the free choice of tickets and the corresponding mobility aids.

While some of these issues need to be addressed through an architectural redesign of the venues, the provision of more detailed information in seat plans, such as the location of handrails and the walking distances, has the potential to give disabled people more freedom to choose their preferred mode of visiting (also see Section 4.4.4).

4.3 Questioning Dependencies on Other People While Respecting the Importance of Social Contacts

Social contacts are inherent to positive experiences at football matches, and can contribute to the provision of accessibility. However, certain social relations rather introduce dependency where agency could be possible.

4.3.1 Self-Determined Social Conduct Enables Accessible Experiences. When chosen at their own volition, participants positively reported on on-site assistance, and also valued their companions.

In particular, staff at the venue were considered friendly and helpful. For instance, P5 stated, "In 99% of cases, the responsible representative for disabilities or the safety personnel helps. And

they are all always friendly and ready to help" (P5). Companions, such as friends or family, are an integral part of the experience. Concerning their ability to offer help, P6 explained, "There I can get largely along on my own, and depending on the circumstances, it is good to have someone at your side" (P6).

Beyond on-site assistance at the event, other people also play an important role in the preparation phase. For instance, wheelchair users consult each other on accessibility issues, with one participant explaining that "I have a neighbour who always goes to the stadium as well. He recommends me the route […] and he also sits in a wheelchair" (P9). Fan representatives for disabilities can likewise ease the preparation as point of contact and support, for instance, "to somehow take over the effort of information extraction or, first of all, deliver this information" (P3). Adding to that, another participant reported, "I felt that I was in good hands at the first visit to the stadium, because I went around [the local stadium before] with the representative for disabilities to find seats that are possible for me" (P2).

This showcases the importance of social contacts to enable accessible experiences, something that needs to be respected by technological solutions designed to support stadium accessibility.

4.3.2 Dependencies Within the Infrastructure Limit Agency. The human-in-the-loop ticketing infrastructures (also see Section 4.2.1) limit spontaneous purchases and, more generally, disabled people's agency. For example, one participant complained about obligatory ticketing hotlines with service times and stated, "Here, I would, as a non-disabled person, who feels like going to the stadium, just quickly get a ticket online" (P12). This ultimately limited agency, or, as he put it, "This will to go to the stadium spontaneously, it is taken from you" (P12). Further, a late approval of ticket availability also thwarts planning, with one companion pointing out that "The shuttles are out, gone. There is only a limited capacity" (C4), explaining that P4, who uses complex assistive technology, relies on accessible transportation to reach the stadium. Additionally, disabled people are often required to provide evidence of their disability to purchase accessible tickets, which can usually be done online, for instance by sending a copy of their "[disability] ID card" (P8). This document may be stored at the home club, but for matches at other stadia and other clubs, this step also impedes spontaneous and quick purchases of tickets.

Likewise, participants reported uncomfortable instances of dependence on other people at the venue, recalling situations in which they wished for more agency. For instance, P10 described the situation at the old stadium of their club, "And one has to bring a 'pusher', who, so to speak, pushes you up the small elevation at the main entrance for wheelchair users" (P10). Further, another participant criticised the catering infrastructure, "I always have to send my companion there […] So that my freedom to decide 'Hey, I quickly go there, he or she can continue watching the game' is taken away" (P12), illustrating that it also impedes him offering help to his companion.

These cases highlight the need for disclosing accessibility information that could prepare for more predictable experiences and increase agency at the stadium, especially as the alternative – articulating needs to other people to receive more information – can be burdensome, because non-disabled people may "have trouble to empathise with disabled people" (P7).

4.4 Improved Interactive Seat Plans Need to Account for Context and Individual Requirements

Our results highlight the importance of accessibility information and its integration into interactive seat plans. However, appraising the prospective use of these representations also within the whole spectator journey needs to consider the lived realities, including additional (individual) requirements that may be addressed differently. Here, we discuss participants' general perspectives on seat plans, and we further provide an overview of participants' individual preferences for their design in Table 2.

4.4.1 Seat Plans Can Improve Planning and Contribute to Accessible Experiences for Various Groups of Disabled Fans. Participants primarily reported on using seat plans for away matches and other types of matches at unfamiliar stadia, where they provided benefits regardless of the type of mobility disability. One participant, who engaged in ground hopping[5], reported positively on a foreign club's ticket sale, "I will be at a match there in January and there were actually different [wheelchair] sections to choose from […] and if you clicked on your seat, you would see in a 3D perspective how is the view from there" (P8), suggesting that current practices of providing high-fidelity information to non-disabled fans might eventually gain relevance for disabled seating. If wheelchair users did detail on accessibility information that needed to be available in seat plans, they primarily mentioned information on the surrounding, for instance, "It could be helpful to view in the stadium where the toilets are […] where is the catering" (P3). However, seat-specific information, for example, whether seats are protected from rain, was mentioned as well, "In [another stadium], rain was entering, but things like that should be mentioned" (P9). However, we want to be transparent that - as a result of separate ticketing processes (see Section 4.2.1) - not all participants regularly used interactive seat plans. Especially for permanent wheelchair users, the limited choice of seats often made seat plans obsolete.

But our results also highlight that in the case of disabled fans who had a mobility disability but did not use wheelchairs permanently at the stadium, more extensive accessibility information needs to be provided through seat plans. In contrast to wheelchair users, participants decided based on such information whether a specific seat provided sufficient accessibility, and whether it was possible to visit the stadium without a wheelchair. Here, participants focused on seat-specific and surrounding-related information. For instance, to avoid falling, P6, who visited stadia with crutches in the past, requested "to know how steep the access to the row is" (P6) and "how wide are the aisles between the rows" (P6). Further, P11 added, "Are there separated sections like [at a close-by stadium] that I can access from above, or […] do I need to walk in from the bottom and walk all the way up" (P11), and suggested a filter "to specify that it is important for [someone] that, for example, the toilets are close-by or the path is kept short" (P11).

[5]Visiting as many stadia and matches as possible.

4.4.2 Integrating Interactive Seat Plans in the Spectator Process. Depending on the phase of the spectator journey, requirements and sources may differ, suggesting a need for their integration. Specifically, while seat plans are designed for the purchasing process, i.e., to find (accessible) seats, they are usually not available after the sale. However, participants also requested better communication of accessibility information at this stage of the spectator journey. P3 required "that this information will be made available together with the ticket" (P3). Likewise, P8 expressed, "So, as soon as one has selected a wheelchair space, the important information for wheelchair users could be displayed instantly" (P8). This indicates that significant preparation takes place after disabled people have received approval for their purchase, suggesting that, to assist in preparation, seating could also be made visible once the ticket has been purchased.

Here, especially in the context of navigation, seat plans bear potential to be integrated into routing application for the stadium environment, for example, to "select a seat in a section, if available, with the shortest path from parking" (P12), bridging the gap between arrival at the stadium and accessing one's seat. Thus, if made available throughout the spectator journey, interactive seat plans could serve multiple purposes: To find accessible seats when purchasing tickets and to navigate to this seat when planning and carrying out the attendance of football matches.

4.4.3 Preparation and Information Needs Extend beyond the On-site Environment. Many participants required information beyond the current scope of seat plans, primarily addressing transportation to the venue and the transfer from transportation areas to the seat. Wheelchair users in particular mentioned that public transport was complicated and challenging, and commented on uncertainties regarding disabled parking.

Regarding transportation, P3, who uses a wheelchair, stated that "crowded trains and buses are not usable then, as [he] cannot get in, even though there would be wheelchair spaces" (P3), and elaborates on the situation with long-distance trains to away matches, "You have to call the mobility centre and organise a lifting platform. And if these are smaller cities, they often do not exist" (P3). As a consequence, participants often chose the car to reduce the burden of planning. For instance, P5 highlighted, "I have relatively few issues, because I like organising, and I have various apps that explain the arrival at the stadium" (P5), which suggests that support for people travelling by car was better.

Concerning their arrival at the stadium, participants expressed the need to receive better information on on-site parking. This included the capacity of (disabled) parking lots. For example, one participant explained, "There are, believe it or not, only three parking spots for disabled people" (P2). Likewise, if parking is provided, preparation is necessary due to varying polices. Here, P8 expressed, "So it is indeed helpful to have information about where I can park beforehand, whether I need a separate parking ticket, or if the standard blue parking badge[6] is sufficient" (P8). Since parking close to the seat is a frequent requirement and information on distances is lacking, participants leveraged other online sources, such as, Google Maps (P6), or dedicated applications for football fans (P8), as well as the German application Bundesliga Reiseführer [8] (P8) or the clubs' Instagram posts (P11) and websites (P12). Thus, these information needs represent the lived realities of the target group, which requires a critical appraisal of how such requirements need to be addressed (besides interactive seat plans).

[6]A parking card that grants permission to park in public spaces advertised for disabled people.

4.4.4 A Collection of Individual Preferences for Context Information in Seat Plans. Based on our coding of the interviews, we craft three areas to provide information in relation to a selected seat:

(1) The **seat and narrow environment** in the seating area: Providing information, such as legroom, protection from rain, and the companion seating, helps disabled people evaluate if the seat can accommodate them, and how much assistance will be required.
(2) The **broader environment** within the stadium: Depending on their individual needs, disabled people require information on the broader environment, for instance, regarding the reachability of toilets, or the barriers on the path to the seat, e.g., through the design of stairs (steepness, banisters).
(3) The **outside environment** surrounding the stadium: To plan transportation and arrival, and particularly, to decide if a distance can be managed using a specific mobility aid, information on the outside environment, including the location of parking, needs to be provided.

5 Discussion

In this section, we first provide answers to the research questions. Then, we discuss pathways towards the holistic provision of accessibility information for stadia, and we highlight opportunities for the design of digital technology to improve stadium accessibility. We close with a critical reflection on how qualitative methods of knowledge production can be combined to achieve a nuanced understanding of accessibility requirements, linking back to Strobel et al. [40]'s autoethnographic account on interactive seat plans.

5.1 RQ1: How do people with limited mobility plan, carry out, and experience the attendance of football matches, and what role does technology play?

Our results show that people with limited mobility establish knowledge and routines to gain access to stadia, and therefore experience accessibility barriers when attending football matches at unfamiliar venues.

Established routines required little preparation when visiting familiar stadia, and the preparation rather concerns the planning of accessible transportation. In contrast, matches at unfamiliar venues, such as away matches, required more planning and were strongly impacted by a lack of accessibility information (see Section 4.1). Once on-site, wheelchair users experienced matches separated from other fans (see Section 4.2). While this separation can be voluntary to provide safe spaces, the built environment and ticketing infrastructure also do not alleviate mixed-ability sections. Especially in cases where tickets are distributed separately and with reduced capacities (see Section 4.2.1), participants reported difficulties planning ahead, but also to spontaneously decide to attend matches at the stadium. This mirrors previous findings regarding

Category	Information	Explanation/Example
Seat and narrow environment	Legroom	Distance to row in front
	Seat quality	Foldable or fixed, availability of cushions
	Place for mobility aids	Storing crutches
	Orientation of companion seat(s)	Companion left, right, in front, or behind
	Seating arrangement with fans	With(out) opposing fans
	Standing up required	For fans passing by
	Restriction of view	When people stand up
	Close proximity of seat	Walls or anything to hold on
	Rain protection	Whether the seat is under a roof
Broader environment	Restrooms	Location and capacity
	Catering	Location and waiter service
	Accessibility info point	Location of on-site assistance
	Entrances to section	Access from above or below
	Handrails and banisters	Location (at both sides of stairs)
	Stairs	Location, steepness, or width
	Isles	Width of isles
	Lifts	Location
	Crowded areas	Location and time
	Noisy areas	Location of loud fans
Outside environment	(Accessible) parking	Location and capacity
	Train station or bus stop	Location and accessibility features
	Road closures	Location and times

Table 2: Contextual information that can be included in interactive seat plans, categorised by seat information and narrow environment as well as broader and outside environment

journey planning practices among disabled people in the context of work [26].

Overall, we note that technology is predominantly used in the preparation phase, where it serves as a tool for information extraction, aligning with previous work [40]. It plays a more prominent role when stadia are unfamiliar, addressing the purchase of tickets, but also extends to the management of train rides and parking. However, human contact, when anticipated, is essential in the preparation, and needs to be acknowledged alongside technology that addresses these issues (see Section 4.3).

5.2 RQ2: What role does the interactive seat plan play in the ticket purchasing process, and how does it (fail to) address information needs of people with limited mobility?

The participants' experiences showed that interactive seat plans are currently more relevant for unfamiliar venues and, primarily, for people who want to choose between mobility aids (see Section 4.4).

Our results add further empirical evidence to previous work [40], suggesting that while seat plans do convey basic information (e.g., orientation and view towards the pitch), they need to be refined to effectively convey relevant accessibility information (see Section 4.4.4 for examples). Further, detailed information on the transition from public or motorised transportation to the venue, navigation to entrances, and navigation to the specific seat is highly relevant for people with limited mobility (see Section 4.4.3), and needs to be included for seat plans to support accessibility. For this, accessing the seat plan needs to be possible throughout the spectator journey, i.e., before and after purchasing tickets.

Extending beyond information needs, our results also highlight how current digital seat plans and the practical arrangement of physical seating areas create segregation between disabled and non-disabled people (see Section 4.2.1). Concerning wheelchair users, our results suggest that separate seating areas as also advertised in some seat plans may increase accessibility, but have drawbacks for inclusion; instead, individuals who do not regularly use wheelchairs may feel compelled to do so for match attendance despite the wheelchair not being their preferred assistive device (see Section 4.2.2). This shows that digital accessibility considerations need to go hand in hand with a critical appraisal of the built environment.

5.3 Technology and Equitable Access to Stadia

The results have demonstrated the potential of technology to contribute to equitable access to stadia. In the following, we discuss technology for improving familiarisation and reducing segregation, and we envision prospective interactive seat plans. While these considerations relate to football stadia, future research may also consider employing them within broader applications of interactive seat plans, such as for travelling via train or plane, or for smaller venues of the performing arts.

5.3.1 Supporting Familiarisation and the Establishment of Routines. Becoming familiar with the infrastructure requires initial effort to pass a threshold (also see Section 4.1). While our analysis rather concerned people who were already accustomed to the circumstances within their known infrastructures, it is yet unclear how other disabled people perceive this barrier. For instance, stressful experiences concerning away matches and a reluctance to visit these new environments suggest that unfamiliar venues can introduce a significant burden on disabled people (cf. [26]). Especially, a lack of information may reinforce doubts whether a venue offers the individually required accessibility. Here, technology, and specifically, a better online provision of accessibility information, can prospectively address these issues.

Organisers, such as the football clubs, would need to provide more content on their websites, detailing specific venue characteristics. Here, seat plans could benefit from context information (see Section 4.4.1 and 4.4.4), for instance, building upon efforts to provide 3D visualisations (e.g., [39]). Additionally, free VR or in-person tours could establish a quiet atmosphere to prepare for the visit (e.g., see [1, 34]), thereby also providing a space to evaluate personal health hazards, e.g., the risks of acquiring a COVID infection [35].

However, human contact should not be replaced with technology, reflecting the interdependent environment disabled people established [2]. Additionally, the potential of artificial intelligence to assist in information extraction as a replacement for such human contact should be carefully reviewed [13].

5.3.2 Reducing Segregation That Results From Digital and Physical Infrastructures. Current infrastructures separate disabled and non-disabled people, often enforcing segregation despite a wish for more inclusion (see Section 4.2.1) instead of promoting their social ties [23]. Here, technology could compensate for inaccessible built environments by describing barriers and ways to circumvent them.

Modelling the built infrastructure, for instance using (3D) stadium maps or seat plans, could help disabled people find barriers and develop ways to address them, especially for unfamiliar venues (also see Section 5.3.1). For instance, to be able to freely choose the preferred mobility aids and integrate with non-disabled fans, some participants requested detailed information on handrails, seats, and walking distances in seat plans. Thus, technology could empower them to self-initiate inclusion without being dependent on other people.

Furthermore, including disabled people in conventional ticket sales could also boost inclusion. Ticket infrastructures could be adapted to reflect two changes. First, current systems exclude disabled people from spontaneous experiences together with their non-disabled peers and instead require thorough planning. Through improved information provision and easier proof of disability in their ticketing system, organisers could reduce the reliance on staff and enable such spontaneous purchases. Second, improved seat plan representations and intelligent seat recommendation systems (cf. [25]) may allow for close-by seating of more than one companion, which ultimately reduces the discrepancy in companion-management between non-disabled and mixed-ability fan groups.

5.3.3 Envisioning Interactive Seat Plans. Our results demonstrate avenues for future improvements of interactive seat plans, suggesting to **extend their current application to more use cases**, such as for navigation. In line with a call for categorising seats instead of people (cf. [40]), seat plans need to **provide more detailed accessibility information**, comprising the narrow, broader, and outside environment of the selected seat (also see Section 4.4.4). Additionally, as articulated in the interviews, interactive seat plans should display the most accessible path between important locations in these environments, for instance, how to get from parking to a lift and then to the seat. Overall, **integrating seat plans into a larger representation of the built environment** could ease efforts to prepare for accessibility. This would, however, **require interactive seat plans to be available throughout the entire spectator journey** (see Section 4.4.2).

Additionally, novel systems could leverage diverse technology: While current systems rely on desktop-based representations of seat plans being responsive to display sizes, future systems may leverage VR for detailed digital twins of seat surroundings and other locations in stadia to explore their accessibility (cf. [34]). Additionally, mobile interfaces could assist navigation on-site, for instance, by enabling routing around and inside stadia and arenas or seat finding using augmented reality (AR) when entering a particular stand (also see Figure 2 for examples).

5.4 Leveraging Interviews to Contextualise Findings Produced Through First-Person Methods

Our interview study was an effort to complement the existing autoethnographic account of large public events by Strobel et al. [40]. While first-person methods such as autoethnography provide in-depth introspection, and centre the researcher as subject of inquiry [7, 18], their subjectivity is also at the heart of criticisms of the method which question the transferability of findings [11]. Here, our work offers the opportunity to contrast the knowledge that was produced through each of the approaches, with results suggesting that key aspects (relevance of accessibility information (beyond seat plans), focus of current infrastructures on wheelchair users, and complex social dependencies) were uncovered through both approaches. Interestingly, our findings presented here do not achieve the same depth at the level of the individual, but offer a complementary opportunity to understand experiences across types of mobility disability. Additionally, while our account articulates the voices of people who have already gained expertise in this area, Strobel et al. [40] provide an account that is exploratory in nature and fuelled by curiosity and unfamiliarity. This contrast helped us uncover nuance, for instance, when understanding the process of familiarisation. Thus, under consideration of the heterogeneity of disability [41] and the subjectivity of the lived experience thereof [38] as well as the value of curiosity and expertise in these studies, we argue that the combination of first-person and broader qualitative methods can help develop a nuanced understanding of phenomena in the context of disability and the implications for accessibility. Thus, combining these methods can contribute to the development of technology that understands and respects individual lived experience while simultaneously addressing broader user groups.

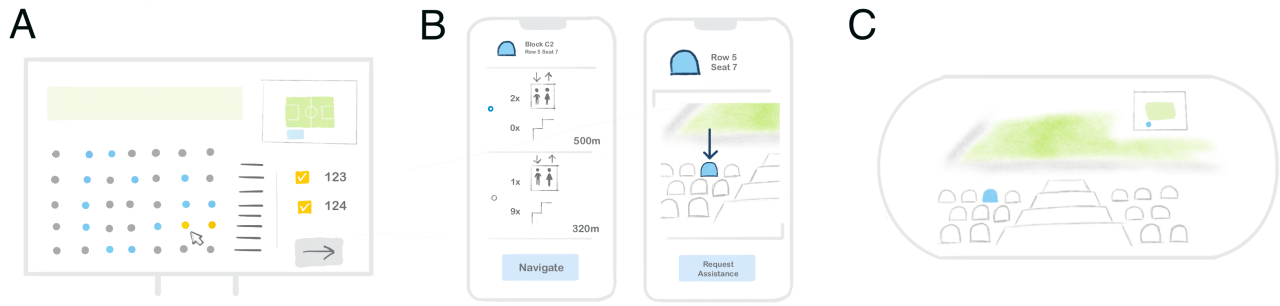


Figure 2: Simplified sketch of a state-of-the-art desktop interface (A) along prospective mobile interfaces (including AR systems) for accessible way-finding (B) and a VR interface for remote exploration of the detailed surroundings (C).

6 Limitations

Our results need to be interpreted in light of some limitations. Our research was conducted in Central Europe and focused on football matches. Further, possibly due to current support structures, wheelchair users who already developed routines for visiting stadia and acquiring accessibility information were overrepresented in our sample: Current contact channels between clubs and disabled people seemed to handle ticketing requests for wheelchair users manually, and therefore, built a network of people who use this mobility aid. Here, it would also be important to explore perspectives of disabled people who are interested in football matches, but do not (yet) watch them in stadia. While our work provides an in-depth account on the topic leveraging established infrastructures in football, future work should broadly explore more diverse target groups (e.g., expand beyond mobility disability), and should address experiences for various sports and other types of public events. Here, we see an opportunity for future work to move beyond qualitative methodology, for example, leveraging broadly accessible online surveys to appraise our findings with bigger samples. Finally, we want to highlight our own positionality that may have impacted how we interpreted and presented the results (also see Section 3.5).

7 Conclusion

Football stadia have yet to become more accessible to people with limited mobility, and technology can play a central role, particularly in the preparation for attending public events. Through a qualitative exploration of disabled people's experiences, we found familiarity with the venue to be a key contributor to accessibility, and we showed how current (ticketing) infrastructures (in)voluntarily affect the separation between disabled and non-disabled people. While social contacts often facilitate more accessible experiences, being dependent on other people can limit the agency of and accessibility for disabled people. Interactive seat plans bear significant potential in the preparation for football matches, particularly for disabled people who want to attend these without wheelchairs. Providing accessibility information in such representations can support the process of familiarisation and tackle unwanted separation. This requires prospective seat plans to adapt depending on the disabled person's situation, e.g., reflecting their mobility aid and prior experience. It also requires them to be situated within a broader framework of information provision that includes the improvement of ticketing infrastructures and the inclusion of personal, human assistance. This opens up room for additional interactive systems, including VR, AR, and mobile systems that can expand on the desktop-based state-of-the-art.

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