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Conceptualizing multidimensional barriers: a framework for assessing constraints in realizing recreational benefits of urban green spaces

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ABSTRACT. Although potential urban green space accessibility is being discussed widely, specific barriers that affect accessibility are often under-estimated. They do not equate to limited or uneven accessibility nor are they exclusively related to physical settings. Rather, the range of barriers and their complex interactions, including people's perceptions, personal conditions, and institutional frameworks, make this topic less clear cut and difficult to put into practice for planning purposes. Given the importance of barriers when people make decisions, we present a conceptual framework to capture the cumulative and interactive effects of different barriers on realizing recreational benefits of urban green spaces. The framework classifies physical, personal, and institutional barriers and highlights their interactions based on three case studies: Stockholm, Leipzig, and Lodz. We argue that constraints to the accessibility of urban green spaces are not so much the interactions between various physical, personal, and institutional barriers, but more the significance that beneficiaries assign to them as perceived barrier effects. Studying barriers seeks to improve the knowledge about the non-use of urban green spaces and to enable us to draw conclusions about the actual accessibility of recreational benefits. Deduced from the conceptual framework, three pathways are contrasted for improving accessibility to the recreational benefits of urban green spaces: the environment, knowledge, and engagement. We argue that these pathways should not be a diffuse objective, but a sensitive and scale-dependent re-balance of individual, physical, and institutional factors for considering justice in environmental and green space planning and management. Our systematic conceptualization and classification of multidimensional barriers enables a more comprehensive understanding of individuals' decisions in terms of accessing recreational benefits.

Key Words: *accessibility; barriers; conceptual framework; infrastructures; institutions; perceptions*

INTRODUCTION

Instead of pure accessibility or the accessibility potential, it is often a set of barriers that limit the recreational benefits from urban green spaces (UGS) for urban dwellers. An intertwined set of barriers constrain the accessibility to urban green spaces and the way their recreational benefits are experienced, used, and co-created through multiple interactions between the UGS and beneficiaries. Although many excellent studies use physical proxies for optimizing green space accessibility in cities (e.g., Handley et al. 2003, Dai 2011, Wolff 2021), barriers are not equal to limited or uneven accessibility nor are they exclusively related to physical aspects or objects. Rather, a variety of barriers and their complex interactions, including people's perceptions, personal conditions, or institutional frames, impact people's daily strategies in accessing UGS benefits that contribute to their well-being (Hoehner et al. 2005, Bisht et al. 2010). Despite the large importance that barriers have for people's decision to (not) visit green spaces, no systematic approach to structure types of barriers, their interaction, and planning responses exists yet. This is where we jump in: we put both cumulative and interactive effects of different barriers into a robust conceptual framework that represents an essential prerequisite for considering the importance of barriers for green space use more narrowly and the consequences for a wider perspective of justice in environmental and green space planning and management (Haase et al. 2017, Angelovski et al. 2020, Langemeyer and Connolly 2020).

Access to urban public spaces and transport in general, and to UGS in particular, is essential for human well-being as acknowledged by the UN sustainable development goals (UN 2015, see SDG 11.2 and 11.7). Due to its spatial proximity alone, UGS, like parks or forests, provide health benefits to people because they improve, for example, thermal comfort and air quality (Jarvis et al. 2020). In addition, recreation, which can only be achieved when UGS are accessed and used (Brown 2008, Wang et al. 2015), contributes to physical and psychological health and well-being via, e.g., relaxation, physical activity, and social interactions (Byrne et al. 2009, Wolch et al. 2014, Rigolon 2016). In this context, accessibility is defined as the relative opportunities different individuals have for achieving these recreational UGS benefits. Barriers, in turn, are factors that constrain or reduce these opportunities (adapted from Pirie 1979, Ma and Haarhoff 2015). In most studies of UGS accessibility, barriers have been underestimated and under-theorized in terms of their effects and interactions. We argue that this needs to change, as demonstrated by the three following developments in accessibility studies:

First, traditionally understood as a spatial proxy for measuring reachability, accessibility developed into a multi-dimensional construct difficult to define and to measure (Bisht et al. 2010). Scholars underline that physical distance itself does not satisfactorily equate to the actual use of UGS (Jones et al. 2009, Wang et al. 2015). Rather, there is a variety of factors at play, such as socio-demographic characteristics, inter-personal or cultural

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aspects, e.g., regarding the attractiveness of UGS amenities (van Herzele and Wiedemann 2003, Murray et al. 2003, Hoehner et al. 2005, Ferreira and Batey 2007, Byrne et al. 2009, Wang et al. 2015). However, these factors are complex. Empirical studies from the UK and the US show that residents who live closer to attractive parks tend to use them less frequently (Ball et al. 2008, Cutts et al. 2009, Jones et al. 2009), whereas other studies show how residents in less affluent areas use nearby UGS for pragmatic reasons (like lack of alternatives; Seaman et al. 2010, PHE 2020). Biernacka and Kronenberg (2018) detected a set of institutional barriers that constrain the availability, accessibility, and attractiveness of UGS, pointing to a diversity of barriers in cities. By demonstrating the contextuality of UGS, Andersson et al. (2019) showed how the achievement of UGS benefits is a complex process mediated by three systemic filters: infrastructure (composition and configuration of the urban landscape), institutions (rules and norms), and the capacities, values, and individual and shared perceptions of urban residents. Although accessibility studies demonstrate the multi-dimensional character of this phenomenon, the assessment of barriers is often restricted to physical features, such as railways, waterways, or highways (van Herzele and Wiedemann 2003, Barber et al. 2021). Mixed results show how factors usually identified as potential barriers, especially simple measures like physical distance, are limited in their capacity to explain if and why urban residents access UGS.

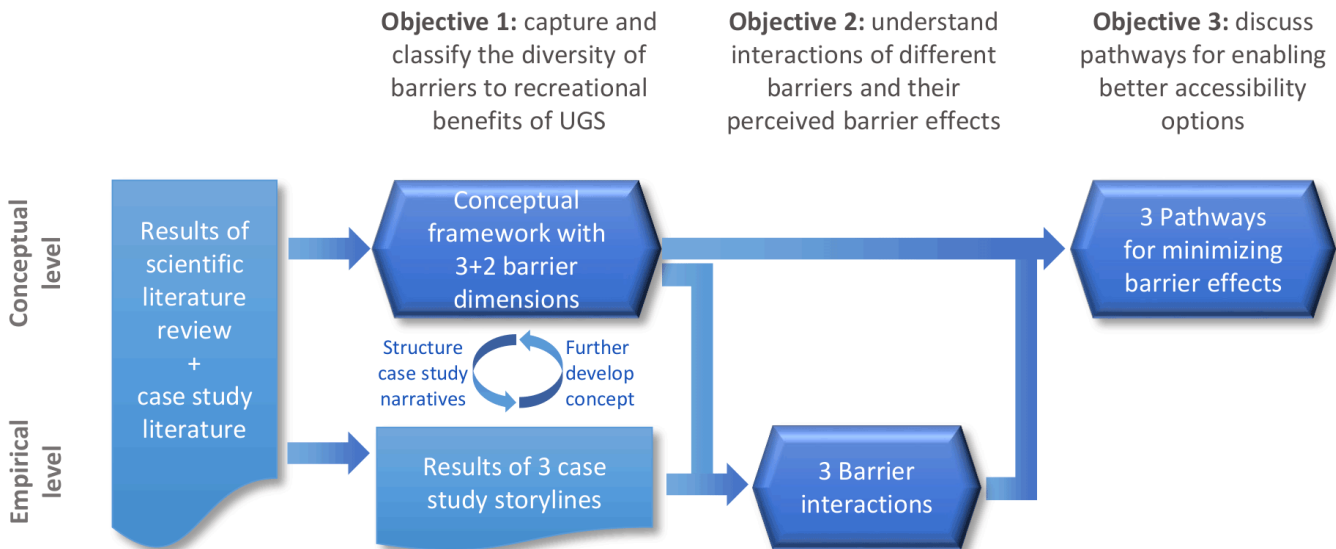
Second, given the diversity of beneficiaries and their activities within diverse physical and institutional UGS settings, the actual experience and benefits of recreational activities are more than the sum of the different factors at play. Rather, barriers interact in multiple ways, and further studying the emergent effects of these interactions is important for understanding how accessibility aligns or not with peoples' needs and preferences in accessing or not recreational UGS benefits (Rossi and Armstrong 1999, Bisht et al. 2010, Byrne and Sipe 2010). Physical factors are shaped by institutional frames and perceived or given meaning by individuals with diverse interests and intentions (Bisht et al. 2010, Matthews et al. 2015). An entertainment event in a green space can be a barrier for some users whereas it can be an attraction for others depending on the options provided to inform or engage with the event and its planning. Few studies focus on interacting constraints within the socio-spatial environment, e.g., safety and cultural concerns (Cutts et al. 2009, Wendel et al. 2012), or institutional environment, e.g., decision-making processes, power dynamics, or financial and organizational constraints (Matthews et al. 2015, Biernacka et al. 2020). Health studies on barriers suggest that communication and information are decisive factors for understanding barrier interactions and people's perceptions or behavior, not necessarily influenced by institutional settings (Pechansky and Thomas 1981, Saurman 2016). Additionally, scholars emphasize that constraints for accessibility and the actual use of UGS are determined by opportunities to engage with activities and accessibility options (Farrington and Farrington 2005, Ferreira and Batey 2007). Consequently, there are plenty of interactions between factors, making this subject challenging to operationalize for planning purposes, which seek to improve the accessibility to UGS recreational benefits in cities.

Third, barriers and constraints are less looked at as determinants of decisions for or against accessing diverse and inherently different UGS (e.g., Wang et al. 2015, Boulton et al. 2020). Conceptual models of park use already underlined that good accessibility opportunities do not translate directly into the actual use(s) of UGS (and respective access to recreational benefits) but it is rather the relevance of people's perception of park space that is an influential factor for or against using a park (Byrne et al. 2009). Wang et al. (2015) tested the ability of physical and non-physical variables, such as aspects of cultural groups, shared activities, safety, and leisure time available, to explain perceived accessibility and attractiveness of different park uses and users. They also emphasized that institutional factors, such as landscape design or maintenance frequency, shape people's use behavior (Wang et al. 2015). Studies on the perception of UGS accessibility are valuable because people consciously or unconsciously perceive and evaluate the variety of opportunities available to them for benefiting from UGS recreational benefits and evaluate well-being outcomes in return for perceived investment costs (Zondag and Pieters 2005). However, surveying park users by asking why they access UGS and what they appreciate in terms of selected amenities largely leaves the hidden reasons behind the non-use of UGS unexplored. Recent studies report that people do not use UGS even if they find them attractive and accessible (Seaman et al. 2010, PHE 2020). Often, decisions are made based on preferences but also to avoid constraints or dislikes, or by weighing alternative ways of spending time and deriving different benefits. Consequently, studying barriers is grounded in an interest to improve the knowledge about not only the use but also the non-use of UGS to draw conclusions on the actual access to recreational benefits.

Although many studies report on the conceptual aspects of accessibility and use behavior (see among others, Matthews 2015, Wang 2015, Langemeyer and Connolly 2020), few studies so far have systematically addressed barriers to UGS recreational benefits using a clear, comprehensive conceptual framework. Understanding the complex and fuzzy setting of barriers to UGS recreational benefits in a systematic way would help to improve knowledge on what constrains the opportunities people have for benefiting from UGS and under which conditions they would access UGS. Uncovering why people do not access UGS also supports developing integrative planning options not seeking to provide UGS with the highest amount on attractive amenities possible, but to specifically respond to barriers to enable those people who would otherwise not have accessed UGS, to access them. Against this background, we endeavor to assess the combined effects of different barriers to recreational benefits of UGS suggesting a conceptual framework that helps to:

1. capture and classify the diversity of barriers covering physical, institutional, and personal dimensions;
2. understand how the interactions of different barriers and their perceived barrier effects constrain the way potential beneficiaries access recreational benefits; and
3. push the discussion of pathways for minimizing barrier effects and enabling better accessibility options for potential beneficiaries.

Fig. 1. Workflow for building the conceptual framework. Note: UGS = urban green space.



METHODS

The core of this research was the development of a conceptual framework to assess barriers to accessing UGS benefits (Fig. 1). The three filters suggested by Andersson et al. (2019, 2021, this Special Feature), i.e., infrastructure, institutions, and perceptions, have been used to conduct a survey of relevant peer-reviewed literature published since 2000. The filters are a common language for aspects that shape the realization of ecosystem service flows, grounded in an interest in values, justice, and resilience. We used the Scopus database and the following query “([barrier, accessibility, OR attractiveness] AND [urban OR city] AND [green and blue infrastructure, green infrastructure, green space, OR park] AND [infrastructure OR institution* OR perception*]).” The resulting 358 records were subsequently screened for availability, and if available, assessed for eligibility according to the following set of criteria: the record is not strongly data or method driven but incorporates conceptual reflections on accessibility to green spaces; the record is not a review paper; the record considers either one filter in detail or multiple filters in combination. This resulted in 127 publications that have been used for building the conceptual framework (Fig. 2). We introduced five barrier dimensions. “Physical,” “institutional,” and “personal” barriers largely cover aspects in line with the infrastructural, institutional, and capacity filters suggested by Andersson et al. (2019, 2021). However, by emphasizing that perception is an important lens that makes barriers very individual (Wang et al. 2015, PHE 2020) we argue that “perceived barrier effects” are not an exclusive element of personal barriers but an integration of physical, personal, and institutional barriers. We further introduced “contextual factors” that impact the mentioned barrier dimensions but operate at different scales.

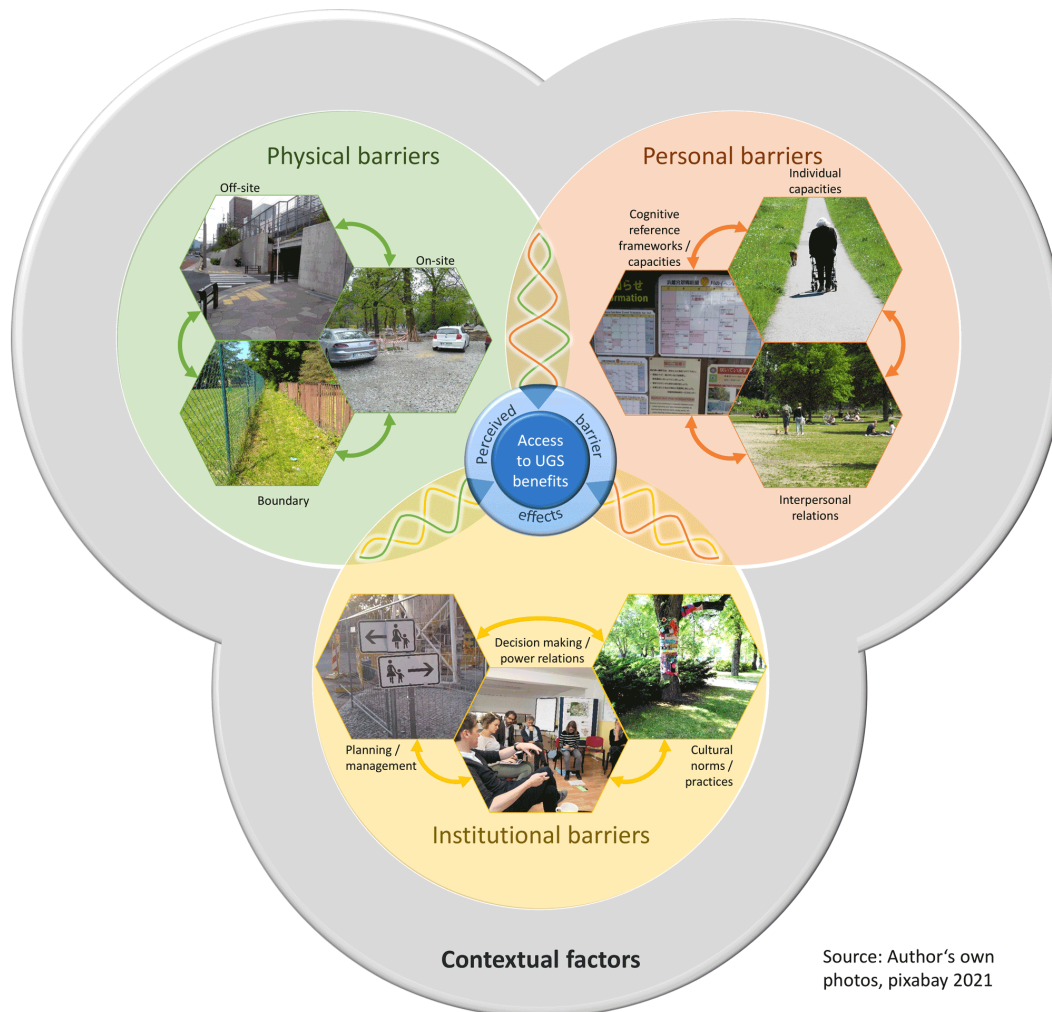
In addition, we applied the framework across three case studies (Stockholm, Sweden; Leipzig, Germany; Łódź, Poland) in an iterative way. We conducted interviews with experts from the three case studies (who also authored this article), asking them for information structured according to the conceptual framework

(see Appendices 1 and 2). The experts have substantial knowledge about the cases, in terms of (1) accessibility issues, (2) relevant official documents (e.g., spatial plans), and (3) stakeholders’ perspectives. We also used the authors’ published literature to back-up some of the arguments. We draw storylines for Stockholm, Leipzig, and Łódź because they represent different social-ecological and planning contexts. The storylines have been used to further develop and fine-tune the conceptual framework (Fig. 1)

By linking the conceptual framework with the case study narratives, we are able to analyze the various interactions of different barriers. The results serve as an illustration for concept application seeking to understand how barriers affect the way users actually perceive the accessibility to UGS recreational benefits by unpacking interactions between different barriers. Interactions between barriers are required to evaluate accessibility options (Higgs and White 2000) by connecting the systemic (physical and institutional barriers) with the individual (personal barriers) dimensions (Bisht et al. 2010). Based on the idea of two-directional relationships, the following three interactions have been conceptualized.

- Environment-related: personal barriers (esp. individual capacities) emerge due to physical constraints produced by the infrastructural and institutional environment (e.g., land-use planning) or physical and institutional barriers are evaluated against the background of individual capacities (Ferreira and Batey 2007).
- Knowledge-related: personal barriers (esp. cognitive capacities) emerge due to lack of knowledge and awareness of accessibility options or information provided by infrastructural and institutional entities are not tailored to groups of persons and individuals (Saurman 2016).
- Engagement-related: personal barriers emerge due to missing opportunities to engage provided by infrastructures

Fig. 2. A kaleidoscope of barriers to recreational benefits of urban green spaces (UGS).



and institutions or physical or institutional opportunities do not lead to an engagement of persons (Farrington and Farrington 2005).

Finally, the classified barrier interactions in combination with the conceptual framework have been used to discuss three complementary pathways of how to minimize barrier effects: environment-, knowledge-, and engagement-focused pathways.

A CONCEPTUAL FRAMEWORK OF BARRIERS TO RECREATIONAL BENEFITS OF URBAN GREEN SPACE

We conceptualized three dimensions of barriers: physical barriers are place-based; personal barriers refer to individuals or groups; institutional barriers refer to framing conditions (Fig. 2; for details see Appendix 3). These dimensions are not mutually exclusive but represent different entry points for understanding barriers to recreational benefits of UGS framed by contextual factors. We expand on all three dimensions of barriers and contextual factors before we address perceived barrier effects.

Physical barriers

Physical barriers are built-up or natural features which, due to their existence or absence, hinder the potential accessibility by restraining users from reaching, entering, or staying in a UGS. These barriers can be distinguished according to their physical or functional relation vis-à-vis a UGS (Morris et al. 2011).

Off-site barriers

Off-site barriers relate to transportation and characteristics of the surroundings (Giles-Corti et al. 2005). Lacking public transport connections and facilities (frequency of stops, lines, rides), street or railway connections, or car and bicycle parking lots do not meet the quantitative and qualitative requirements of potential UGS users (Cutts et al. 2009). Common effects, such as higher travel costs, unreasonable distances or time can be reinforced by constraints on walkability in the surrounding neighborhood. These can include missing or poorly maintained sidewalks, construction sites, built-up or fenced areas, or a lack of road or river crossings and their inadequate connection with UGS entrances (Wang et al. 2015).

Boundary barriers

Boundary barriers at the interface between features outside and inside UGS constrain the way users can enter UGS, including built-up structures, e.g., walls, fences, or buildings, and natural elements, e.g., water bodies, dense forests, shrubs, undergrowth, hedges, or rocks. Major roads, railway corridors, or even tramlines usually cannot be crossed and impact recreational benefits within shorter distances, e.g., by traffic noise or pollution (Hadavi and Kaplan 2016). The lack or uneven distribution of access points can increase the walkable distance whereas the physical features of existing entrances might exclude certain user groups, e.g., when only stairs and no ramps are available (Morris et al. 2011).

On-site barriers

On-site barriers often take the shape of “absent” physical features within UGS. Several features do not promote accessibility directly but enable different activities or make the stay within a UGS more attractive (Biernacka et al. 2020). Their absence presents a barrier to an extended potential use of UGS. Features supporting the use of a UGS, such as paths, lights, public toilets, benches, or waste bins relate to the basic needs of users and are particularly relevant for people with limited mobility, such as wheelchair users, elderly, or infirm people (Holt et al. 2019). The presence of vegetation, like trees, supports the enjoyment of nature and provides shade or, in combination with water bodies, also fresh air (Wendel et al. 2012). The balance between natural and paved surfaces can impact activities (sitting on the grass) but even more the way the surface heats, which can impact users’ thermal comfort (Matthews et al. 2015). Features supporting the active UGS use determine the use of UGS directly, for example, sports fields, skate parks, playgrounds, or fitness equipment promote specific UGS uses, or support social gathering such as, e.g., cafés, picnic, or barbecue sites (Ma and Haahrhoff 2015). In contrast, there are also on-site barriers that actually impact users’ movements within a UGS, e.g., closed areas, dense forests, or areas that become muddy or flooded after rainfall events (Byrne et al. 2009).

Personal barriers

Personal barriers relate to an individuals’ characteristics or conditions, thus constraining their accessibility to recreational benefits while being socially embedded and conditioned (Gulliford et al. 2002).

Individual capacities

Individual capacities determine to what extent an actor is able to derive benefits from UGS. They can be related to their physical attributes or health condition, e.g., allergies (Seeland et al. 2009, Raymond et al. 2017). Furthermore, personal resources, such as time budget and finances can represent a barrier depending on factors like age, family situation, and professional status or gender (Rutt and Gulsrud 2016, Holt et al. 2019). For example, people with children or domestic responsibilities can have quite different time budgets than people without children (Jay and Schraml 2009, Wendel et al. 2012). Financial affordability and available time budgets provide actors with more options for accessing recreational benefits because distance or entrance fees do not play out that strongly as barriers (Berney 2010, Seaman et al. 2010). These capacities change over time, like with reduced mobility at certain ages or when someone receives a driving license and can therefore access other UGS located farther away.

Cognitive reference frameworks and capacities

Cognitive reference frameworks and capacities determine how well actors can read and understand their environment and the opportunities it offers. For this literacy of assessing opportunities for recreational benefits, language skills and the level of education essentially impact the ability to navigate through access options (Lindsey et al. 2001). It can also be shaped by the professional relationship or physical engagement in working with or within a UGS (e.g., volunteer, practical action, employed as gardener). This is related to an actor’s cognitive framework for reading the landscape depending on preferences, attitudes, and individual beliefs, influenced for example by religion, ethnicity, or socio-cultural background (Sen 2009, Fischer et al. 2018). For instance, some groups might use UGS mainly for meeting other people, whereas other groups might seek to enjoy nature, escape from stress, or allow their children to play (Wendel et al. 2012). In addition to cognition, lacking an emotional association with a place or a type of environment (expressed as, e.g., place attachment; Burduk et al. 2009) might represent a barrier in accessing recreational benefits. For example, associations and experiences, or a lack thereof, may limit the attractiveness of a place or type of UGS (Sreetheran and van Den Bosch 2014, Giusti 2019). Lack of knowledge and emotional bonds in relation to a UGS, and cognitive references or capacities can present major barriers also for working through institutions to leverage change or getting involved in learning activities, decision making, or other potentially relevant processes and experiences.

Interpersonal relations

Interpersonal relations refer to the level at which people are intertwined with other individuals or groups sharing similar values or behaviors, such as family, friendship, community, and neighborhood. These relations operate at the level of societal values, judgement, and mechanisms of in- and exclusion (Hadavi and Kaplan 2016, Seaman et al. 2010). Low levels of inclusivity in social networks can hinder options for accessing UGS benefits, for example, by discouraging people from visiting nearby parks or visiting them more frequently (Berney 2010). The lack or low level of interpersonal relations can lead to people not feeling welcome in a given space or fitting in with the profile of other users, which can in turn translate into a form of self-retreat in which people are not confident going out or do not dare encounter others at all (Biernacka and Kronenberg 2018). However, the exclusion of individuals or whole groups, e.g., of different ages, ethnic or cultural background, can also be involuntary (Valentine 2008, Fincher and Iveson 2012). For instance, the dominance of males, unsupervised children, or migrants could produce ambivalent feelings and some groups could feel discriminated against because of specific cultural expressions (e.g., dress code) and consequently might not dare to go to parks. Actual and potential encounters, negative past experiences, e.g., of racial violence (Finney 2014), and different conflicts determine individuals’ ability and willingness to access UGS. Thus, use and appropriation of space with associated consequences like noise, social stigma through discriminating attitudes or behavior, as well as criminal activities can lead to exclusion (Leslie et al. 2005, Fischer et al. 2018). These barriers change over time with users accessing recreational benefits differently because of specific events or scenes that appear, e.g., an event of violence or the appearance of a drug scene.

Institutional barriers

Institutional barriers emerge from socially constructed and formalized structures and processes within and between institutional actors in terms of policies, property rights, and social control, e.g., written laws, rules or agreements, as well as informal issues, such as codes of social life, norms, and customs that regulate the interaction, expectations, and responses between actors (North 1990, Vatn 2005, Ostrom 2009). Institutional barriers can be a consequence of rigid or inadequate structures, processes, rights, and responsibilities in relation to a resource, such as a UGS (Beunen et al. 2017). This operationalization implies that institutional barriers are constantly shaped and reshaped by a variety of formal and informal institutional actors, such as planners, politicians, non-governmental organizations, and private interest groups such as individual property owners and housing associations. Those actors play different roles in decision-making processes and accordingly have different degrees of ability to influence such processes. By shaping decision-making processes and contexts as well as the use of UGS, institutions privilege certain ways of doing things and discourage others. These barriers, which can be especially persistent, are thus twofold: limited rights to use land and limited ability to influence decisions on land use.

Planning and management

Planning and management have an impact on accessibility by shaping the physical layout, management, and property rights of UGS. Different sectors responsible for land-use planning and UGS management have different regulations, mandates, responsibilities, and financial resources. Also, lacking or insufficient tools, such as legal plans, financial resources, or administrative interventions, can lead to insufficient design and management of UGS. Lacking maintenance can lead to closure or neglect of areas, making them not accessible or attractive to use anymore (O'Donnell et al. 2017). Existing management can also be a barrier, for example, in the form of permanent or temporary access or use restrictions of certain parts of UGS (opening hours, entrance fees, user rules) or introducing a protection status of an area or a species in reaction to the increasing crowding and vegetation stress (Matthews et al. 2015, Biernacka and Kronenberg 2018). The physical design and designation of the UGS and its features, e.g., playground, dog walking, or sport areas, may prioritize different potential users and not others who are not attracted by these features or the way they are designed (Littke 2015). Barriers emerging from property rights are relevant for semi-private UGS, such as allotments or gated community-like areas in which UGS are exclusively used by the members or residents of this particular allotment or estate even though they are considered (semi-)public. The ongoing privatization of unbuilt land is a clear barrier that increasingly narrows accessibility options for UGS benefits in cities (Colding et al. 2013).

Decision making and power relations

Decision making and power relations shape and are shaped by institutions through continuous interaction, negotiations, and reconfiguration of relations between different actors (Ernstson et al. 2010, Colding and Barthel 2013). Different planning sectors have different languages and terminologies, financial and personal resources, and associated power resulting in more or less formal hierarchies and power dynamics between institutional

actors from which several barriers can emerge (Rutt and Gulsrud 2016). Poor cooperation and incentives to exchanges and interactions can hinder the flow of benefits between beneficiaries and UGS (Matthews et al. 2015). This is aggravated by the lack of professionals among government officials and policymakers with a clear understanding of these complex flows, leading to a lack of interest for institutional support of UGS benefits (Kronenberg 2015). Even if UGS receives some formal regulative support in the planning process, it might become overrun by other interests that have a higher (in)formal priority or provide more short-term gains that outcompete long-term goals (Kabisch et al. 2016). Some potential solutions are politically unpalatable, expensive, may impact the rights of private property owners, or may require major changes to existing planning systems (Bulkeley 2013). These goal conflicts are particularly challenging in a pluralised actor setting with different power, strategic interest, and impact on the final decision (Biernacka and Kronenberg 2018). For instance, housing market changes in most cities do not only create competing investment decisions but also increasingly support decisions that hinder the realization of improved access to recreational benefits. Housing investments are not combined with greening in all countries (Domaradzka 2019) and even if UGS might be created, they are mostly accessible for privileged group (Shokry et al. 2020, Garcia-Lamarca et al. 2021).

Cultural norms and practices

Cultural norms and practices are systemic and embedded into institutional frameworks (O'Donnell et al. 2017). We understand cultural norms and practices as being a substantial part/ingredient of the general rules that make up institutions. Cultural norms and practices can influence the management and decision-making processes within more or less informal hierarchies. This can even lead to resistance to change, e.g., of practices, management solutions, or cooperation (Carlet 2015). Furthermore, ways of behaving in a given society are shaped by unwritten rules about what is allowed or accepted and what is not within a UGS (Tessin 2011). For this social control, the diversity, conformity, norms and values of activities, as well as the openness and tolerance against disturbances of different interests to other interests is decisive (Boone et al. 2009). Cultural norms and practices can be seen as one root cause of interpersonal barriers, i.e., they can force adapted behavior or involuntary exclusion of whole groups, for example, of different ethnic or cultural background (Valentine 2008), like when one group of users tells another group what behavior is or is not allowed and appropriate.

Contextual factors

Contextual factors have an impact on the three aforementioned barrier dimensions, e.g., by producing new or reinforcing existing barriers. These factors may include sudden or gradual, short-, mid-, or long-term changes that operate at different scales that matter when we look at barriers to UGS. Climate change can slowly alter UGS characteristics through heat or hydric stress and, thus, change people's use of UGS (e.g., if heatwaves become more frequent or intense) although seasonal to daily weather conditions can determine certain UGS uses or greatly influence users' experience of UGS (e.g., presence of flowering vegetation in the spring vs. snow in winter; Morris et al. 2011). Overcrowding of a park during the weekend or the lack of illumination at night and the associated safety issues are temporal factors, which refer more to physical and personal barriers (Boone et al. 2009, Wendel et

al. 2012). We are focusing on those factors that relate to the UGS itself although we are fully aware that UGS and their closer contexts always form part of larger contexts, such as local governance systems or housing markets that may affect the closer contextual environment of the UGS. For instance, as a consequence of market interest and particularly housing-market mechanisms (rising rents, upgrading), users of a UGS are displaced providing an increasing barrier for them to use a UGS (e.g., longer travel time, etc.).

The assessment of barriers is sensitive to place-dependent factors of UGS. The wider geographic location of UGS determines certain conditions, such as temperature ranges, the daily amount of sunlight, wind regimes, walkability. Factors like size or the intended purpose of UGS provide a different potential for recreational uses and lead to different levels of use and conflict potential depending on the UGS. For instance, the intended purpose of a nature reserve does not allow activities at night due to limited lighting that would both harm wildlife and impact experience of nature. In contrast, urban parks might allow barbecuing whereas other UGS, such as golf courses, allow access just for certain groups (Pauleit et al. 2003).

Perceived barrier effects

Most importantly, decisions by potential users to actually use (or not) UGS are not constrained by the pure existence of barriers and their mere interaction. Rather, each barrier dimension and the way the interactions between them are perceived and appraised by potential users is crucial for understanding the actual use behavior (Thériault et al. 2005, Ferreira and Batey 2007, Wang et al. 2015). For instance, UGS can be perceived as inaccessible even though objectively measured barriers are absent (Jones et al. 2009). Several scholars argued that people evaluate both physical and personal attributes combined with norms and attitudes forming their perceived accessibility (Zondag and Pieters 2005, Bisht et al. 2010, Wang et al. 2013). Perception is an integral part of physical, personal, and institutional barriers and is conceptualized as a central filter between barrier dimensions and the actual accessibility to UGS benefits. This offers a way to understand to what extent other factors of people's appraisal add meaning and value to barriers and the way they are constantly reshaped and re-evaluated by the interactive connections between all barrier dimensions. Still, perceived barrier effects vary depending on user's self-awareness of individual capacities and interpersonal interactions. For instance, women or elderly might consider safety more likely as a constraint in contrast to male or younger individuals (Berney 2010, Seaman et al. 2010). Having felt unsafe in another physical UGS setting before essentially impacts the way people perceive and re-evaluate a UGS (Rutt and Gulsrud 2016). These effects are reinforced by the lack of socio-cultural or institutional control, such as rules, norms, or maintenance (Jones et al. 2009)

STUDYING BARRIERS FROM A CASE STUDY PERSPECTIVE

Flaten Nature Reserve in Stockholm

Flaten Nature Reserve in Stockholm, a forest designated for nature conservation, outdoors recreation, and cultural heritage (Stockholm Stad 2020), is embedded but in some ways apart from the surrounding landscape. An adjacent highway is an important car-based connector to the larger region but is perceived as noisy,

thereby constraining the attractiveness of certain recreational activities. In combination with few clear pathways and entrances from rail-bound public transportation, the highway also acts as a barrier for entering the area. The effect of these barriers is reinforced by a lack of information on directions to the area, within the immediate surroundings as well as overall, e.g., little information on how to get from the city center to the area by subway. Consequently, accessing the area requires both cognitive capacities to identify and get to the entry points, as well as a certain time and financial effort to get there.

The physical contrast between the area and its mixed residential and more park-like surroundings is also emphasized by administrative boundaries. The formal protection of the reserve has no influence on the surroundings, nor are the physical surroundings considered in detail in the management documents for Flaten. Different municipal units guide spatial planning and urban development around the reserve. Sectoral mandates, variable integration in green plans, and the lack of active cooperation between planning units at the landscape level inhibit planning and management of connections and access points. This creates both real and perceived physical barriers, e.g., increasing distances, new roads perpendicular to expected flows to and from the area, unclear walking paths and cycle routes from neighboring municipalities, as well as reduced visibility and overall legibility when more tall buildings are built and a feeling of not belonging to the reserve.

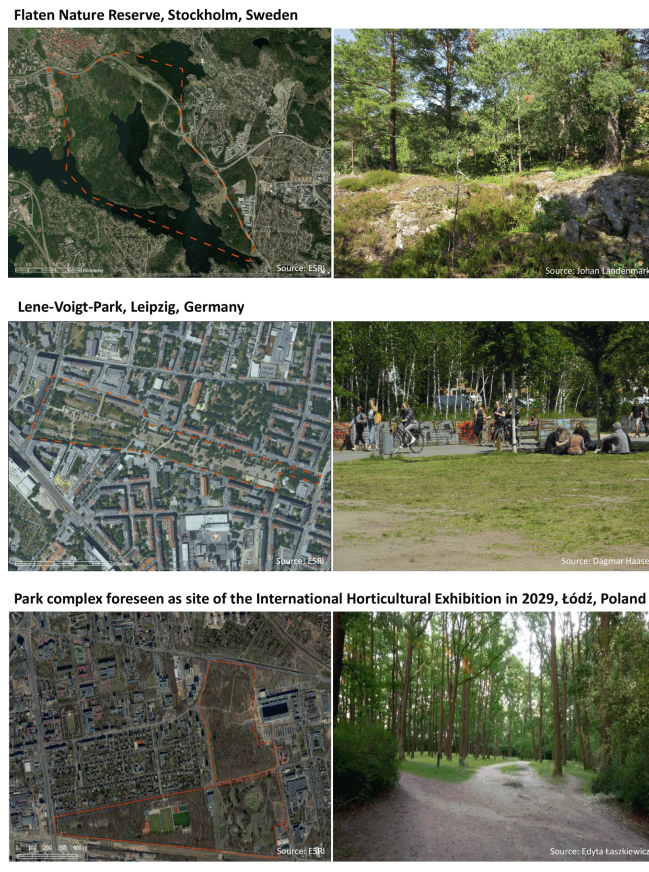
The cultural norms of traditional outdoor recreation activities and behavior shape the planning and management of the area relating to the goals of nature conservation. This limits the intensity of management and how many adaptations in terms of facilities for increased accessibility is allowed, e.g., pathways for wheelchairs, illumination that might hinder mobility (Fig. 3). This also contributes to the perception of the area as unsafe or limiting to other interests, not least those with non-Swedish cultural background (Stockholm Stad 2020). The individual is left to find their way because facilities are unevenly distributed, information is limited, and only available in Swedish.

The Lene-Voigt-Park in Leipzig

The Lene-Voigt-Park in Leipzig, created at a former railway brownfield in 2001-2004, covers a set of barriers due to its size and shape. The park lacks features, such as benches, playgrounds, and sports facilities, nor does it provide an appropriate environment for those searching for shade because the park lacks taller trees. Aside from that, dusty surfaces instead of grass coverage in many parts develop into small dust bowls with high particle concentrations in hot and windy summers. Consequently, the use of the park is rather selective, not attracting people looking for recreation like sports activities or play activities, e.g., families, as well as people who need a place to sit or have health constraints, e.g., older people (Ali et al. 2020). Due to this physical unsuitability, some potential users do not perceive the area as a "normal park" but rather as a public space that can be passed by.

Interpersonal relations and conflictual situations are other relevant barriers to using the park. The limited space within the park, also due to its narrow shape, fosters competition for the few places with shade in hot summers as well as conflicts between faster (e.g., between bikers) and slower-moving people, i.e., with a walker, wheelchair, or baby buggy (Fig. 3). Other conflicts

Fig. 3. Photographs of case studies.



emerge due to perceived disturbances from noise, e.g., between people with loud music and those who read and relax quietly. Some informal norms make it less attractive for different types of users to go to the park as those whose interests do not meet the likes of the majority, e.g., of younger users, avoid using the park. We could call this (in)voluntary exclusion by appropriation and it creates perceived and/or experienced barriers among those who are excluded this way, i.e., their interests are ignored, dwarfed, or made impossible by the action of others (Ali et al. 2020).

The city's housing market development is an essential contextual barrier that impacts decision-making processes and the design of the surroundings. Rising housing costs as a consequence of upgrading or gentrification led to the participatory process of the early 2000s as part of the planning process largely neglecting some uses and users and the emerging effects for the surroundings when designing the park (A. Konzack, *unpublished manuscript*). The high housing costs and the lack of planning led to exclusionary displacement forcing households with limited income to leave the area. Displaced people cannot physically access the park without increased efforts anymore because their interest in living close to the park was dwarfed by market interests producing negative perceptions.

The Łódź park complex

The Łódź park complex of the large historic 3rd May Park, Baden Powell Park, and the neighboring green square are foreseen as the site for the 2029 International Horticultural Exhibition (hereafter, Expo). It is important to understand that the spaces in which large events take place produce barriers not only during the event but also before and after it (preparation and dismantling) and are typically affected by commercialization (Smith 2016, 2019). Currently, access is mostly restricted by a large, fenced area with sports facilities located inside the park complex, with associated access roads, and (illegal) car parking. These infrastructures and the related noise constrain other activities in the parks and foster potential conflicts between the users of the sports area and those seeking silence and contact with nature. A lack of safety around the park and near the former railway tracks is perceived as an additional constraint (Fig. 3).

According to the current plan for implementing the Expo, additional parts of the parks will be fenced and occupied by exhibition pavilions (PwC Advisory and Chapman Taylor 2019). It is expected that the character of the parks will change especially in terms of loss of natural elements, the character of wilderness, and recreational options due to increasing waste, trampled lawns, paved surfaces, tree cuts, and lower water table threatening the parks' greenery with insufficient access to water. In addition, it is expected that the character of the surrounding residential neighborhood, Radiostacja, will change as well. The planned construction of large housing estates on the southern edge of the park complex, with busy streets and parking lots, will affect the quality and quantity of park users, e.g., crowding or noise (Waliszewski, No to Green Expo Association, Jan. 2021, *personal communication*). The exclusion of certain groups is also related to fees to the Expo area and a limited number of entry points, further obstructed by new fences and buildings.

Residents requested proper participation as part of the public consultations in 2019 because they feared a significant loss of greenery within the area and in the surrounding housing estate. However, they claimed that they had not been properly informed about consultations and discussions with the City Hall of Łódź (Waliszewski, No to Green Expo Association, Jan. 2021, *personal communication*). Local authorities tend to downplay any opposing arguments and neglect residents' opinions and needs. For the city authorities responsible for the Expo, the successful organization is a question of prestige by investing funding for creating both an event and a landmark (PwC Advisory and Chapman Taylor 2019). As a consequence of insufficient consultation, the residents felt excluded and omitted. They feared that the makeup of park visitors would change not only during but also after the Expo with tourists, young people, and families engaging with the space in a way that excluded residents, elderly people, sporting activities, or users seeking silence and contact with nature (Waliszewski, No to Green Expo Association, Jan. 2021, *personal communication*). Conflicts due to noise and congestion as well as the exclusion of nearby inhabitants by appropriation by new users are expected. This is reinforced by the new infrastructure and organization of the parks, which will make navigation through and to the area more difficult, e.g., for hitherto users.

BARRIER INTERACTIONS AND PERCEIVED BARRIER EFFECTS

To show how crucial it is to understand which barriers are at play but also how they interact and what outcomes these interactions produce, we return to the cases (Appendix 1) and expand the conceptual framework (Fig. 2). From the variety displayed in Figure 4, it is apparent that not all dimensions and interactions of barriers play out equally among the three case studies. Most importantly, perceived barrier effects are difficult to measure, and the case study material could only provide first indications on how people perceive barriers. Thus, this aspect is not covered by Figure 4. However, perceived barrier effects are an important lens that makes barriers very individual and challenging.

Physical and institutional barriers intersect with individual capacities in complex ways. The three cases demonstrate some of the ways these interactions may unfold. Physical barriers largely constrain individual capacities for accessing recreational benefits by the way the environment is (re)shaped (environment-related interactions, Fig. 4). In Łódź, the upcoming Expo will significantly change the setting on-site, off-site, and at the boundary, which will considerably constrain an individual's capacity to access UGS recreational benefits. The effect of physical barriers can be further modified by planning, management, or decision-making processes, e.g., when information flows toward residents are blocked during decision or planning processes (knowledge-related interactions, Fig. 4). Poor planning and management exacerbate and reinforce the effect of major infrastructural changes on personal barriers, e.g., in Łódź, or produce disadvantages for residents with limited resources, e.g., in Leipzig. In Stockholm, the very uneven "readability" of recreational affordances and the absence of information challenges the recreational literacy of potential users.

However, physical and institutional barriers are not shaping the setting of barrier interactions alone. Even more obvious are the interactions toward cognitive capacities and frameworks as well as interpersonal relations, which are largely influenced by the way information is shared among beneficiaries, e.g., in Stockholm, but even more by the way people engage and cope with barriers (engagement-related interactions, Fig. 4). The consequences of failed or inconsequential participation processes are not just a physical design ignoring beneficiaries' needs, but actually reinforce emerging conflicts based on individual capacities (e.g., elderly vs. young). This can even imply self-reinforcing effects because people feel excluded, e.g., by the way they have been involved in (or excluded from) decision-making processes, like in the case of Łódź, or by conflicts between different uses and needs, like the case of Leipzig shows, leading to self-exclusion or involuntary exclusion from UGS. The influence of contextual factors, such as increasing rent and associated displacement on planning and decision making in Leipzig creates more uneven (inter-)personal barriers across the population whereas in Stockholm management is largely shaped by cultural practices that challenge cognitive capacities.

The described interactions essentially shape perceived barrier effects, which finally lead to a decision of (non-)using UGS recreational benefits. As a consequence of a reconfigured environment, an area is perceived as inaccessible due to environmental-related barrier interactions stemming from noise,

congestion, or the loss of natural elements, which is obvious in Łódź. Also, the Stockholm case shows that perceived barrier effects emerge because of knowledge-related interactions: insufficient knowledge resulting from the information provided and the cognitive capacities of potential users. The resulting feeling of "getting lost" is reinforced by a perceived unsafety at night or during the winter due to the absence of illumination. In all cases, most perceived barrier effects emerge as a consequence of engagement-related interactions. For instance, in Łódź, perceived barrier effects emerged due to a feeling of being excluded from the planning and decision-making process; they emerge in Leipzig because the use of space is either unclear or conflicted. These effects are reinforced by social power relations if there is no counteraction, i.e., more socially powerful actors displace others by an appropriation of the green space as has happened in Leipzig.

DISCUSSION

For which places, activities, and potential beneficiaries do barriers actually matter? Enabling accessibility to UGS for improving the well-being of urban residents requires knowledge that goes beyond a single barrier dimension. The presented conceptualization classifies the diversity of barriers and demonstrates how barrier interactions and their perceived barrier effects constrain the way beneficiaries access recreational benefits. For any planning attempt at increasing the accessibility of UGS benefits, the central message is that barrier effects are a product of physical, institutional, and personal dimensions that intersect in a somehow blurry manner. As the three case studies show, these links can be classified into environment-, knowledge-, and engagement-related interactions (Ferreira and Batey 2007, Saurman 2016). Combining the three types of interactions with our typology of barriers, we see three complementary pathways for minimizing barrier effects and enabling potential beneficiaries to access UGS benefits. As we will show, the three pathways do have different implications for environmental justice, which needs to be considered.

Environment-focused pathway

Within an environment-focused pathway, accessibility options are increased by reducing physical barriers and allow potential beneficiaries to better connect with UGS benefits (Fig. 5). Physical flows can most effectively be supported by focusing on all three elements of physical barriers. People must have appropriate and good-quality facilities on-site, e.g., benches or lighting, UGS must be physically and visually welcoming at the boundary, and there must be multiple transport options off-site, e.g., various transport modes, walkable pathways, or alternative networks, e.g., on former rivers and streams (Parker 2016, Park 2017). All these measurements should allow multiple uses of UGS, e.g., by sharing facilities or designing and managing them so that they are adaptable according to changing needs and preferences, like the Greenspace Master Plan of Ottawa emphasized (City of Ottawa 2006). Most importantly, this pathway seeks to minimize potential conflicts between different uses/preferences or between nature and use of UGS, but also between transport and green corridors or between transport corridors of different hierarchies off-site. This can be achieved by clearly programming different areas with different functions (e.g., areas for unleashed dogs, allowing for both tranquil and livable

Fig. 4. Interactions between different types of barriers for three case studies (for details see Appendix 1).

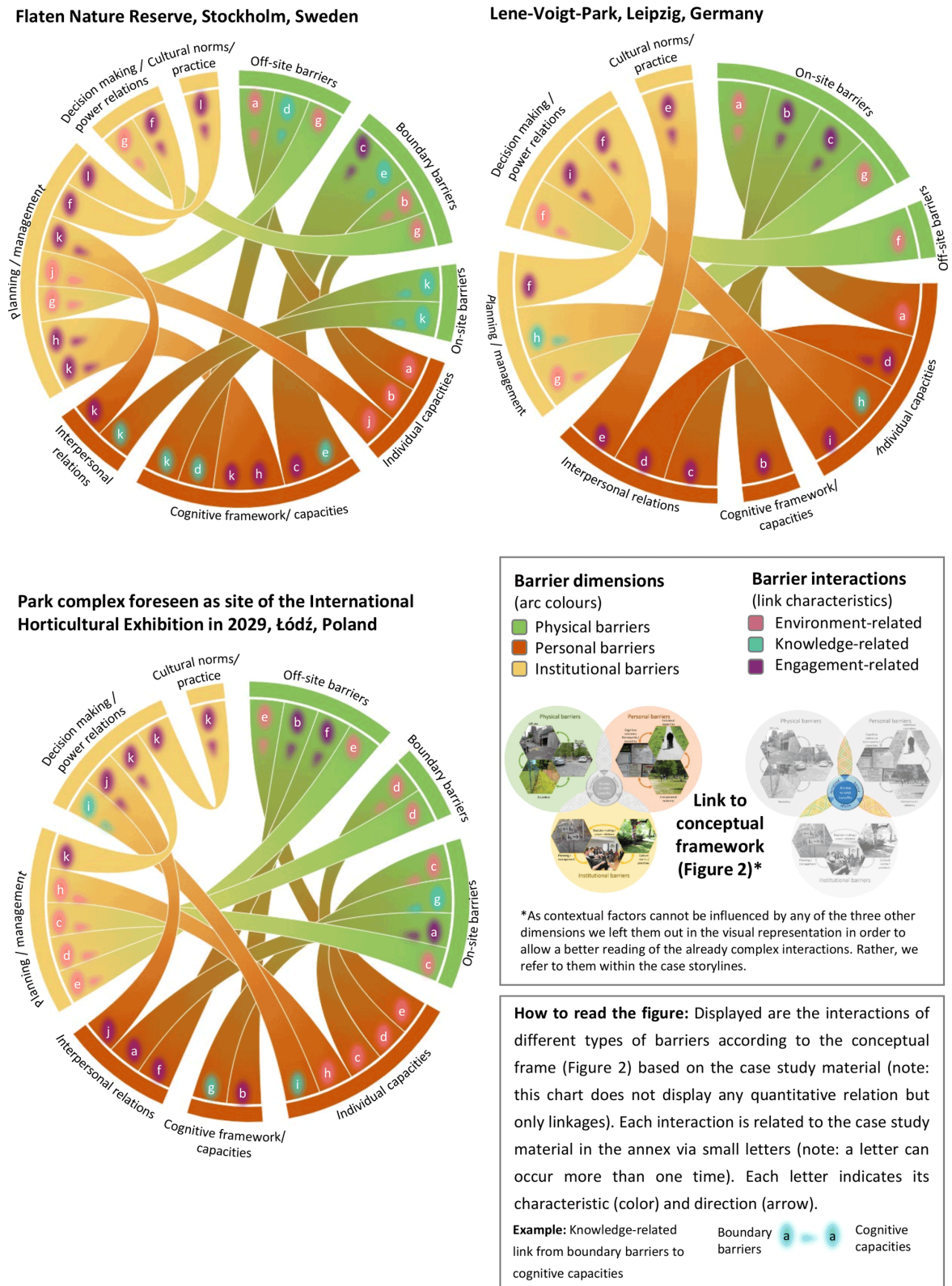
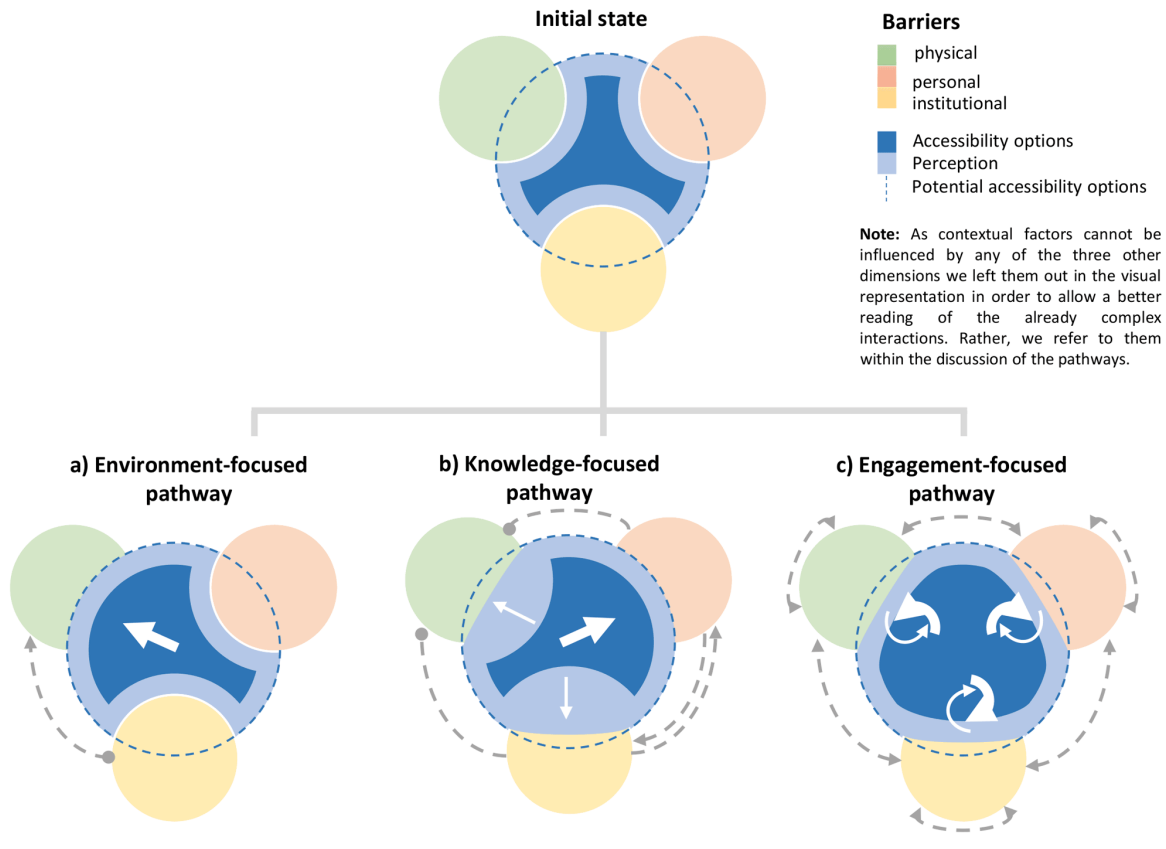
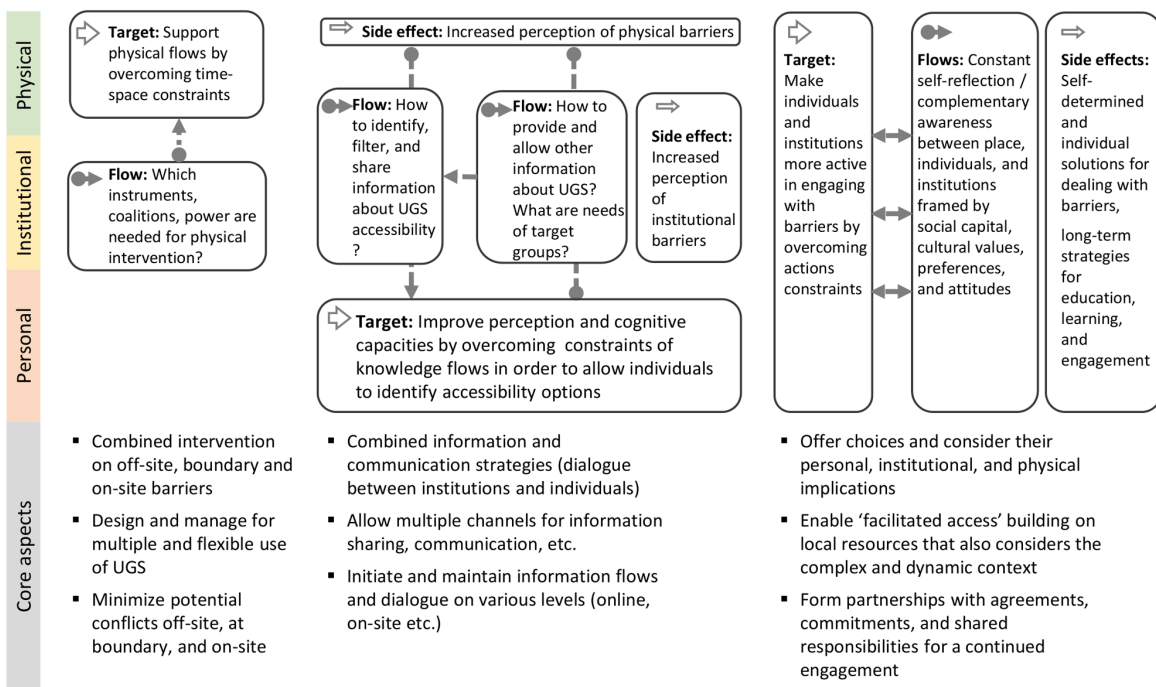


Fig. 5. Three complementary pathways for engaging with emergent barrier effects. Note: UGS = urban green space.



Legend and explanation



areas), by sensitive land management of fragile natural features and corridors, and by safe crossings of transport corridors (PHE 2020). However, physical interventions tend to be institutionally complex and hampered by cooperation between planning sectors, e.g., as evidenced in the Stockholm case. Consequently, institutional barriers constrain the design, implementation, and thus, the final use of the infrastructure, as the case of Łódź shows. Furthermore, the considerable, costly, and permanent physical impacts might increase mobility dependency of people (Ferreira and Batey 2007). When a person is afraid of traveling by subway, a new subway stop close to a park will not increase his or her accessibility options. Most importantly, this pathway is limited in terms of considering every need and interest, e.g., even participatory processes usually tend to be exclusive for certain groups as in the cases of Łódź and Leipzig suggest. Consequently, the perception of people is only changing with respect to the provided infrastructural environment; it is not changing with respect to the individual and institutional settings.

Knowledge-focused pathway

A knowledge-focused pathway seeks to improve the perceptions and cognitive capacities of potential beneficiaries for dealing with barriers (Fig. 5). The goal is not to provide a ready-to-use infrastructure, but to allow individuals to identify accessibility options. Governments are expected to provide sufficient information to make individuals feel confident using UGS. The information can contain aspects about, e.g., the location of a UGS, how to get there, what to expect from it, for whom this is relevant, and what to do there (Kenyon et al. 2003). In addition, to understand how the space is or will be used, a detailed knowledge of local needs, cultural contexts, and attitudes is required. Consequently, communication requires a two-directional information flow and options for individuals to provide their information, e.g., via nature education paths or participation during planning processes (Farrington and Farrington 2005), an aspect which was largely neglected in the Łódź example. This pathway needs to allow multiple information and communication channels, e.g., via social media or physical interaction, which acknowledge the diversity and differences of users and non-users. For instance, locals with strong networks helped in providing and circulating information and initiating a dialog (PHE 2020). Information flows promote a form of perceived self-determination and enhanced knowledge, thus minimizing personal barriers and, as a side-effect, provide self-help, enabling actors to navigate also through the physical-institutional barrier settings, as in the Stockholm example (Saurman 2016). However, this pathway is sensitive to the way it considers target groups and the type of knowledge. For instance, certain groups can be discriminated against if the information is not provided in Braille or different languages as in the Stockholm case (Byrne 2012, Holt et al. 2019). Because this pathway hardly considers unexpressed needs, desires, or other tacit knowledge of potential beneficiaries, their actual attitude regarding physical and institutional barriers remains largely uncovered (Boulton et al. 2020). Of similar relevance with regard to perception is the reliability of information allowing individuals to trust it and be confident enough to benefit from it (Seaman et al. 2010). For instance, people who anticipate experiencing a specific observation based on a given information mistrust this information and its provider if they have been disappointed.

Engagement-focused pathway

An engagement-focused pathway seeks to make individuals and institutions more active in dealing with barriers by unlocking their motivation. Individuals do not consider participation or engagement even if they know about it, whereas most decision makers and professionals are not aware of the multiple benefits of UGS or how multiple barriers actually work in reality but rather pay attention to specific aspects relevant to their organization and budget options (O'Donnell et al. 2017). To motivate active engagement, this pathway builds on the two pathways above but understands accessibility as a form of living standard, belonging to a community or identifying with a place (Ferreira and Batey 2007). This requires offering choices rather than a single accessibility solution that cannot accommodate all potential beneficiaries and considers the physical, institutional, and personal aspects of the offered choices simultaneously (PHE 2020). "Evidence suggests that 'facilitated access', that is organised transport to a site, followed by a supported led activity, can be successful in reaching underrepresented groups" (PHE 2020:41). For instance, using the local resources of clubs, associations, or civic initiatives and their regularly scheduled group activities can unlock the motivation to engage with UGS (e.g., using or participating in decisions). However, co-design or community-led processes need to consider the complex and dynamic context to avoid unintended consequences (Boulton et al. 2020). Promoting UGS while ignoring the social and political contexts might lead to green gentrification. Partnerships across the institutional hierarchy covering public, private, and individual actors can be formed to explore alternatives to providing public access to UGS, e.g., by reducing the threshold between public and private space (City of Ottawa 2006). It is important that partners give their time and commitment to a specific project and beyond to ensure a constant exchange and a continued motivation for engagement (O'Donnell et al. 2017). Designating and sharing responsibilities allow beneficiaries to actively use, maintain, and shape selected UGS, e.g., via volunteer work, gardening, tree sponsorship, or any other form of stewardship like Ottawa demonstrates (City of Ottawa 2006). All of these aspects can support self-organization and engaging with UGS (Byrne 2012). Individuals not only have the capacity to deal with barriers but to produce individual solutions based on creativity and personal will (Farrington and Farrington 2005). However, this facilitated hands-on exploration of options is a long-term and iterative process that requires constant self-reflection and complementary awareness between people, place, and institutions framed by the associated social capital, cultural values, preferences, and attitudes (Gray et al. 2006). Acknowledging the need for this awareness eventually influences the relevant regulations or even cultural norms, e.g., if users and administration acknowledge temporary gardens, support collaboration, or co-funding options. This, in turn, might enable long-term strategies for education, learning, and engagement in the form of feedback loops (Fig. 5).

The pathways need to address different spatial and temporal scales: for addressing certain barriers, planning is sufficient, for others it is up to politics even at the regional level with some barriers that hardly can be minimized by local actions. This becomes obvious when contrasting the two case studies Leipzig and Stockholm. It needs to be questioned to what extent the described pathways deal with context, power, and market factors.

These aspects are beyond the scope of the current paper. In addition, and in line with the broad literature on events organized in public spaces (Smith 2016, 2019), the Łódź case has shown that it is important to account for both expected and unexpected barriers before UGS are reshaped, e.g., when an event is organized. This would enable green space authorities to minimize the negative impacts of such interventions, especially in terms of green space accessibility during and after such an event.

Another aspect which needs further research is the dual role of factors as either barrier or enabling factors. The case studies indicate that barriers not necessarily only reinforce each other but certain factors may also counteract or mitigate one another, or jointly reshape and differentiate which set of recreational activities are accessible, and to whom. Potential enabling factors that are not fulfilled can be perceived as barriers. For some beneficiaries, the liminal place identities may reinforce the perceived strength of other barriers, whereas for others this opens opportunities that outweigh other barriers (Kamvasinou and Milne 2019). For instance, paved surfaces in the Leipzig space discourage people from sitting there, but it allows skaters to use the area. Based on this conclusion, the barrier approach has the potential to effectively link aspects of the distribution and recognition dimension of environmental justice (Langemeyer and Connolly 2020): the barrier approach discusses how diverse constraints could be met by infrastructural improvements in a cross-concept analysis.

Finally, any empirical assessment of the introduced framework will not be able to reach all of the potential beneficiaries with an applied method, e.g., a survey, due to a lack of interest, engagement, cognitive capacities, or the availability and understanding of technical equipment (e.g., apps). Because this challenge is common to almost all methods, it is an emergent barrier to studying multidimensional barriers.

CONCLUSION

Barriers are important for individuals' decision making regarding the use of UGS. However, barriers are often underestimated whereas potential accessibility is widely discussed. We put forward a framework for systematic conceptualization and classification of multidimensional barriers to assess constraints in benefiting from recreational services of UGS.

First, a barriers perspective can provide an essential contribution to both urban planners and scholars. Aligned with previous studies, we suggest attributing equal importance to personal and institutional barriers, on par with the more frequently addressed barriers. Seeking to systematize the fuzziness of barriers for planning purposes, we captured the diversity of barriers within the plurality of beneficiaries' personal characteristics and within diverse physical and institutional UGS settings. Complex knowledge about potential obstacles for beneficiaries is required for developing integrative planning pathways. Deduced from the conceptual framework, we contrast three pathways that specifically address the diversity of barriers to UGS use through a sensitive re-balance of individual, physical, and institutional factors.

Second, we suggest a conceptualization that disentangles the complexity of wicked barrier interactions and acknowledges that it is not purely the existence of barriers and their mere interactions

that constrains the accessibility options people have. Rather, perceived barrier effects are an outcome of the significance that potential UGS users assign to various specific barriers and their interactions. Understanding these effects, in particular the interactions we have detailed within the complex settings of places, contextual factors, individual characteristics or behavioral intentions, and institutional frames, as well as the grounds for different perceptions, is critical for continuously engaging with barriers and their outcomes. This represents an important addition to the environmental justice debate. The presented conceptual framework enables a comprehensive understanding of urban dwellers' decision making regarding UGS use, with a view to obtaining recreational benefits in cities.

Responses to this article can be read online at:

<https://www.ecologyandsociety.org/issues/responses.php/13180>

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Appendix 1: Overview of barrier dimensions (see figure 2) in case studies.

	Flaten nature reserve, Stockholm, Sweden	Lene-Voigt-Park, Leipzig, Germany	Park complex foreseen as site of the International Horticultural Exhibition in 2029, Łódź, Poland	
Physical barriers	On-site	<ul style="list-style-type: none"> - Lack of playgrounds, illumination, shadow-providing trees, toilets and seating accommodation appropriate e.g. for older people (e.g. benches missing armrest/back) - Trampled grass/lawn; very dusty and, in case of wind, creation of little dust bowls - Small area, thus not much space for following activities on-site - Lack of waste bins, often much rubbish in the park and stodged dust bins - Combined ways for cyclists and passers-by produces conflicts - People searching for a “normal park” perceive the area not as “park-like” as the area might not be suitable but rather a greened brownfield where you can pass or bike 	<ul style="list-style-type: none"> - Traffic training and sport facilities (tennis court, football fields, treadmill, outdoor gym, cloakrooms) within the park with associated access roads / fenced parking spaces - Lack of safety within the park is perceived as constrain <p>Expected changes related to the exhibition:</p> <ul style="list-style-type: none"> - Rubbish and waste by visitors, trampled grass/lawn - Recreation/leisure activities are limited due to stands, facilities, fences, paved surface, and other physical restrictions - Tree cuts with lack of shadow and reduced visibility of greenery/trees 	
	Boundary	<ul style="list-style-type: none"> - Busy freeway at the Northern/North-eastern border of the nature reserve - Fences and gates at the Western border - Unclear entrances and directions from the bus stops - Lack of waste bins and waste dumping 	<ul style="list-style-type: none"> - Semi-busy roads around the entire park - Lack of waste bins and waste dumping in the park surrounding 	<ul style="list-style-type: none"> - Uneven distribution of entrances, no formal entrance on the longest southern border <p>Expected changes related to the exhibition:</p> <ul style="list-style-type: none"> - New fences and buildings obstructing entry/crossing - Planned concreted parking spaces and new busy street on the southern border
	Off-site	<ul style="list-style-type: none"> - Lack of information or signs about the larger landscape (direction / existence of ways) - No clearly marked paths from rail-bound public transportation to the nature reserve - Low frequency of buses and few bus stop entry points to the area - Private land uses around the area that are fenced 	<ul style="list-style-type: none"> - Displacement of former residents from the areas 	<ul style="list-style-type: none"> - Lack of safety around the park / near former railway tracks is perceived as constrain <p>Expected changes related to the exhibition:</p> <ul style="list-style-type: none"> - Heavy traffic, parking spaces, and increasing noise with less attractiveness of the residential neighbourhood Radiostacja - New residential areas lead to increased use pressure on the park
Personal barriers	Individual capacities	<ul style="list-style-type: none"> - Limited mobility and accessible for certain persons (e.g. wheelchair users) - Relatively far from built-up areas requiring a certain time budget or physical fitness - Many of the activities the area presumably caters to, require equipment and other resources that are not equally available to everyone 	<ul style="list-style-type: none"> - Fears of slow persons (parents with buggy, elderly with walker/wheelchair, disabled) to be overseen and overrun by fast movers (bicycles, runners) 	<ul style="list-style-type: none"> - Part of the area is heavily overgrown, with no paths, which can be difficult for the elderly, disabled people and families with small children <p>Expected changes related to the exhibition:</p> <ul style="list-style-type: none"> - Entrance fee to exhibition limits the use of the park for less affluent people
	Cognitive capacities / framework	<ul style="list-style-type: none"> - Most information in Swedish, no audio-information or information in braille - Very few information regarding what you can/are allowed to do in the area and what is prohibited (relevant esp. for non-Swedish people) - Making use of wilder areas require knowledge of forests, e.g. where to find berries or mushrooms, which areas are sensitive to disturbance, where lake ice might be weaker 	<ul style="list-style-type: none"> - All information in the area, overall limited, is in German (although the neighbourhood has a high share of foreign people) and there is no audio-information or information in braille - Information that originally was established at the entrance of the park disappeared 	<ul style="list-style-type: none"> - Sports fields/facilities and associated noise by car parking/roads disturb navigating within the park <p>Expected changes related to the exhibition:</p> <ul style="list-style-type: none"> - Lack of specific information regarding the location of pavilions, the scale of tree felling and the scale of city expenses
	Interpersonal relations	<ul style="list-style-type: none"> - The beach is getting increasingly crowded making space somewhat contested - Shift in user groups at the most popular sites in the reserves over time (e.g. families at swimming site during summer before 6 pm, after 6 pm only groups of youngsters) - Conflict potential between various groups and their use of the reserve (prefer wild, silent nature experiences alone; use reserve as a social arena with family / friends) 	<ul style="list-style-type: none"> - Homogenous visitors make it more difficult for people with another habitus to access (park is visited mostly by young people, prevent e.g. elderly from using the park) - Noise from sport fields often disturb other visitors who seek for quietness in nature - Conflict on the ways between fast (cyclists, skateboards) and slow (passers-by, elderly and buggy, or people with handicap) traffic, not paying attention to each other - Crowdedness of the park at weekends and during the hot season 	<ul style="list-style-type: none"> - Conflicts between the users of sports area and park users seeking silence and contact with nature in the middle of the park <p>Expected changes related to the exhibition:</p> <ul style="list-style-type: none"> - Exclusion of nearby inhabitants by appropriation by another group (e.g. visitors) - Congestion / noise from outdoor events discouraging some users (fairs, concerts) - Lack of safety, because of the large number of visiting people, crowds

	Flaten nature reserve, Stockholm, Sweden	Lene-Voigt-Park, Leipzig, Germany	Park complex foreseen as site of the International Horticultural Exhibition in 2029, Łódź, Poland	
Institutional barriers	Planning and management	<ul style="list-style-type: none"> - The status of nature protection restricts most forms of urban developments - Area boundary creates strict institutional identity for land use within the area without impact on development of the surrounding (e.g. no restriction to urban development) - Property rights limit accessibility within the area (semi-private/private allotments) - Swedish right for public access to all land (Allemansrätten) is somewhat restricted due to certain rules apply (e.g. dogs on leash, permit to fish, bike on paths) 	<ul style="list-style-type: none"> - Green regeneration plans for the larger area did not include a comprehensive acknowledgement of potential negative social consequences that got more importance after 2010 due to a more contested housing market (rising costs and displacement as a result of rising attractiveness through/after greening) 	<ul style="list-style-type: none"> - Local authorities downplay any arguments against the organization and discuss the residents' opinions only superficially <p>Expected changes related to the exhibition:</p> <ul style="list-style-type: none"> - Sole focus of the park complex management on Expo, neglecting other aspects/needs
	Decisions and power relations	<ul style="list-style-type: none"> - Institutional boundary between the protected area and the private built-up land as the formal institution of the nature reserve prohibited planning and management of landscape connections due to institutional frames (e.g. few incentives for physically connecting the area to the larger landscape) 	<ul style="list-style-type: none"> - Housing market dynamics after 2010 (rising demand and rising costs) led to increased displacement from the area (direct) and increased exclusionary displacement - Opportunities of municipality to influence real estate/housing market is limited 	<ul style="list-style-type: none"> - As part of public consultations in 2019 residents expressed concerns about the loss of greening within the area, in the surrounding housing estates, and of a recreational area relating to an adjacent hospital - Residents of the surrounding housing estates claim that they have not been properly informed and participated about consultations and discussions with the City Hall
	Cultural norms and practices	<ul style="list-style-type: none"> - Very traditional Swedish outdoor recreation activities promoted - Nature values and enjoyment of these values by applying, broadly, the right to roam - Border areas are sometimes used for more illicit activities (drugs, squatting etc.) discourage potential users 	<ul style="list-style-type: none"> - Entrance areas are at some places used for more illicit activities (drugs, squatting etc.) discouraging potential users 	<ul style="list-style-type: none"> - Local authorities neglect other concerns as the organization of the Expo is prestige and ensures their political success
Contextual factors	<ul style="list-style-type: none"> - Different rules and objectives between spatial planning around the reserve (urban densification with ownership) and the nature reserve creating increasing distances between public land, new roads perpendicular to expected flows to and from the reserve, reduced visibility and overall legibility when more tall buildings are built 	<ul style="list-style-type: none"> - Displacement of poorer households from the areas around the park, driven by housing market mechanisms with rising housing costs (the park plays a certain role as trigger for rising housing costs) and so, they cannot benefit from the park as before 	<ul style="list-style-type: none"> - Local authorities are responsible for the organization of the Expo supported by the Marshal of the Lodz Region and President of Polish Nurserymen Association - Authorities invest public money in this project while still expecting a final decision from the Polish government on providing additional key funding 	

Appendix 2: Overview of barrier interactions (see figure 3) in case studies.

	Flaten nature reserve, Stockholm, Sweden	Lene-Voigt-Park, Leipzig, Germany	Park complex foreseen as site of the International Horticultural Exhibition in 2029, Łódź, Poland	
Barrier interactions	between physical and personal barriers	<ul style="list-style-type: none"> - Remote from housing areas requires high effort in terms of time and finance to get there by walking, biking, public transportation or car (a), additionally constrained by lack of entry points (b) - Adjacent motorway perceived as noisy constraining certain recreational activities (c) - Lack of information related to entry points (e), direction within the area, and the wider transport network (d) requires strong cognitive capacities in order to access the area 	<ul style="list-style-type: none"> - Park is selective not attracting people looking for relaxation, active recreation like sport activities or play activities as e.g. families, as well as people who need a place to sit when being in a park or have health constrains e.g. older people (a) - Due to this physical unsuitability, a part of potential users does not perceive the area as a "normal park" but rather a public space which can be passed by (b) - Limited space within the area fosters competition e.g. disturbance by noise e.g. between people doing sports and parties and those who want to relax quietly (c) - Physical settings foster conflicts between faster e.g. between bikers, and slowly moving people e.g. with rollator, wheelchair, buggy with little children (d) 	<ul style="list-style-type: none"> - Remaining fenced areas, pavilions waste, trampled lawns, paved surface, and tree cuts limited options for recreation or leisure activities (a) - Lack of safety around park / near former railway tracks is perceived as constrain (b) - Due to loss of natural elements and character of wilderness the area will not be perceived as a park anymore (c) - New fences and buildings obstruct the entry of the area (d) - During the Expo heavy traffic, parking spaces, and increasing noise with less attractiveness of the park complex and the residential neighbourhood Radiostacja (f) - Conflicts due to (nearby) noise and congestion as well as exclusion of nearby inhabitants by appropriation by new users are effects (a, f) - Hitherto users have quite good knowledge of how to navigate through and to the area while specific information lack for new users (g)
	between institutional and physical barriers	<ul style="list-style-type: none"> - Different rules and objectives for spatial planning and ownership (f) - Lack of active cooperation between planning sectors prohibit planning and management of connections and access points (g), creates physical barriers e.g. increasing distances, new roads perpendicular to expected flows to / from the area (h) 	<ul style="list-style-type: none"> - City's housing market development is an essential contextual barrier which impacts decision making options, processes and the design of the surrounding (f) - Participatory process of the early 2000s as part of the planning process largely neglects a couple of uses and users when designing the park (g) 	<ul style="list-style-type: none"> - Character of the park surrounding change as construction of parking lot and very large housing estates with busy streets and parking lots will affect the quality and quantity of park users in combination with lack of entry points and loss of natural elements within the area (c, d, e)
	between institutional and personal barriers	<ul style="list-style-type: none"> - Lack of active cooperation between planning sectors and lack of information (e.g. unclear walking paths and cycle routes from neighbouring municipalities) creates perceived barriers e.g. feeling of not belonging to the reserve (i) - Cultural norms of traditional outdoor recreation activities and behaviour shapes the planning and management of the area relating to the goals of nature conservation (j) - Limited intensity of management in terms of facilities e.g. pathways for wheelchairs, illumination (k) - This also contributes to the perception of the area as unsafe, not informative, limiting to other interests, not least those with non-Swedish cultural background (l) 	<ul style="list-style-type: none"> - (In)voluntary exclusion with feelings and experiences that interests are ignored, dwarfed or made impossible by the action of others (e) - Rising housing costs (rental or property) as a consequence of upgrading or gentrification led to direct and exclusionary displacement i.e. people have to leave the area and cannot access UGS anymore e.g. for costs reasons (h) - Housing market mechanism limits the engagement with UGS e.g. in terms of social isolation and of being neglected by planning authorities when planning UGS accessibility (i) 	<ul style="list-style-type: none"> - Exclusion of certain groups fostered by management due to fees at designated entry points (h) - As part of public consultations in 2019 local authorities provide very little / only general information about the planning and downplay any opposing arguments, and neglect residents' opinions and needs (i) - In consequence of lacking participation residents feel excluded and omitted (j) - For the City authorities responsible the Expo the successful organization is a question of prestige (k)

Appendix 3: Barrier dimensions and barrier elements

Physical barriers		
Off-site barriers	Transportation infrastructure	<ul style="list-style-type: none"> ▪ <i>Lack of transport connections</i> ▪ <i>Intersecting transportation corridors (e.g. major car roads and bikeways)</i>
	Surrounding neighbourhood characteristics	<ul style="list-style-type: none"> ▪ <i>Sidewalks preventing (pleasant) walking or missing</i> ▪ <i>No crossings</i> ▪ <i>Missing connections between transportation and entrances to UGS</i>
Boundary barriers	Linear elements	<ul style="list-style-type: none"> ▪ <i>Adjacent major transport lines</i> ▪ <i>Adjacent natural barriers e.g. water of hedges</i>
	Built structures	<ul style="list-style-type: none"> ▪ <i>Buildings and built-up blocks</i> ▪ <i>Fences</i>
	Entrances and access point characteristics	<ul style="list-style-type: none"> ▪ <i>Unequal distribution</i> ▪ <i>Shape limiting access (e.g. lacking waling frames, no platform for wheel chairs)</i>
On-site barriers	Limited usability of 'enabling' facilities	<ul style="list-style-type: none"> ▪ <i>Features supporting passive activities</i> ▪ <i>Features supporting active activities</i>
	Facilities and structures constraining activities	<ul style="list-style-type: none"> ▪ <i>Built-up elements e.g. fences</i> ▪ <i>Natural elements e.g. hedges</i>
Personal barriers		
Individual capacities	Conditions	<ul style="list-style-type: none"> ▪ <i>Poor or reduced physical fitness</i> ▪ <i>Poor or reduced health</i>
	Resources	<ul style="list-style-type: none"> ▪ <i>Restricted time budget</i> ▪ <i>Restricted financial means</i>
Cognitive capacities and outlook	Capacities	<ul style="list-style-type: none"> ▪ <i>Language skills</i> ▪ <i>Level of education</i> ▪ <i>Professional relationships (e.g. being employed as gardener)</i>
	Outlook	<ul style="list-style-type: none"> ▪ <i>Cognitive framework (e.g. religion)</i> ▪ <i>Preference, attitude, willingness</i> ▪ <i>Individual beliefs</i>
Interpersonal relations	Voluntary exclusion	<ul style="list-style-type: none"> ▪ <i>Lack of confidence</i> ▪ <i>Self-retreat</i>
	Involuntary exclusion	<ul style="list-style-type: none"> ▪ <i>Discrimination</i> ▪ <i>Exclusion by appropriation</i>
Institutional barriers		
Planning and management	Planning and policy	<ul style="list-style-type: none"> ▪ <i>Lack in design / implementation</i> ▪ <i>Legal restrictions</i>
	Maintenance	<ul style="list-style-type: none"> ▪ <i>Closure or neglect</i> ▪ <i>Use restrictions</i> ▪ <i>Protection status constraining activities</i>
	Management	<ul style="list-style-type: none"> ▪ <i>Opening hours, fees, user rules</i> ▪ <i>Features for a certain purpose</i> ▪ <i>Property restrictions (e.g. semi-private UGS)</i>
Decision contexts and power relations	Power asymmetries	<ul style="list-style-type: none"> ▪ <i>Informal hierarchies</i> ▪ <i>Lack of agency</i> ▪ <i>Lack of understanding/learning</i> ▪ <i>Lack of partnerships/networks</i>
	Decisions	<ul style="list-style-type: none"> ▪ <i>Conflicts of interests and goals</i>

		<ul style="list-style-type: none"> ▪ <i>Lacking exchange / interaction</i> ▪ <i>Different strategic interest</i> ▪ <i>Imbalanced strategic coalitions</i>
Cultural norms and practices	Informal practice of authorities	<ul style="list-style-type: none"> ▪ <i>Resistance against innovation</i> ▪ <i>Pragmatism in decision making</i>
	Unwritten norms, rules, values relevant for users	<ul style="list-style-type: none"> ▪ <i>Societal rules for behaviour, norms and use restrictions</i> ▪ <i>(Non)compatible activities</i> ▪ <i>(Non)openness, (in)tolerance</i>
Contextual barriers		
Temporal context	Event-related	<ul style="list-style-type: none"> ▪ <i>(Sudden) disturbance of use by inter-personal (e.g. drug scene) or natural (e.g. storm damage) events</i>
	Process-related	<ul style="list-style-type: none"> ▪ <i>Heatwaves, droughts</i> ▪ <i>Lack of learning, information gathering and negotiating</i>
	Season-related	<ul style="list-style-type: none"> ▪ <i>Poor weather conditions</i> ▪ <i>Temporary closure</i> ▪ <i>Lack of illumination during night</i>
Spatial context	Place-dependency	<ul style="list-style-type: none"> ▪ <i>Neighbourhood characteristics (residential/industrial, attractive/non-attractive)</i>
	Scale dependency	<ul style="list-style-type: none"> ▪ <i>Housing market mechanism (rising rents, upgrading)</i> ▪ <i>Governmental arrangements and social shifts</i>