

Article

Influence of Urban Green Spaces on Quality of Life and Health with Smart City Design

Abdullah Addas ^{1,2} 

¹ Department of Civil Engineering, College of Engineering, Prince Sattam Bin Abdulaziz University, Alkharj 11942, Saudi Arabia; a.addas@psau.edu.sa

² Landscape Architecture Department, Faculty of Architecture and Planning, King Abdulaziz University, P.O. Box 8 0210, Jeddah 21589, Saudi Arabia

Abstract: Publicly available green spaces are great places for people to relax. Currently, the deficiency of such spaces is decreasing daily, especially in urban regions. Urban green spaces (UGSs) have become a topic of great importance in enhancing life expectancy and health. To overcome these issues, the current research highlights the importance of UGSs for the residents' living quality and urban health. UGSs are relevant for analyzing and investigating better urban lifestyles and development. To perform the experimental work, a green laboratory (GL) in a smart city (SC) area was involved in the investigation. The GL was made of wood, and different types of green infrastructure were analyzed. The research investigation resulted in upgrading the locality. Semi-structured interviews were conducted to enhance the quality of the research. Interviews with residents, occupants of offices, and government experts were conducted. Special survey questions, i.e., quantitative and qualitative, were developed while considering the current demands of the residents. A total of 500 responses were recorded, and by using the MAXQDA software, an analysis was carried out. The results showed that there was a dire requirement for UGSs in terms of size and quantity because of security and opportunities. The proposed research results will provide an opportunity for open spaces to be created in this local district. To fully improve residents' living style and health, the necessity of deploying UGSs became more apparent. Finally, it became clear that green spaces are necessary to improve the country's economy.



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1. Introduction

More than half of the world's population now lives in cities. In Europe and North America, this figure is already at about two-thirds, and by 2050, it will be two-thirds worldwide [1]. Urbanization is certainly one of the greatest changes that humanity has experienced. Graz is experiencing high population growth, with around 3000 more people [2]. Infrastructure and housing must match this to keep up with the rapid growth. Brisk building activity can be found in many parts of cities. Urban planners and developers aim to make cities for the residents, make them interesting for visitors, and maintain this status. Here, the residents are given the most important position since they are the ones who live in this environment and shape it the most. Tourists, on the other hand, leave a city after a certain amount of time. The design of cities depends on the expansion of housing options and infrastructure, as well as the important determinants of health, quality of life, and aesthetics. Healthy and happy city dwellers are what a city is made of. Therefore, it is always important to take measures to maintain the health of residents. As social beings, people need contact with others, exchange, and conviviality [3–7].

On the one hand, the current conditions prevent exactly these original human needs. Life in cities has become increasingly isolated, noisy, and hectic in recent years and decades. The trend towards single living arrangements, jobs in individual offices, and the car as the

primary means of transportation contribute to this isolation. The contributors to increasing physical and mental illnesses, such as traffic load, noise, poorer air quality, extreme temperatures, and violence, are more common in cities than in rural areas [8–12]. On the other hand, cities offer many structures that make life easier than life in the countryside, which is one reason why cities are experiencing a boom again. The high density of jobs, infrastructure, and leisure activities is in high demand. Therefore, cities with a high quality of life record high yearly population growth. Qualified workers, students, companies, and tourists are attracted to city life.

Public spaces play an important role in the design of cities. They help counteract these isolating developments. Who does not like spending their free time on a park bench or in a cafe, watching the hustle and bustle of others or meeting acquaintances? One form of public space is green space, but urbanization and densification put such spaces under a certain amount of pressure. They are essential for livable cities due to their various advantages for people and the climate [13–19].

According to numerous people who have usable greenery close to their living areas, they are happier and healthier. Green spaces are the perfect environment to take a break from the stress and busyness of everyday life. In times of climate change, greening our cities has become an important strategy [20–24]. In Graz, the topic of urban greenery and vegetation is also being raised due to the controversy surrounding the Mur power plant, the Augarten Bay, and the poor air quality in recent years [25–28]. Demonstrations and other events are being used to increase awareness of these problems so that more and more people are interested and motivated to take action. Recently, even young residents have been drawn to the streets to ask for a better climate. Green space is used in all of these events because its diverse benefits play a very important role. Living sustainably is increasingly part of the modern lifestyle [29,30].

In a survey on the quality of life in Graz, many individuals indicated the need to take action in the district of Lend [31]. Such action could be, for example, furnishing many public areas, living together in neighborhoods, helping to shape the living environment, providing common areas, and improving the environmental quality. This need for action justifies the construction and investigation of green and common areas in the district of Lend. The will to become involved in one's district is strikingly high and was found in most districts in about 50% of the citizens. This value gives hope, and it is a clear call to involve people in cities' various administrative and political decisions. In the "Ecotopia Report", the socioeconomic structure was compared to that of Graz in the station district [32].

The gender distribution and age structure in the station district did not differ from those in Graz as a whole, though there were differences in mother tongue, education, and income level. While, on average, the proportion of people with a non-German mother tongue in Graz is 12.5%, in the station district it is 27%. The secondary school and teaching categories were overrepresented in Bahnhofsviertel, with high school and university degrees being underrepresented compared to Graz as a whole. This was also reflected in the income level. People who lived in the district were, on average, less comfortable with their living spaces than those in the rest of Graz.

There were also significant abnormalities in environmental quality. The factors of natural spaces and landscapes in the area, the noise levels in living areas, and the design of parks and green spaces showed statistically significant differences. People in the station district were satisfied, even very satisfied, with the cleanliness of public streets and squares and with the drinking water quality, as in all of Graz. There were no major abnormalities in any of the other categories in the survey. These values must not be over-interpreted, but they show clear tendencies in the mentioned categories.

Although Graz has a relatively high density of green spaces compared to other European cities, they are unevenly distributed. Some of the outlying districts and sub-communities have many green spaces. There is even said to be a "green belt". In addition, some more affluent inner districts, such as Geidorf and St. Leonhard, have a high level because of the vegetation density in the inner courtyards of the Wilhelminian-style build-

ings there. The situation is different in the districts of Lend, Gries, and Jakomini. The building structures are denser there, and open spaces and courtyards are more sealed, making them less green. Therefore, the empirical part of this work focuses on one area of urban development in the district of Lend, looking at the following:

1. How does living urban greenery affect city dwellers' quality of life and physical and psychological health, and what qualitative functions does green space have?
2. How do green spaces differ regarding environmental and social justice and sustainability, and what contributions can they make to the neighborhood?
3. How are different stakeholders involved in the development and improvement of urban green spaces?

2. Materials and Methods

This section describes the methodological approach used to answer the research questions described above, including the selection of the project area and the types of interviews conducted. In addition, it is explained how the statements from the conducted interviews were further evaluated. As part of an extensive literature search, databases were consulted to find scientific publications dealing with urban greenery and quality of life, as well as health and all related topics and disciplines. To generate additional knowledge about the study area and the situation, informal talks, lectures, and walks in front yards were repeatedly conducted with various people in the city, and photo documentation was collected.

2.1. Smart City Construction Site

Architectural competitions were held to realize the development of individual construction sites that were advertised. The winning projects were commissioned for implementation. The awards contained numerous specifications and explanations of the characteristics of the areas, buildings, green spaces, traffic, infrastructure, sealing, noise emissions, and energy consumption.

2.1.1. Science Tower and Helmut-List Halle

The Science Tower was constructed with an attractive design. It is a 60 m high tower and is located north of the Helmut-List Halle. The tower has a diameter of 19.5 m at the bottom and opens conically towards the top, with a diameter of 23.5 m. There is a photovoltaic glass facade consisting of Grätzel cells, which were developed by the chemist Michael Grätzel. The double-shell facade forms a coat around the basic shape of the tower. The cells convert light into electricity. The tower is an object for research on new buildings and energy-producing facade elements. There is a heavily used rooftop garden with a meeting room in the middle. The Helmut-List Halle is an important attraction in the design of the SC. The south side of the hall consists of 370 m² of solar panels.

2.1.2. Smart Center

The "Smart Center" construction site south of the Helmut-List Halle has another marvelous design. It is intended to accommodate local supplies, housing, and services. The industrial flair of yesteryear was included in the design of the southern component. The outer walls of the building are stacked, and colorful containers are used as workshops and storage rooms. In the middle of its S shape, many large open spaces are planned, and intensively landscaped gardens and rentable roof terraces are being created.

2.1.3. School Campus and Cool City

A new middle school is part of the design of the SC and is planned to be built with all facilities. There will be twelve classes on the campus. The capacity of the school will be about 700 students. It will attract a greater population to Graz. Terraces and open spaces will be integrated into the lesson rooms. With its different window sizes, the facade is architecturally distinct in the district. Sports areas and bicycle parking spaces

are also considered in the design. To fulfill the students' demands, the Cool City building was developed. The building consists of 107 apartments and has a residence capacity of 250 students. Many other important places, e.g., a kindergarten, an international restaurant called "Streets", a roof garden, a parking deck, numerous covered bicycle parking spaces, and public and semi-public rooms, have also been designed.

2.1.4. Northern Construction Site

This area consists of several buildings and has become a modern-designed residential building with almost 500 differently sized residential units. A tower is also being built, and it will only be used for office space. In the basement zone, the building will have local supply and industry offices. The green spaces should be in the shape of balconies, loggias, gardens, playgrounds, and—especially for the large park-like ones—inner courtyards.

2.1.5. Central Construction Area

The smart city's most spacious residential buildings are being built north of the Science Tower, where a large inner courtyard is also planned. This can be used for passage on hot days, and atomized water can be used for cooling. According to the architects, a high residential density results in high quality of life, permeability, and views. In addition, areas for gastronomy, trade, and tourism are planned. Much energy is required in the north and will be produced on-site with photovoltaics and heat pumps. There will be one photovoltaic facade in the direction of the train station. Both construction sites are planned to be car-free—cars will be parked in underground garages under blocks of flats.

2.1.6. Public Space

A green and open-space strategy was formulated with a framework plan, and it includes a large park and a public square. New residential and commercial areas are included in the plan. It is imperative to plan for enough non-compact green spaces. Pure green or enclosed gardens are not sufficient for this. The architects of the newly created buildings included generous green areas. It is important to have species-rich planting to create a spatial distance between the buildings. These areas must have the appropriate infrastructure (e.g., seating, lighting, playgrounds, etc.). A Europe-wide idea competition was announced for the design of the public spaces. Two companies in Graz were able to decide on this for themselves. The exact design for the two areas is to be refined together with the landowners and citizens.

2.2. Principles of the Smart City

By 2023, the focus will be on a central public park, representing a green transverse axis. Meadows, water areas, trees, and seating elements should give residents a space to play and relax. The focus should be an elevated water surface with a fountain and cycle paths. Together with a few smaller areas, a total of 11,000 m² of green space will be created. A public square will be created around the Science Tower. Appropriate planting, street furniture, and gastronomy should enable a high quality of accommodation. The highest priority should be assigned to pedestrians.

A framework plan can be a basis for developing land rezoning in a neighborhood of a smart city. Some principles of smart cities should be briefly mentioned:

- City of short distances: all basic needs should be achieved through a mix of services that can be covered within a neighborhood, such as housing, work, education, local supply, leisure, health facilities, and gastronomy.
- Priority for soft mobility: public transportation at regular intervals, connection to a cycle path network, e-mobility and sharing options, parking spaces, and multimodal nodes for reaching objectives outside of the area.
- Careful and economical use of resources: Meaningful densification and conversion of existing areas. The energy supply should be CO-free, and renewable energy should be used.

- A new attitude towards life and a high quality of life: attractive outdoor space design through numerous green spaces, thoroughfares, offers for sports and games, information, and engagement for citizens.
- Affordable housing: Housing and operating costs should remain reasonable. Mixed-use and different-sized apartment floor plans allow the costs to vary [31–35].

3. Smart City Investigation Area

The strong population growth of Graz, in combination with its limited land reserves for building, has led to problems in the steady expansion of the city. Its topographic position presents natural boundaries. The SC areas are designed to defy such limitations by using densification, reusing existing resources, and renewing already existing areas. The low-emission, resource-saving, and energy-efficient “Smart City Graz” is prescribed in the latest version of the urban development concept [36–40].

The SC area of Graz and the extension of the development area up to the train station were selected as the study area, as shown in Figure 1.

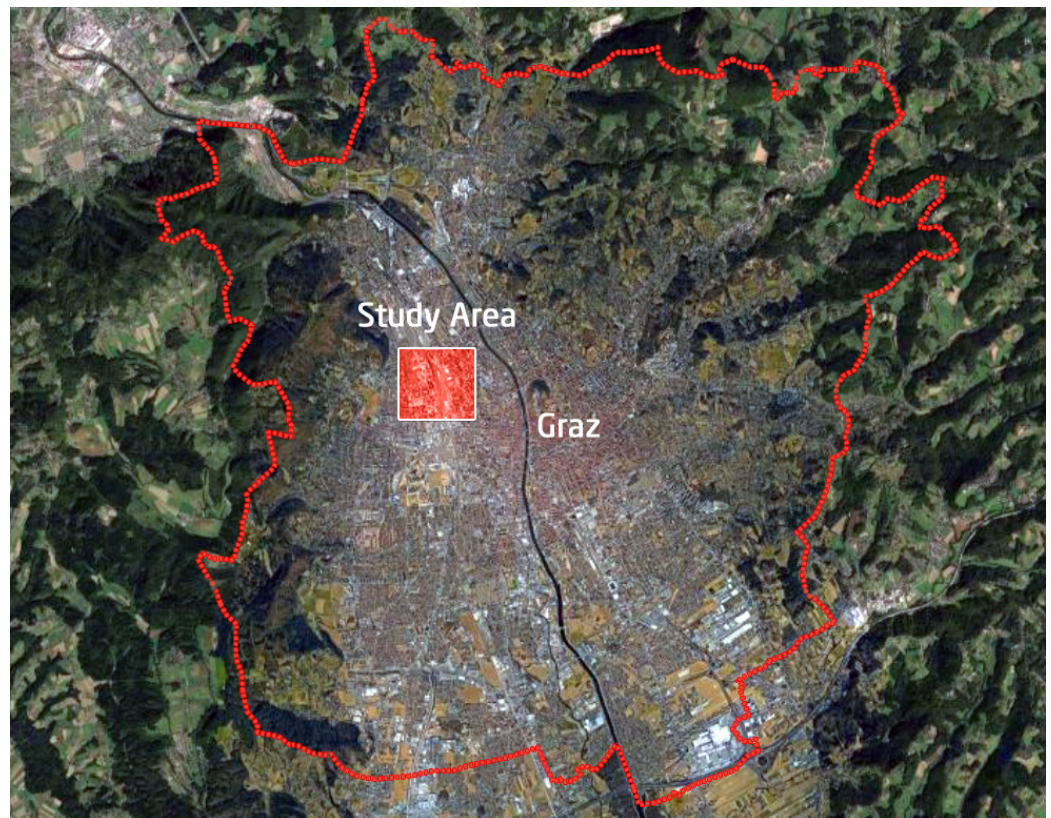


Figure 1. Geographic location of the study area in Graz.

The SC area of Graz is an urban development project that is two kilometers northeast of downtown Graz. The main train station is about 800 m further south. It is located in the district of Lend, to the east and west of Waagner-Biro-Strasse. In the south, Dreierschützengasse is limited to the west by Waldertgasse and an adjacent area of detached houses, in the north by Peter-Tunner-Gasse, and in the east by the route of the southern highway. The total site extends over 127,000 m².

3.1. Green Laboratory

The Green Laboratory (GL) is an architecturally appealing timber construction at Waagner-Biro Straße 99, in which all kinds of greening techniques were carried out. The new design ideas were developed in the GL. With the GL, the neighborhood management

group designed changes. The container was replaced by a new building, an “Urban Box”. Architects designed this innovative, modular, transportable wooden building.

The main goal of the GL is a high-quality interim or subsequent use of the arable land in the SC district before it is further developed. The building consists of a multi-functional room with a kitchenette (36 m²), an anteroom, and a toilet (about 10 m²). It is somewhat similar to the on-site container used by the NWS. Due to the original use of this area, the ground is relatively gritty. It consists of earth, many pieces of gravel, and some rubble. Therefore, the soil is not perfect for planting. With the management of the district, and as a result, the GL, a creative reactivation of the arable land was achieved. Now, many different types of plants and vegetables—mainly from the NWS—are grown. The location of the GL is shown in Figure 2. It has a green facade. Fleece was used as a substrate. Plants were placed in the holes, e.g., lettuce, tomatoes, and peppers. This kind of facade greening requires separate watering methods and is more expensive. The watering is automatic and digitally controlled.

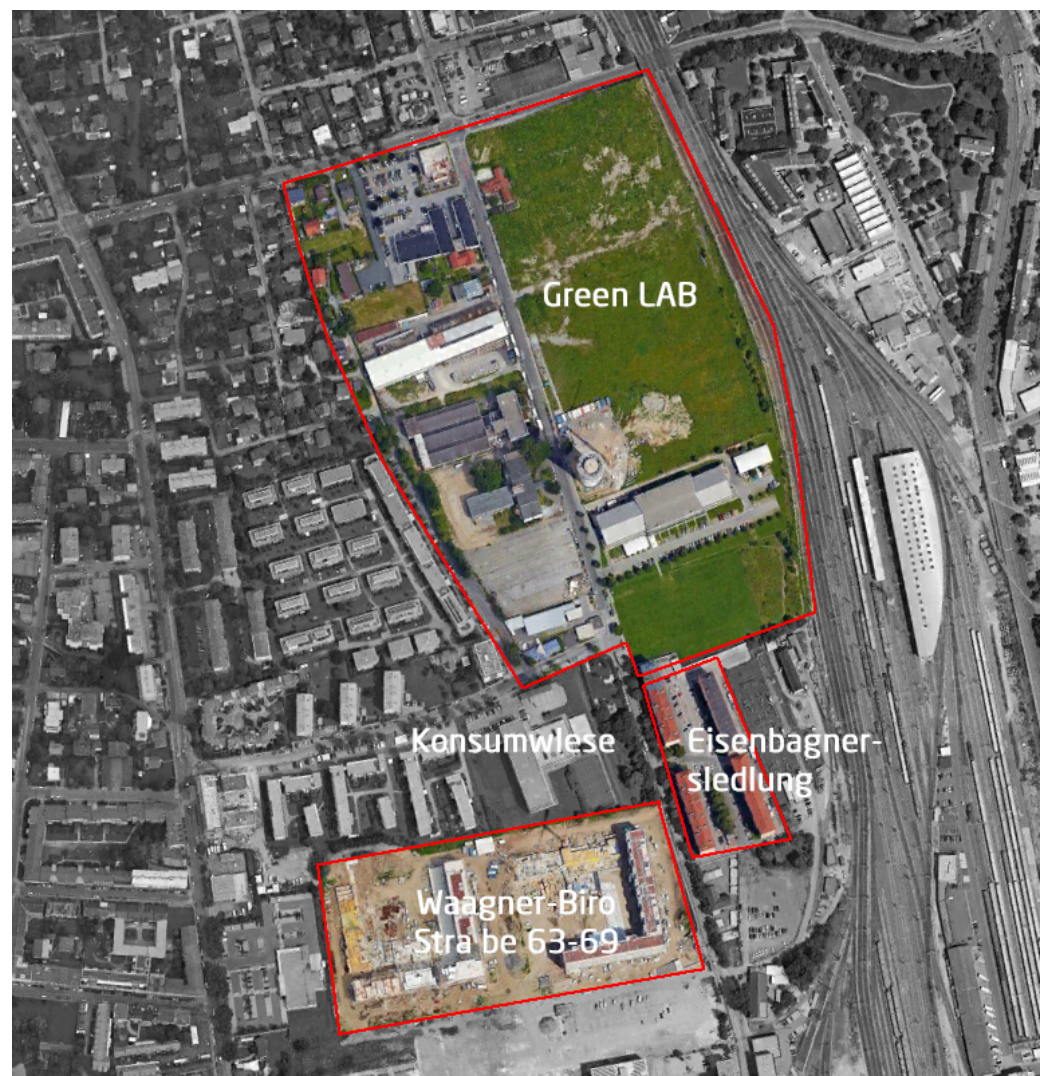


Figure 2. Location of the GL and Wagner-Biro Straße.

3.2. StadtLABOR Project

StadtLABOR Graz deals with sustainable urban development and sets impulses for accompanying innovation and transformation processes in cities. The changes in cities, communities, districts, and quarters are open development processes in which innovation,

creativity, and learning occur. StadtLABOR looks at the development of urban spaces as a cooperative process. Projects carried out by StadtLABOR, such as district management, are an interface for municipal departments, local companies, builders and developers, energy suppliers, NGOs, and citizens. Entirely in line with the principles of a living lab, ideas and solutions are developed through cooperation, co-creation, and inclusive participation in a holistic and practice-oriented way. The involvement of stakeholders is the expertise and claim of StadtLABOR [41–45].

The characteristics and goals of StadtLABOR are the following:

- Long-term partnerships between actors: The transformation of a place happens over a longer period. This requires mutual trust, cooperation at eye level, and a common vision.
- Alternative places of action: whenever possible, at project sites, places in which interdisciplinary cooperation is facilitated are created with a low threshold of accessibility.
- Trying out and quickly sharing knowledge: There are usually several approaches to a topic or problem. Their solutions are tested in real life, making the changes more visible.
- The sustainable city as a goal: The city of the future is resource-saving, energy-efficient, compact, mixed, inclusive, resilient, and above all, livable. StadtLABOR currently employs twelve people, in addition to interns. They come from the fields of architecture, spatial planning, economics, communication, social work, etc. This interdisciplinarity structure is experienced as a great strength.

In StadtLABOR projects, the management group is a point for information and contact in the smart city setup. This was first designed as a construction container located in an area in the middle of the parking lot of the Helmut-List Halle.

The building serves as an interface for citizens, local companies and institutions, the city of Graz, and the project consortium. This takes care of the existing green space in the district and allows these actors to work on ways to expand and strengthen the urban green space with concepts for vertical greening, roof greening, insect hotels, school gardens, etc. The district's acceptance of transformation processes and technological and social innovations is strengthened by informing and actively involving the residents. Awareness of projects should be increased so that the general public and citizens can be inspired by the vision. In addition, there are consultation hours, informative events, discussion rounds, inspections of areas, round tables, and walks organized in the district to get in touch with the citizens and discuss the topics of living, housing, mobility, change, and urban diversity. To carry out neighborhood management on site, a terrace with raised beds and seating was created, and this was used for working as well as to invite people to linger and receive information.

The current topics of district management include, above all, the co-creation of a meaningful ground floor for use in the SC by tradespeople. The intention is to claim land and solidify the feasibility of more vibrant green infrastructure in the Waagner-Biro district. This is carried out in the form of an interdisciplinary team project where members, students, and other stakeholders, including all relevant actors, worked together. An open summer school for local actors, experts, and students took place. The project's results were used in quantitative and qualitative analyses, statements and representations of resources, prototypes, and potential and possible implementation measures. To make the district greener, more livable, and inclusive, hardware (investment, structural, spatial, and technological measures) and software (maintenance, processes, communication, cooperation, knowledge, learning, support, and anchoring) were investigated. This worked best through interdisciplinary cooperation, the active involvement of stakeholders, and an open-minded attitude. According to StadtLABOR, this project was an important step in anchoring and implementing the process of transformation into a green SC.

Qualitative guided interviews were chosen for the empirical part of this work. The interview is the most commonly used qualitative and quantitative method [16,17]. In interviews, a distinction can be made as to whether the interlocutor is an expert or a layperson.

Experts demonstrate their knowledge about the field or subject being researched within a specifically selected topic. These people are classified as employees or representatives of a specific organization, institution, or company with in-depth knowledge, and not as private individuals [18–22].

Layperson interviews are important for learning about the individuals' experiences, opinions, and desires. Such respondents are the most affected by the situation or have certain contact points with the topic. However, they usually have no professional background in the subject. A layperson's choices and establishment of contact must be well thought out. These people are often unfamiliar with participating in interviews. Therefore, it makes sense to conduct a brief discussion with them to clarify the course of such a scientific interview [23–25]. Residents from the district of Lend and people who worked there or were visitors to the GL took the role of laypersons. Officials and politicians from Graz contributed as experts.

3.3. Key Interview Criteria

Before creating the question blocks for the interviews, their degree of structuration and their depth had to be considered. Semi-structured guided interviews were created. In this type of interview, the questions were set in advance, and the order was not decisive. There was room for explanations, stories, and any changes to the questions. Although this was an open and flexible form of an interview, the interviewer could steer the direction of the topics of conversation. This type of interview made it easy to compare people's perspectives [26]. According to Kallio et al. [27] this method is also useful if the respondents know little about the topic being researched or are expected to have an opinion about it. Before the interviews were conducted, a guide was drawn up for both interview groups. This list of questions directed the conversation toward the research topic [27]. The key criteria when creating the guide included the following:

- Keeping the questionnaire short so that the respondents did not spend too much time answering it.
- The questions needed to be formulated in such a way that they were easy to answer.
- Open questions were preferred, as they encouraged detailed answers.
- There were some questions with yes/no answers, and no leading questions were to be asked. The answers needed to reflect the personal attitudes of the respondents [27].
- The guides of semi-structured interviews are commonly divided into two categories: main questions and follow-up questions. The main questions address the research topics but can also be opening questions. Follow-up questions serve to delve deeper into the subject matter. One must be somewhat prepared with the main questions but can also be spontaneous during the interview.
- The interviews were partially standardized. For the resident interviews, all respondents were asked the same questions. However, these were answered differently in terms of their details, and some questions were always preferred, while some were left out.
- The experts also received the same questions, but intermediate questions were repeatedly asked depending on the topic.
- In the lead-up to an interview, it was also necessary to consider when and where it should occur, i.e., the time, place, and influence of the interview. It made sense to start the interviews directly at the place of investigation or the workplace of the interviewees, as this provided a further impetus and could even encourage observation. It was observed that for the audio recordings, a quiet place needed to be selected for the interviews [28–30].

The interviews were intended to obtain statements from those surveyed and to draw conclusions about the need for green infrastructure. The goal was to find the extent to which green space benefited city dwellers and whether projects such as the GL contributed to this need. The open-ended approach allowed the interviewees to be approached neutrally and for the interviewers to listen to how they thought of, perceived, and benefited from green

length of the interviews ranged from 7 to 43 min. This also heavily depended on the type of respondent. Some answered well more than what was asked, and some answered succinctly. In the interviews, the employees of the NWS were able to provide a variety of valuable information gained through their work. Other short interviews were also conducted in different places, such as at bus stops, the railway station, and in green areas. This proved challenging, as most individuals declined the conversation. Some interviews lasted between two and five minutes and provided insights into respondents' assessments of the existing green spaces, but they were not included in the evaluation.

All interviewees were asked for permission to record the interviews. The respondents were then anonymized. This made less sense for the experts, as anonymization would lead to a loss of information [46–50]. The audio recordings were later used to write transcripts. The verbiage of the transcripts could greatly vary. Some loss of information had to be accepted, as gestures and facial expressions were not included in the audio recordings. Certain filler words and irrelevant information could also be omitted if necessary. The transcripts were written immediately after each interview to avoid loss of information. Interviews with residents were used for this work, and unimportant passages of text were not transcribed. The expert interviews, on the other hand, were fully transcribed.

After completing the transcription process for the respective interview groups, the residents' transcripts were loaded into the data and text analysis software MAXQDA [51] for easier analysis. This software allowed codes, i.e., categories, to be formed, and for these to be included in the transcripts to assign text passages to the appropriate category. In most cases, the codes of the interviews corresponded to the questions in the guide. Based on this coding, the interview results were summarized, analyzed, and interpreted. The expert interviews were conducted without software coding. A qualitative content analysis method was used in the subsequent textual analysis [35]. The text material was broken down into passages, sorted by subject area, and analyzed step-by-step. Some passages could belong to two or more categories. Then, it was necessary to make interpretative decisions [35]. With qualitative, open methods, the researcher must know that their origin, age, gender, and socioeconomic status influence the interviews and their evaluation. These factors are not static and depend on the daily state of affairs and the relationship with the other person, and it is important to be self-reflective.

3.5. Evaluation of Graz's Green Spaces

The second thematic block dealt with the interviewees' evaluations of Graz's green spaces. Questions were asked about assessments of the topics of safety, disruptive factors such as rubbish, noise (from construction sites), and air quality, and conflicts of use. The experts were also closely questioned about conflicts of use and interests. When it came to safety, the opinions were very different. Many respondents felt that the public green spaces were safe—at least during the day. They appreciated the diversity of people and activities. The much-cited topics of alcohol and drugs were frequently addressed. Most people who said that they felt safe in the parks were not very affected. The respondents who did not feel safe in the parks often cited alcohol and drug issues as the main reasons.

How do parents communicate about larger green spaces with their children? In this context, complaints about people with a migration background were often made. Some people even went so far as to avoid the city center in general because, for them, this topic was not only (but above all) relevant in the parks. In addition, some public places were said to be unsafe. None of the respondents had ever experienced an incident in which they were in a confrontation. Many also reported that they felt less insecure when they were younger. The topic of drugs was also always discussed in the expert interviews. The experts were aware that this was a big topic in Graz. However, they also agreed that this problem could not (only) be solved by green space optimization, such as with tall trees and better lighting. This would only shift the problem to other places. However, if such problems were addressed proactively with more social work, they would be less frequent. Public parks should remain accessible—locking them up at night is not the solution.

The cleanliness of the public green spaces in Graz was consistently rated very positively. Nearly all interviewed people were positive about the city's efforts in this respect. Only isolated people reported small accumulations of rubbish. Noise was reported to come from the Smart City construction site, especially for homes and workplaces in close proximity. Interestingly, most residents did not feel disturbed by the noise from the construction site but were neutral about it or had at least become accustomed to it. Some residents felt more disturbed by the many children playing. Especially in the larger and newer blocks of flats (e.g., Waagner-Biro Straße 63–69), where there were many playgrounds for children. However, these also satisfied a high demand because these apartments had a high density of children. Two interviewees from the railway settlement said that they could hear children playing until late in the evening, even though there was still a row of houses and a street in between, and they felt disturbed by it. Based on the survey results on the quality of life in the city of Graz, the statement "People in the station district are less happy in comparison with the Graz average and are significantly less satisfied with their living space" could not be confirmed in the interviews—most of those surveyed residents liked living there.

The construction site of the Augarten Bay in the Augarten was also a disruptive factor. Many found it very unfortunate that old, large trees were felled for this purpose. Even if the Bay would become an attractive place to rest in the park and new trees were planted again, these large providers of shade would be missing for the next few years.

Dogs were mentioned in every single interview. This indicated the high relevance of this topic in Graz. In the current southern construction area, there was a dog meadow before the construction began, which was not officially set up as such but was tolerated by the city. After the construction began, there was still a need for more dog parks, so the users appropriated the meadow at the northern construction site for this purpose. In general, there were not enough dog parks in Graz. This was evident in the parks, where dogs were often let loose and were allowed to leave their excrement behind. It was generally removed immediately with dog bags. People who were in more problematic life situations, who might have kept dogs for their safety, often cared less about this. This could lead to conflicts, as one interview partner mentioned. Especially on playgrounds, free-running dogs were not welcome next to small children.

The experts confirmed that keeping dogs is a big issue in Graz. According to one interviewee, there were dog parks to avoid conflicts between dog owners and those who avoided them. Another saw the possibility of fenced dog parks that were also controlled by security guards to ensure that no dogs were let loose. This would, however, be expensive and difficult to implement. Dog partnerships with dogs from an animal shelter could be a solution to this.

When asked which elements would be needed the most in the green spaces, the respondents listed the following elements in descending order of frequency: shade, seating, drinking fountains, biodiversity, water elements, fitness equipment, and more and better-labeled bike lanes. Seating should also be planned. For example, no metal benches were set up. These would become hot in the summer and cold in the winter. Water features or fountains could be in the form of small pools on otherwise paved surfaces. However, these would be much more complex to implement because one must look at the inflow and outflow, and hygiene regulations must be observed. Biodiversity could be greatly increased.

This would require wildflowers, flowering meadows, and more diversity in tree species. Recreation zones with hammocks or training equipment would be conceivable. There is a great need for more green space. Residents from districts that were poorly supplied with green spaces suffered from above-average travel distances. New residential areas often only have "pseudo-green spaces", which do not provide the rest that one needs. This puts increasing pressure on the few large parks. Therefore, the outcry from the population about planned changes to a parking area was even greater. When expanding green space, one must be creative and innovative. For example, schoolyards could be made

public during the holidays. The city should always invest money to create new areas, plant front gardens, and ensure good transport connections for the public.

When asked about interactions with other park users, many reported that they often spoke briefly with strangers. Some reported that they made new contacts or even friendships, which were mostly developed through their time at a playground. People who had recently moved to the city actively sought out green spaces for social activities to get in touch with other people. The respondents themselves guessed that very few were still in conflicts of use. It was assumed that with a clearly defined use (dog meadow, playground, sports field, etc.), there was less potential for conflict. However, is that the point of inclusive, socially sustainable green spaces? Everyone should have equal access and be able to pursue the activities that they prefer. Certain clusters of like-minded people can be found in some parks in Graz, and people recognized that other user groups did not feel that they belonged or even felt pushed aside, which emerged from the interviews. This topic was reinforced by the fact that it was often minor. There were points of contact and, thus, fear of strangers. In parks, mixing does not happen on its own. The city would have to create incentives for this and to attract people. The issue of alcohol and drugs in public areas is a field of action that must be pursued. That people use certain green spaces or inner-city areas to avoid feelings of insecurity shows a great need for action. It limits the quality of life. Perhaps newly emerging green spaces can be designed differently and include other uses, as there is a desire for more green space in Graz.

4. Qualitative and Quantitative Interviews

After Gries, Lend is the district with the second-lowest housing satisfaction level, as shown in Figure 4. It was found that the quality of life worsened for 41% of the residents of Lend in the last five years, while 39% felt no changes. An environmental quality indicator was assessed according to characteristics such as air quality, noise level, accessibility, equipment, and cleanliness of public areas.

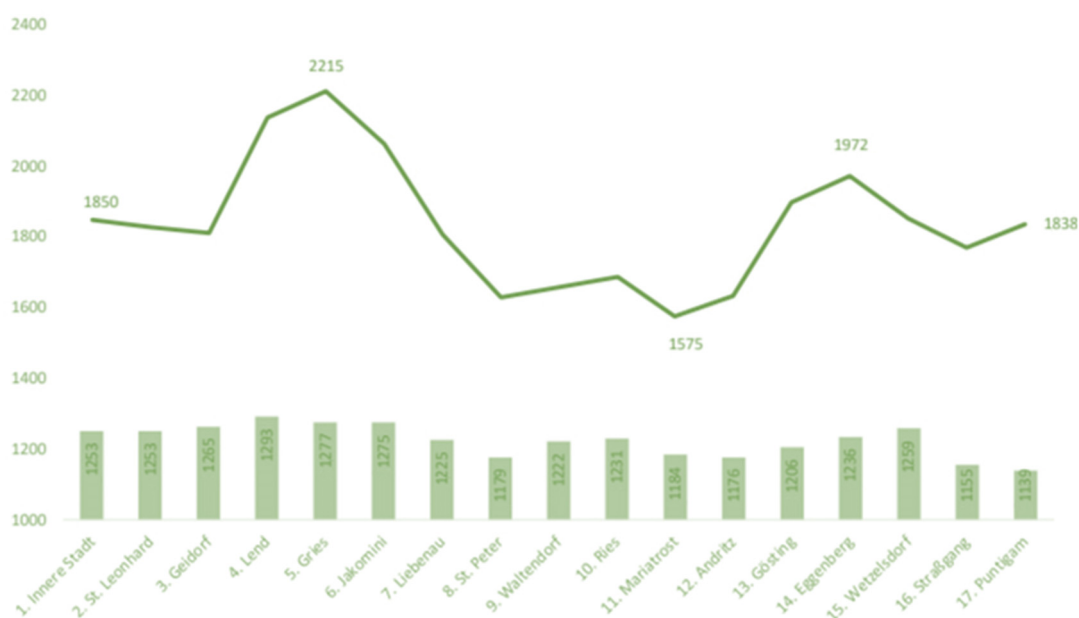


Figure 4. Satisfaction with and importance of the housing situation.

A moderate to major need for action was identified for all categories of environmental quality, as shown in Figure 5. There is great need for action in Lend concerning air quality, noise levels, the equipment of public parks and green areas, and the cleanliness of public roads, squares, parks, and green spaces.

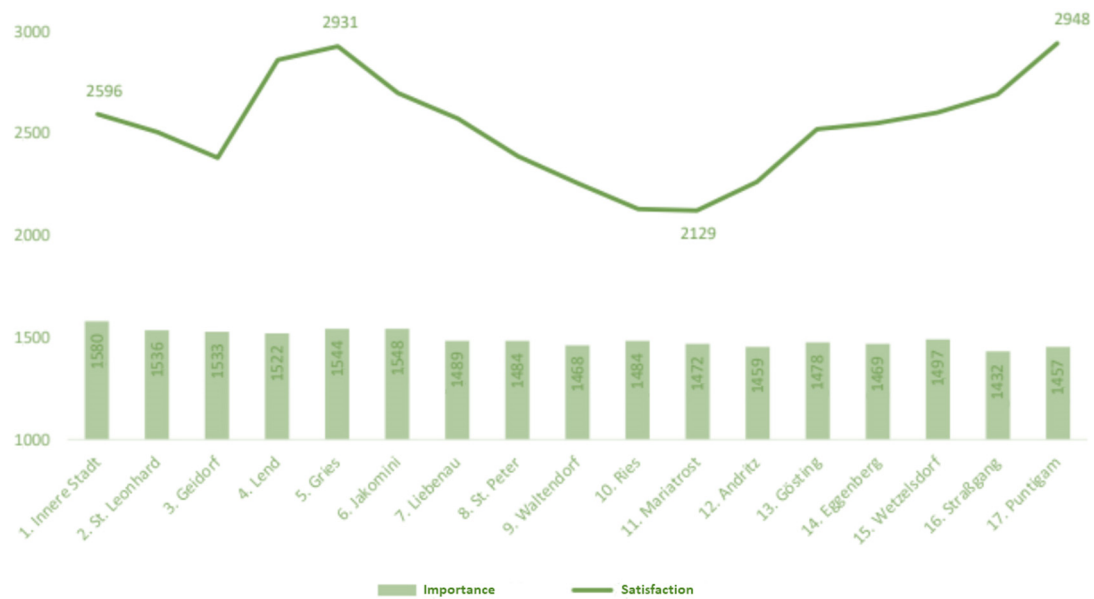


Figure 5. Satisfaction with and importance of the environmental quality.

The recreational and leisure value indicator was used to assess the offerings, quality, and accessibility of leisure and recreation areas, playgrounds, dog parks, sports facilities, and other units, as shown in Figure 6. The answers to this were very different. However, residents' satisfaction with Lend was more in the middle of the range. It was the outskirts that indicated a greater need for action. In Lend, there is a need for action regarding the equipment of public places (lighting, seating, drinking fountains, etc.) and the accessibility of recreation areas on foot. The range of clubs and their activities positively stood out.

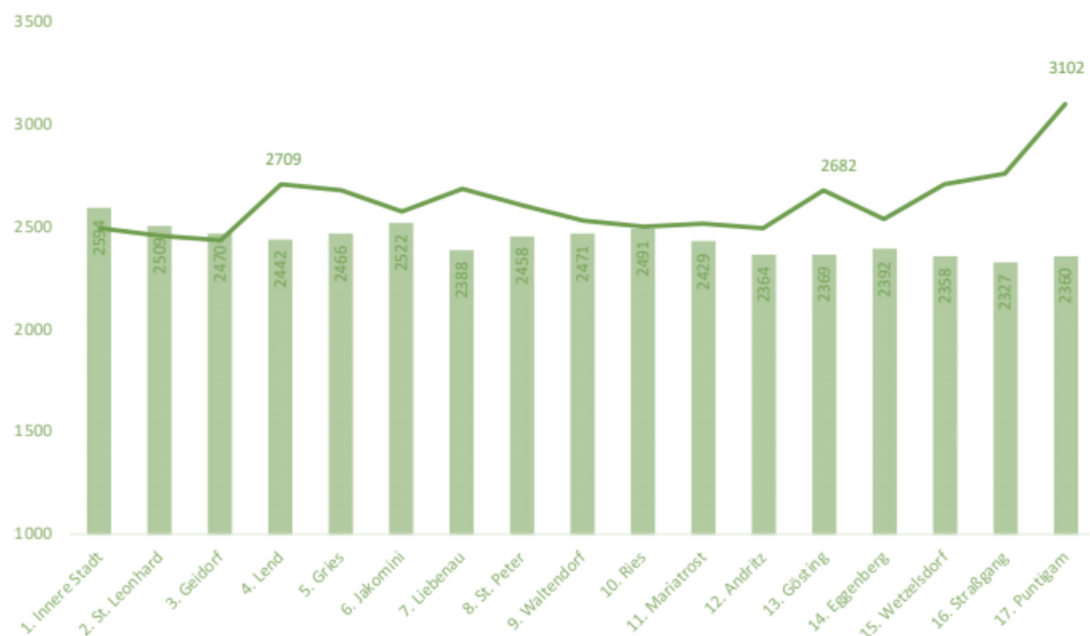


Figure 6. Satisfaction with and importance of recreation and leisure.

Figure 7 shows the importance of green spaces regarding residents' satisfaction. It was observed that the residents demanded more green spaces within the city. This would enhance the recreational and leisure value and offer a quality of life to city dwellers. This means that the number of playgrounds, dog parks, sports facilities, and other units should be increased. A total of 60% of the interviewees were between the ages of 40 and 50,

30% were 20–30, and 10% were under 20. Regarding gender, 65% were male and 35% were female.

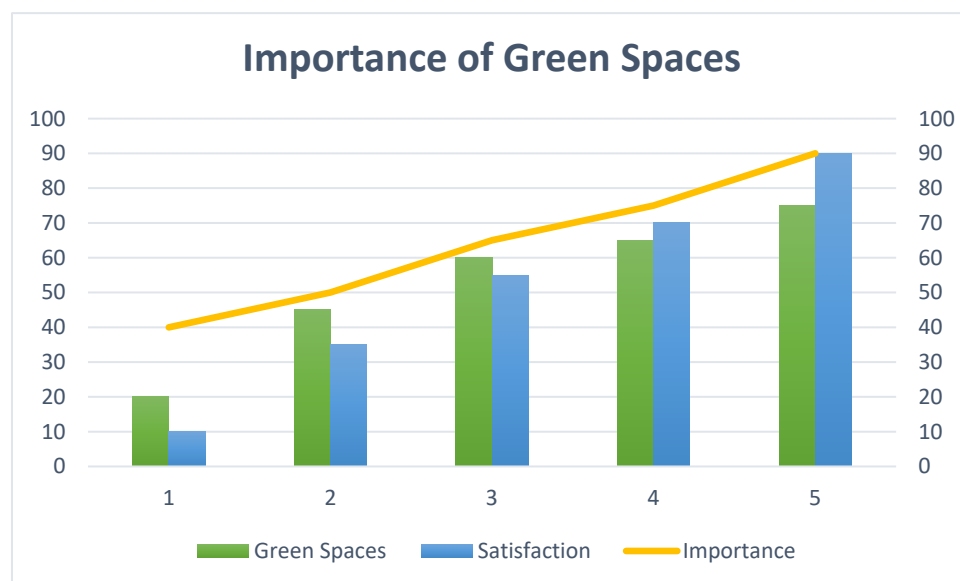


Figure 7. Impact of green spaces in terms of satisfaction and importance.

5. Conclusions

This work aimed to determine the influence of green spaces on the wellbeing and satisfaction of city dwellers. The GL, a wooden building with a vertical and green roof, answered this question. The district gardens in the SC of Graz were examined. The research questions asked at the beginning were combined with theoretical and empirical knowledge to find the answers.

1. How does lively urban greenery affect city dwellers' quality of life and physical and mental health, and what functions does it include for quality green space?

Urban green space can be understood to mean many different types of open spaces. Extensive parks, rows of trees, green roofs and facades, community gardens, inner courtyards, green terraces and balconies, roadside greenery, parks, schoolyards, cemeteries, forests, open meadows, and many more are considered. Green space, e.g., facade greening, roadside greenery, or cemeteries, offers various ecological, economic, psychological, physical, social, and aesthetic functions. Green infrastructure filters out pollutants and heavy metals in the air and water, can lower the air and surface temperature, absorbs less solar radiation, can absorb rainwater, and can lead to a better energy balance in buildings. It also provides habitats for animals. In addition to the effects on climate, regular stays in the countryside primarily influence one's physical, mental, and social health, and quality of life. It has also been described that stress can be reduced, concentration can be increased, fears and depression can be prevented, and one can escape the daily city noise and engage in more physical activities. Even the view of green space through a window can impact job satisfaction and productivity. Green elements placed indoors can also positively affect blood pressure, mood, and stress. Time spent in public green spaces can lead to interactions with other park users. In addition, certain elements of green spaces, such as maps, display boards, or sensory parkour, seem sensible. The citizens that were interviewed frequently confirmed the findings from theoretical studies. One knowingly and consciously benefits from staying in the countryside. Graz set itself the goal of providing 3 m² of green space per person in the single-family housing areas and 10 m² per person in densely built-up areas. As revealed by the expert interviews, these are only guide values from the zoning plans, which are far from being achieved. There is still a great need for action regarding the available green spaces in Graz and their size.

However, “green” does not always have a singular meaning. The design of green spaces led to the realization that green infrastructure can include many uses outside of the usual ones. Many criteria for a high-quality green space were observed. They could provide protection, comfort, and happiness, and should include meeting places, good lighting, thoroughfares, and furniture. In the case of participatory processes, an alternative park design was addressed. The population was not yet very creative, which could be due to the lack of good examples. Regardless of whether it is a small- or large-scale green space in the city, there are numerous positive effects, and it should, therefore, always be funded by private individuals and the public sector.

2. How do green spaces differ regarding environmental and social justice and sustainability, and what contributions can they make to a neighborhood?

Through the fulfillment of different usage requirements and the sense of belonging of the users, the social diversity of the visitors keeps increasing. Ideally, social exclusion processes would be limited, and there would be opportunities to become involved. People have different demands for public spaces depending on their life situations. In addition, gender, ethnic affiliation, age, and socioeconomic status influence how a space is appropriated. In practice, however, albeit unconsciously, exclusion processes often occur in green spaces.

Moreover, if there are no matching elements for the type of use that one wants, the choice falls on a different green space, and possibly even another kind of recreation. The people who were interviewed did not report concrete exclusion processes. Preferences regarding the selection of a recreation area for more mixing should create public incentives.

Wealthier neighborhoods often have more and better-equipped green spaces than neighborhoods with a socioeconomically disadvantaged population. For people who are disadvantaged in terms of time or financial resources, recreation in a nearby green space is necessary, as it provides free relaxation, and if it is within walking distance, no other vehicles are necessary. Living space in green areas is often associated with higher financial costs, especially when there is already great pressure on the housing market. There is newly created or improved green space in Graz, and the rent only rises when tenants change. The socially disadvantaged often live near major roads or industrial sites, increasing the need for local recreation. In Graz, the districts of Lend, Gries, and Jakomini are particularly noteworthy for their high demand for more green space.

As meeting places for people, green spaces contain a strong social component. Regardless of if one engages in a leisure activity with friends or alone, there is often an opportunity to talk to others. The interviewees confirmed this, especially when visiting the park with children or dogs. In green spaces in which something is created together, such as community gardens or the GL, interactions with others are almost inevitable. A small green area with a playground in a residential area in Graz was restricted to a small number of residents. It did not offer a wide range of uses but could be used for the neighborhood to have an essential social value. Courtyards mostly serve several residential parties. According to those surveyed, these also often act as meeting places for residents.

3. How are different stakeholders involved in the development and improvement of urban green spaces?

Through citizen participation, the social resources of a community can be strengthened, and contacts can be made with others. In urban development, different opinions are always important since changes affect a very heterogeneous population. Multifunctional green space design is beneficial to various stakeholders. These findings were largely confirmed in the expert interviews. Participation processes are an important instrument for urban development and urban planning. However, they require very good preparation and extensive financial resources. Citizens who offer their time and commitment without being financially compensated for successful work are vital. One common issue is that it is mainly citizens who are already critical and articulate that participate. Therefore, ways must be found to reach a broad population and to provide motivation, such as through workshops

or excursions. Few interviewees were willing to participate in the design of green spaces, as was confirmed in the interviews. However, there is often a lack of information about the possibilities for participation and time resources.

Graz has guidelines for citizen participation that describe the exact steps involved in the process. However, many projects are carried out without participation. Participation is not enough for every project. Projects and decisions in the SC area are being carried out without participation, since very few citizens are still onsite. Usually, only the neighbors are informed. Not least because of the climate change debate, we are also in a situation in which citizens themselves have become active in various initiatives, which now only need to be recognized and implemented by decision makers and politicians. We are slowly moving in the right direction. After completing the proposed research, it was observed that green spaces play an important role in the design of an SC. Green spaces also attract more residents, increasing the city's trade, which is useful for improving the economy of a country.

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Appendix A

Table A1. Quantitative questions.

1	How (often, like . . .) do you use the green spaces in Graz, and which ones?
2	Could you please briefly describe how your professional activity related to UGSs in Graz looks?
3	What is the significance of green spaces for city dwellers?
4	What do you think their most important functions are?

Table A2. Guidelines for general interviews (qualitative).

Topic	Questions
Use of green spaces	i. Which green spaces in Graz do you use to relax?
	ii. For which activities do you mainly use green spaces? With whom?
	iii. Which equipment in the green space do you use and how?
	iv. How many times per week? Approximately how long do you stay?
	v. How do you achieve this?
	vi. Do you have a green area at home? Green inner courtyard? Garden?
Evaluation of the green spaces used	i. How do you rate the security within the green spaces you use?
	ii. How do you rate the cleanliness within the green spaces you use? Are there disruptive factors?
	iii. What do you think the green spaces you use need more of?
	iv. Do you feel sufficiently removed from the city stress (street noise, hustle and bustle, etc.)?
	v. Do you interact with strangers? Are there usage conflicts between users?

Table A2. *Cont.*

Topic	Questions
Benefits for the interviewees	i. To what extent do you feel the need to use green space? ii. Do you wish for more green space in your immediate environment? iii. To what extent do green spaces increase your quality of life? iv. What is nice about them? v. What would be different if everything was paved?
Green Laboratory	i. How long have you known about green LAB and how do you use it? ii. How (often) do you think you will actively use the green LAB in the future (be it for information, meeting, playing, gardening, etc.)? iii. Can it represent another green space in the district?
Opportunities to participate	i. Would you like to be actively involved in the design/planning/maintenance of green space if there was a chance? ii. Do you see opportunities to create green spaces yourself?
Personal characteristics	i. In which district do you live? ii. Do you do a sitting or standing job? iii. Do you have children or dogs?

Table A3. Guidelines for the expert interviews (qualitative).

Topics	Questions
Creation of green space	i. How is new green space created in Graz? How is it planned and developed? ii. The framework is between 3 m ² per inhabitant in detached housing areas and 10 m ² per inhabitant in densely built-up urban areas. What measures are being taken to counteract this? iii. Are areas such as those with facade greening, which are not directly usable, counted? iv. The Green Space Offensive of the city of Graz demands, among other things, “multifunctionality, high aesthetic standards, nature conservation, enabling communication and integration, and taking into account climate change.” How do you think qualitatively high-quality green space looks? v. How is this multifunctionality achieved?
Challenges	i. What challenges and conflicts of interest exist in the Graz green space (or in its planning, maintenance, and use)? ii. Do you see problems with access to green space for certain sections of the population? Green Gentrification: Does it happen in Graz that new green space is created or improved, and will rents increase?
Participation	i. How are different stakeholders involved in the development and improvement of green space? ii. Do citizens want to be involved at all or to create green space themselves?
Smart city—GL	i. Do you think there will be good coexistence and exchange among the future residents of the Smart City and the surrounding residents? ii. GL on Waagner-Biro Strasse: Can you give an estimate of which ones? iii. How important is the GL as a temporary project for the district?
Final question	How can you contribute even better/differently to the health of city dwellers who you motivate to be active?

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