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Assessment of population perceptions regarding recreational use of Bydgoszcz selected areas using fuzzy relations

Abstract: The public space in cities is designed for recreation and communication. It is vital and interesting to study if people feel safe and comfortable, and what factors result in their attachment to their nearby public space. The paper discusses the community's need to use urban space for recreation based on surveys conducted in 2016-2017 in three separate zones of the city of Bydgoszcz, with 2,328 respondents. In the study, three research areas were defined (namely, the attachment to public space, the sense of security in public space, and the sense of meeting the needs of public space users). The study, based on fuzzy relations, demonstrates that respondents are generally very attached to usable spaces and look for places to regenerate their mental strength.

Keywords: recreational use; social space; needs of the population; fuzzy logic

1. Introduction

The development of cities by the idea of sustainable development requires efficient space management (Chojnacka 2014). Kusińska (2017) emphasizes that public urban spaces underwent rapid and diverse transformations in the 20th century, resulting from technological and infrastructural progress. Undoubtedly, the factors shaping them were social, environmental, and cultural processes. When defining public space, we should remember that architects, urban planners, and sociologists perceive it differently. According to Wiszniowski (2016), the essence of public space is defined by a privileged role as a place of social activity. He emphasizes that urban planners and architects see space in terms of its functionality. They

pay particular attention to its architectural and urban resources and values that serve the satisfaction and aspirations of its inhabitants. For sociologists, space is a place of community integration and initiatives undertaken therein for the benefit of the community (Wiszniewski 2016). The structure of urban public space includes, among others, squares, streets, and green areas (Bierwiazzonek 2016), which serve as places for social interactions. Green areas and squares are places for relaxation and entertainment (Johnson and Glover 2013). Currently, people pay much attention to ensure that they are of high quality, as Rupa (2015) points out in his study. Akyıldız (2022) additionally notes that green infrastructure is becoming more important in urban spaces, as

there is a tendency for cities to adopt an ecological direction with a focus on green axes. In her work, she examines the importance of green places as an identity and memorable component. She indicates that urban green spaces are vital city components as a recreation place and intersection of the city's arteries. Moreover, their characteristics support building residential houses, offices, and public buildings nearby. Therefore, well-designed public spaces encourage the community to use the natural landscape (Das 2008).

In this study, the authors will focus on discussing the community's needs for recreation using urban space terms. An assessment will be made of the extent to which it meets the expectations of the populations (both those living in Bydgoszcz and those who visit it occasionally) and to what extent it does not. The topic discussed in this work is justified because, more and more often, the structure of the components of modern cities is

not the domain of specialists alone, but the local population is getting involved in the planning practice, influencing the character and image of the surroundings they use. This results, on the one hand, from increased awareness of the place where they live and, on the other hand, participation in spatial planning. In this context, it is vital to assess the population's perceptions of the places they visit every day or just a visit. Konior (2021) points out an important thing here, namely a clear shift noticeable from the perspective of the last decade, which involves placing humans at the center of activities related to the protection of cultural heritage and the renewal of urban space (making it more friendly). Examining the population's feelings (although only subjective) may provide the basis for determining why they choose certain places (use them recreationally) more willingly and how to make these places come alive in urban space.

2. Study area

The city of Bydgoszcz has a rich history reflected in its architecture, natural conditions (and it is called “situated on the water” or “facing the rivers”), as well as culture. In the past, it had an industrial character, and today, according to Perlik-Piątkowska (2022), it attracts tourists with its charm and romanticism. It is not without reason that it is called the pearl of Kujawy, with examples of medieval and 18th-century buildings, and buildings from the 19th century dominating the space. The Bydgoszcz Canal, a unique example of 18th-century technical thought on a European scale and today a favorite place for walks, also contributes to the economic development of Bydgoszcz (Perlik-Piątkowska 2022).

The justification for selecting three research zones in Bydgoszcz (the “very” center, outside the very center, and Fordon) was to show how the perception of these spaces is shaped in terms of how they meet the needs regarding recreation and relaxation places offered there. Moreover, it was important to check whether people staying in selected areas identified with them emotionally and felt safe there.

The “very” center zone is the oldest part of Bydgoszcz, shaped by many social and economic processes (Fig. 1). Its current, attractive image is influenced significantly by the adjacent surroundings (function and technical condition of buildings, type, and quality of streets and square surfaces, small architecture, forms of greenery, and their mutual relations in the transformed area) (Rembowicz-Dziekiowska 2012). The old town zone is distinguished by a green (riverside) area on Młyńska Island, which plays an important role in the city space, integrates the city with the river, and performs various functions (representational, culture-forming, touristic, identification) (Jaszek 2022). Kanior (2021) emphasizes that Młyńska Island is an example of a unique symbiosis of cultural and natural values (with the preserved old chestnut, maple, willow, and lime trees), creating a unique spatial and landscape system. Undoubtedly, the very center of Bydgoszcz is a place that, in terms of the attractiveness of the tourist space, is defined primarily by tourist values, i.e., a set of elements of the natural environment and non-natural elements that, together or individually, are of interest (Kurek,

2007), not only to tourists but also to the local community.

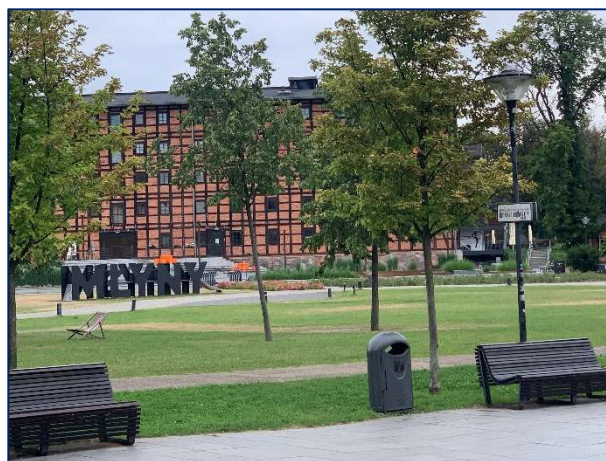


Figure 1. Zone: the city centre, Wyspa Młyńska (left), Ku Młynom str. (right)

The zone outside the very center of Bydgoszcz includes the following districts: Bartodzieje, Bielawy, Błonie, Czyżkówko, Glinki, Górzyskowo, Jachcice, Okole, Szwerderowo, Wilczak (Fig. 2) and Wyżyny. The zone is characterized by numerous

cultural, architectural, and environmental values. Historic architecture (including religious buildings, tenement houses, and modernist buildings from the interwar period) intertwines with contemporary, friendly spaces with numerous green oases used for recreation.



Figure 2. Zone: the outside of the very center of Bydgoszcz, Marina Gwiazda (left), Spacerowa str. (right)

The Fordon zone (Fig. 3), in turn, is a district of Bydgoszcz (once a separate city) located in the Fordon Valley on the Vistula River, characterized not only by an attractive natural environment (forest enclaves, landscape parks, housing estate parks, caves) but also by a wealth of cultural heritage (sacral

buildings) and architectural heritage (old houses). Today, this administrative unit retains many traces of its past (the origins of Fordon date back to the Middle Ages, and its history is closely related to industry and transport), which makes it an attractive, diverse urban space.

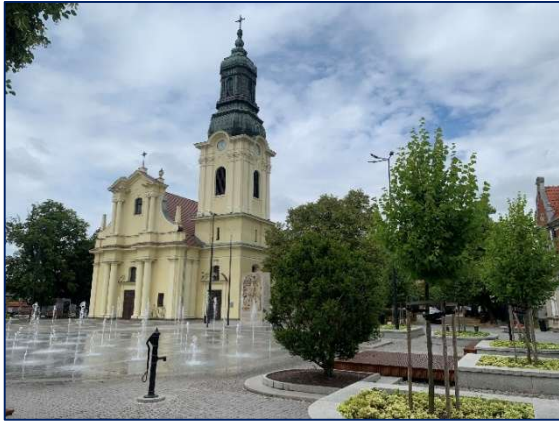


Figure 3. Fordon zone, Church of St. Nicholas (left), Vistula River embankment (right)

3. Material and methods

The work uses the results of a survey conducted in 2016–2017 in three separate zones of the city of Bydgoszcz (the city center,

zone outside the very center of Bydgoszcz and Fordon) (Fig. 4).

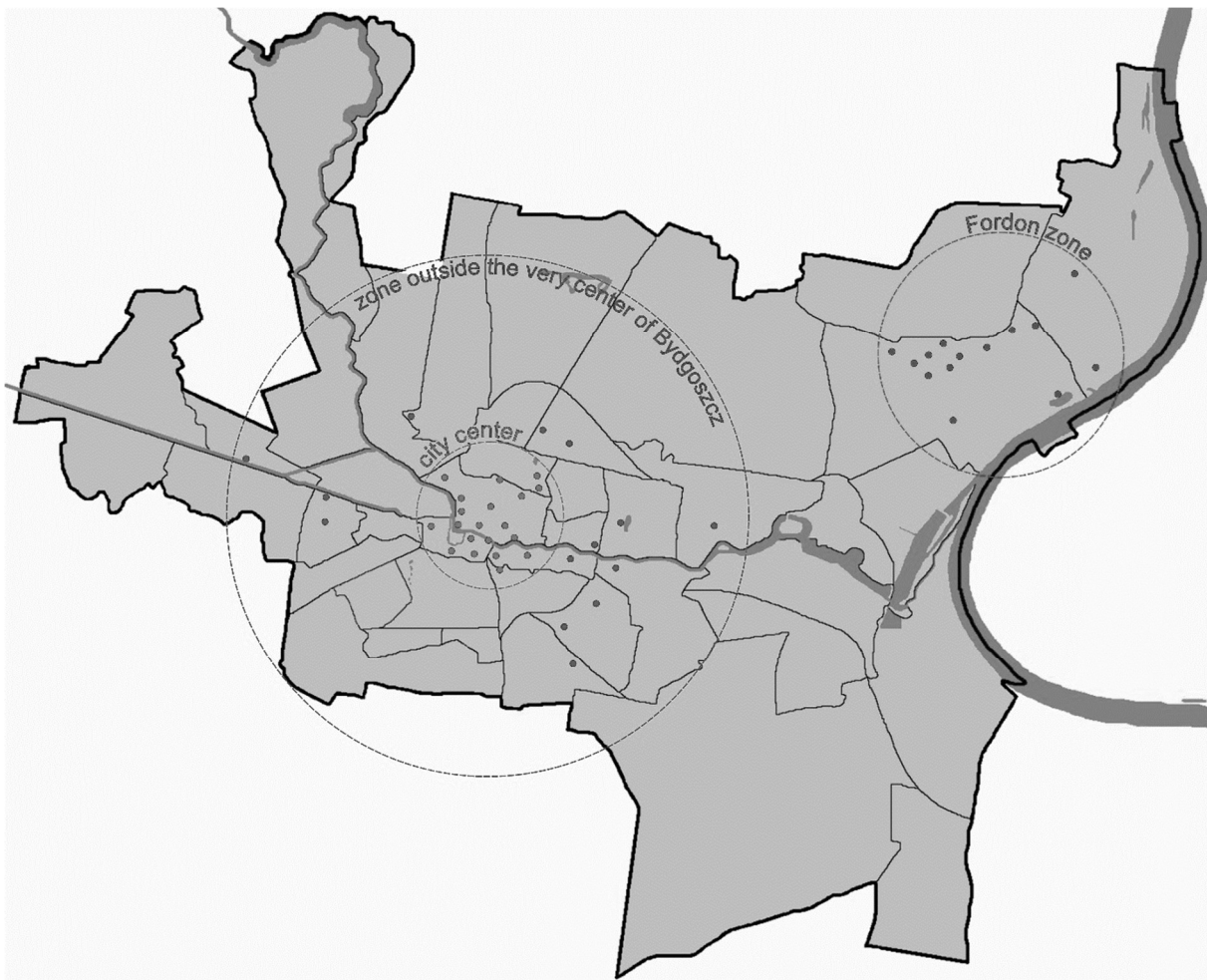


Figure 4. Map of Bydgoszcz indicating the zones and points where the study was carried out

Respondents were recruited for the study randomly. Data was collected using a researcher-supervised survey, so that it could have provided respondents with explanations, reducing the number of errors caused by incorrect interpretation of the meaning of the question (Sołoma 2002). In the survey, a group of 2.328 people took part (including 1.257

women, i.e. 53% of all respondents). The respondents came mainly from the city of Bydgoszcz (45.9%) and were aged 26-55 (43.7%). The vast majority are people with secondary education (29.4%) and higher education (21.4%) (Fig. 5), as well as having families (71.6%).

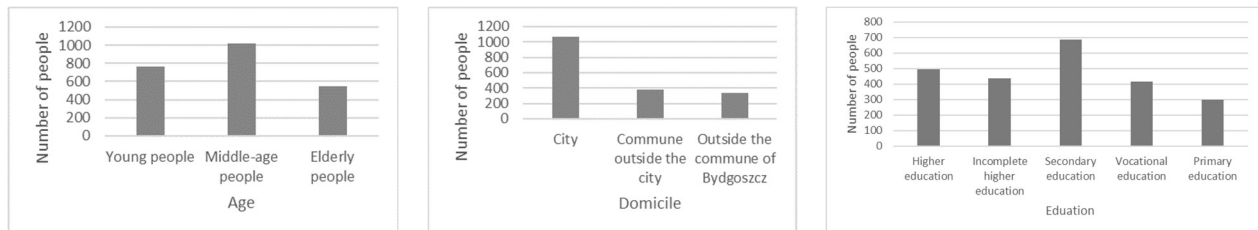


Figure 5. Diagrams of some characteristic of respondents: age (left), domicile (middle), education (right)

Three research areas have been defined for it, namely:

- A1 – attachment to public space,
- A2 – a sense of safety in public space,
- A3 – meeting the needs of public space users.

The survey (apart from the information enabling the collection of statistical data about the respondents themselves) consisted of 11 multiple-choice questions:

- Q1 – What means of transport do you use to get around Bydgoszcz?
A: by car; B: public transport; C: bicycle; D: on foot.
- Q2 – How often do you spend time in the park?
A: every day; B: once a week; C: once a month; D: several times a year or less often.
- Q3 – How often do you spend time in a public square?
A: every day; B: once a week; C: once a month; D: several times a year or less often.
- Q4 – How often do you spend time in the space directly next to your place of living?
A: every day; B: once a week; C: once a month; D: several times a year or less often.

- Q5 – Do you feel attached to the public space where you live?
A: strongly agree; B: agree; C: it's hard to say; D: disagree; E: strongly disagree.
- Q6 – Do you feel safe in the public space where you are?
A: strongly agree; B: agree; C: it's hard to say; D: disagree; E: strongly disagree.
- Q7 – What element is the most important in shaping the sense of security?
A: monitoring; B: traffic lights; C: place lighting; D: pleasant sounds of nature (f.e., birds singing); E: presence of friends/family.
- Q8 – Do you feel good in the designed space?
A: I feel good; B: I have no opinion; C: I feel bad.
- Q9 – Are you satisfied with the public space, where you live, or spend a lot of time?
A: strongly agree; B: agree; C: it's hard to say; D: disagree; E: strongly disagree.
- Q10 – Should architects designing public spaces in the city consult the project with potential users from the stage?
A: early design phase (concept) to best meet the expectations of potential users; B: advanced design phase (e.g., having ready-

made solutions) to have the possibility to discuss challenging design problems; C: I don't know.

- Q11 – How many forms of activity most often bring you to this public space?

A: 8-9 activities; B: 6-7 activities; C: 4-5 activities; D: 2-3 activities; E: 0 activities.

The authors used the fuzzy logic method to analyze the data (Zadeh 1965; Chandran and Kandaswamy 2016). At first, the experts (authors of the article), apart from preparing the set of relatively simple questions, determine the values (belonging to interval

Let $R1 \subset X \times Y$ and $R2 \subset Y \times Z$. Values of relation $R3 \subset X \times Z$ are calculated

$[0,1]$) of the relation between the complex research areas and the questions. Moreover, the experts have to create the rules for coding respondents' answers to achieve values belonging to interval $[0,1]$.

The above issues are formally defined. The first concept refers to the creation of a fuzzy relationship connecting research areas with questions. Let X be a non-empty space. A fuzzy set A is a set pairs (x, μ_A) , where $x \in X$ and $\mu_A: X \rightarrow [0,1]$ is a membership function describing the level of membership to the set A . Let X and Y are two non-empty spaces. A fuzzy set of $X \times Y$ is called a fuzzy relation.

using the formula:

$$R3(x, z) = S_{y \in Y}(T(R1(x, y), R2(y, z))), x \in X, z \in Z, \quad (1)$$

where T is t-norm and S is t-conorm (Rutkowski, 2012). In the article, because of

the simplicity of calculations, the authors choose the following norms:

$$T(a, b) = a \cdot b, \quad S(a, b) = a + b - a \cdot b. \quad (2)$$

Let X be a space of research areas, so $X = \{A1, A2, A3\}$ and Y be a space of survey questions, $Y = \{Q1, Q2, \dots, Q11\}$. Let $R1 \subset X \times Y$ be a fuzzy relation where $R1(Ai, Qj)$ shows the level of connection between the research area Ai and question Qj for $i = 1, 2, 3$ and $j = 1, 2, \dots, 11$. Let Z be a space of respondents, so $Z = \{O1, O2, \dots, O2447\}$. Assume that $R2 \subset Y \times Z$ be a fuzzy relation where $R2(Qj, Ok)$ shows the coded value of the answer of respondent Ok to the question

Qj , where $j = 1, 2, \dots, 11$ and $k = 1, 2, \dots, 2447$. Let $R3 \subset X \times Z$ be a fuzzy relation between research areas and respondents, where $R3(Ai, Ok)$ shows the estimation of the opinion of respondent Ok of the research area Ai .

Table 1 presents the values of the fuzzy relationship between research areas and questions. For example, $R1(A1, Q1) = 0.2$, which means that question Q1 connects to research area A1 at the 20% level.

Table 1. Values of the fuzzy relationship R1 between research areas and questions

Question Res. Area	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11
A1	0.2	0.5	0.5	0.5	0.7	0.1	0.1	0.2	0.1	0.5	0.2
A2	0.3	0.1	0.1	0.1	0.1	0.7	0.6	0.2	0.3	0	0.2
A3	0.5	0.5	0.5	0.5	0.2	0.2	0.5	0.6	0.6	0.5	0.6

Next, the answers to the survey questions were coded with numbers from the interval

[0.1] and presented in Table 2.

Table 2. Values assigned to individual answers

Question Answers	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11
A	0	1	1	1	1	1	1	1	1	1	1
B	0.67	0.67	0.67	0.67	0.75	0.75	0.75	0	0.75	0.5	0.75
C	0.33	0.33	0.33	0.33	0.5	0.5	0.5	0.5	0.5	0	0.5
D	1	0	0	0	0.25	0.25	0.25	-	0.25	-	0.25
E	-	-	-	-	0	0	0	-	0	-	0

The answers from the respondents were coded in accordance with the data in Table 2.

Part of the values of the fuzzy relationship R2 are presented in Table 3.

Table 3. Part of the values of the fuzzy relation R2 between questions and respondents

Question Respondent	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11
O1	0	0.33	1	0.33	1	1	0.25	1	0.75	0.5	0
O2	0.67	0.67	0.67	0.33	1	1	0	1	0.25	1	0.25
O3	0.67	0.33	0.67	0	0.75	0.75	0.75	0	0.5	0.5	0.25
O4	0.67	0	0.67	1	0.75	0.75	0.25	1	0.75	1	0.5
O5	0.67	0.33	0.67	1	0.75	0.5	1	0	0.25	0	0.25

By formulas (1) and (2), the authors determined the fuzzy relation R3 values and presented the part of them in Table 4. The value of $R3(A1, O1) = 0.944$ means that respondent O1 is very attached to the public

space of Bydgoszcz, the sense of security of person O1 is lower and amounts to 0.832, and the feeling of fulfillment is very high and is 0.938.

Table 4. Part of the values of the fuzzy relation R3 between research areas and respondents

Respondent Res. Area	O1	O2	O3	O4	O5	O6	O7	O8	O9	O10	O11
A1	0.944	0.969	0.838	0.957	0.893	0.883	0.964	0.94	0.97	0.885	0.874
A2	0.832	0.846	0.751	0.942	0.914	0.919	0.91	0.973	0.969	0.907	0.892
A3	0.938	0.932	0.802	0.903	0.806	0.96	0.921	0.896	0.959	0.909	0.86

4. Results and discussion

The conducted research revealed that, in general, respondents in all three zones show great attachment to usable space. According to the respondents, the closer they get to the city center, their sense of security decreases (Fig. 6). This state of matters may be influenced by many indicators, e.g., hard ones, showing the number and type of crimes, but also soft ones, i.e., how the population perceives the city (Arak 2017). Recreational space turned out to be the best outside the city center. This state of things could probably be influenced by urban greenery, which increases the attractiveness

and importance of a given place. Moreover, even small development elements in the form of flower pots and containers related to small garden architecture objects can change the appearance of the street itself, emphasize the representative character of the building, or diversify the surface of the square (Rembowicz-Dziekiowska 2012). At the same time, in the respondents' opinion, publicly available infrastructure like sports facilities, walking areas, and prepared playgrounds for children play a vital role in meeting their recreation needs.

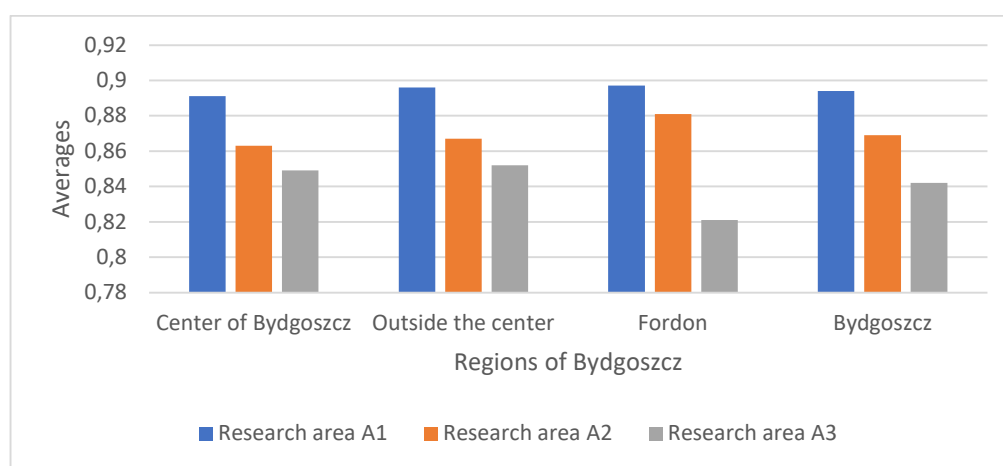


Figure 6. Averages of research areas' estimations of respondents questioned in different regions of Bydgoszcz

Analyzes conducted according to the gender of the respondents showed that in all three surveyed zones, women, not men, felt a greater sense of belonging to a given space,

and it better satisfied their needs for passive or active recreation there (Fig. 7). They also felt safe (more often than men) in these places.

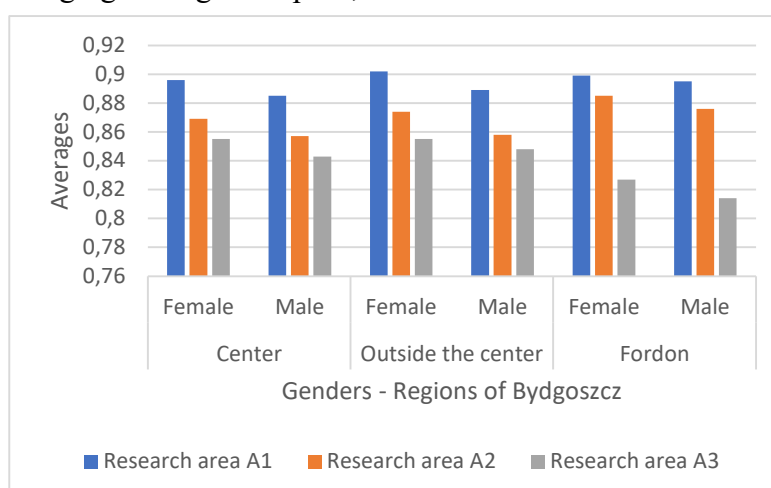


Figure 7. Averages of estimations of people questioned in different regions of Bydgoszcz with the respect of gender

In turn, considering the age of the surveyed people, we notice that respondents from younger (up to 25 years old) and older (56 years old and above) age structures declared greater attachment to the city center space. They felt a strong connection with the area more often than middle-aged people, perceived its development positively, and did not feel

thread discomfort. Respondents outside the city center saw the examined aspects slightly differently. Here, people with older age structures reported that the development of the surroundings for recreation purposes met their expectations much more than for middle-aged people (a similar situation is noted in Fordon) (Fig. 8).

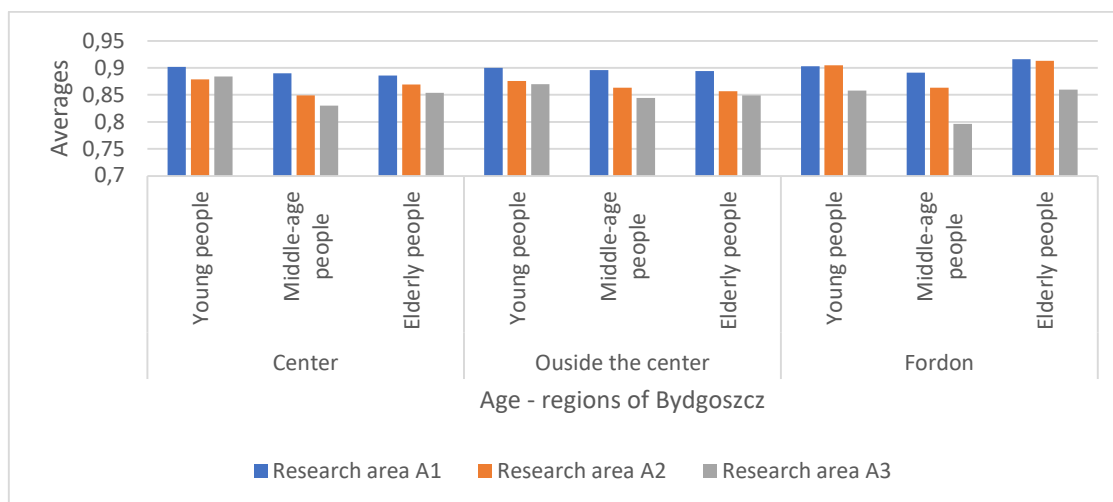


Figure 8. Averages of estimations of people questioned in different regions of Bydgoszcz with the respect of age

Older people in Fordon felt safer than people of middle and younger age. Perhaps it was related to a greater sense of belonging to the place where they lived. However, we must remember that the sense of security is a subjective concept, and whether a given person feels negative emotions related to it is often an individual matter. Personal safety includes immunity to situations involving a threat to life, health, family and loved ones, well-being, or maintaining the condition of the living environment (Mordwa 2016). In this study and that conducted by Jerschina et al. (2012), we should remember that this is a study of individual and collective consciousness, not a study of actual acts of crime, their perpetrators or victims. At the same time, it is worth pointing out, following Bojanowska (2021), that factors such as the location of the apartment/house, available social infrastructure (apart from the apartment/house, which is the main space in which the senior stays), awareness of belonging to the local

community, network of social relations, and the already mentioned sense of security are also of great importance for the comfort of the life of senior people. Therefore, fascinating observations we can make consider how single or family people in the surveyed zones feel about their attachment to a given public space, its safety, and its development. The respondents' declarations show that, apart from the city center, all research areas A1, A2, and A3 were perceived better by people having families (1.664 people) (Fig. 9).

A similar situation was observed in the Fordon zone (however, both groups of respondents rated the safety in the zones at a similar level). Considering the people's responses from the "very" center of Bydgoszcz, we notice that those without families rated the city's spatial space higher about safety and its development (they treat their attachment comparably and highly). On one hand, this could be explained by their preferred lifestyle. People without families

find it easier to manage their time. Therefore, they use the city's infrastructure more often daily. Families (especially those with children)

are focused on weekend rest (spending free time recreationally with loved ones).

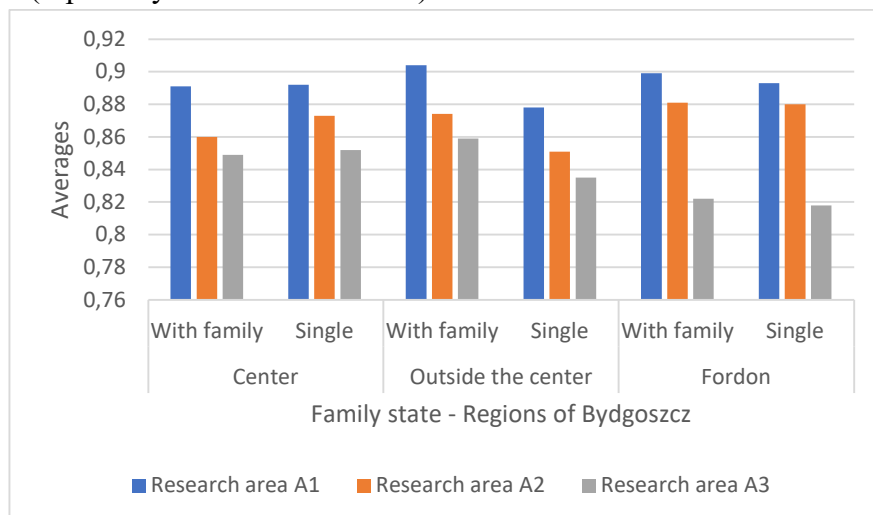


Figure 9. Averages of estimations of people questioned in different regions of Bydgoszcz with the respect of family state

Looking at the level of education of the respondents, we can see that in each of the surveyed zones of Bydgoszcz, people declared (with the majority of people with secondary education constituting 29.4% of the respondents and primary education comprising 12.7%) their great emotional attachment to them and their good preparation for them. To practice various forms of recreation and spend free time here (Fig. 10). Perhaps in this regard, this space arrangement meets their basic needs, and they no longer have any more requirements. Those with higher educational potential (21.2% of the total) may feel discomfort when using them due to the concentration of some services like increased noise or a grown number of tourists. As a result, they feel a reduced sense of security in these zones, more so than those with primarily primary, secondary, and vocational education (Fig. 10).

For comparison, in the study by Bogucka and Sieniecka (2016), we note that people with higher education rated the level of safety in their city (in various districts of Poznań) as the highest. The authors emphasized that the sense of security significantly affects the quality of

life of people in urban space, and research in this area is of great importance in planning preventive actions. Fascinating observations are provided by research conducted by the Public Opinion Research Center (CBOS) (Bożewicz 2023), stating that 88% of our society considers Poland to be a country where people live safely. Only fewer than one in ten had the opposite opinion (9%), and 3% of respondents had no opinion. Men are more likely than women to believe that life in Poland is safe. The sense of security in the neighborhood of the respondents is almost universal. In 2023, 96% of respondents (no change compared to the previous year) answered that the place where they live (district, housing estate, village) could be called safe and peaceful; however, only three people out of a hundred were of the opposite opinion (3%, one percentage point less compared to 2022). Safety issues in public spaces (city) are also described by Bierwiazzonek (2016). He places this issue among the most vital problems in the functioning of modern societies. Oktay (2012) also points to them in his research.

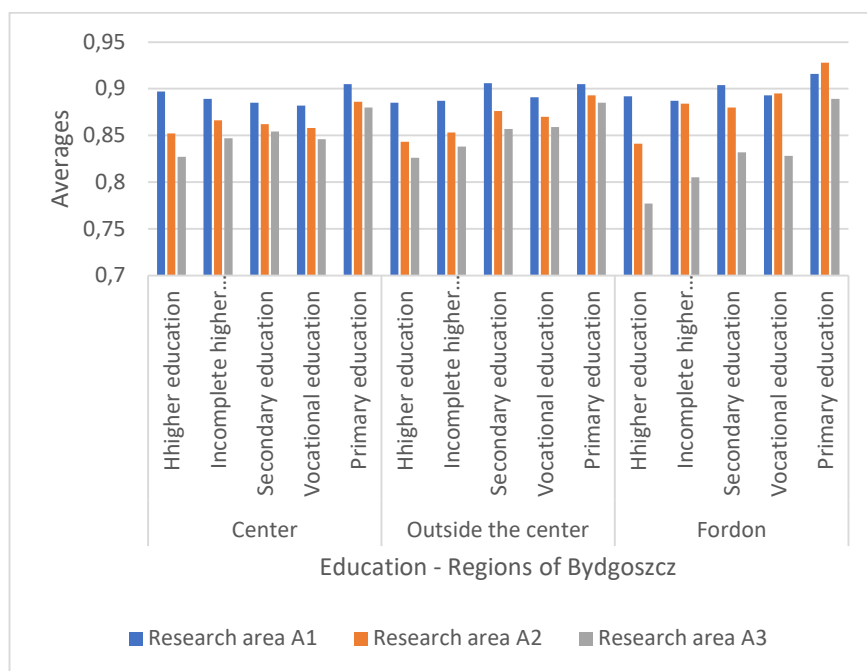


Figure 10. Averages of estimations of people questioned in different regions of Bydgoszcz with the respect of education

Considering the place of residence of the surveyed people, we can observe that those from the city of Bydgoszcz (and those living outside the Bydgoszcz commune) in all selected zones gave similar assessments of A1, A2, and A3 and scored them higher than people living in the Bydgoszcz commune (Fig. 11). This may indicate that visitors to zones from areas further away assessed them perhaps more subjectively, but also less critically

because they compared them with the spaces in which they lived. Other people (visiting the zones more often or permanently residing there) showed a more objective approach because it was easier for them to diagnose them in terms of development (existing spatial order, recreational, environmental, or cultural values) and their general accessibility.

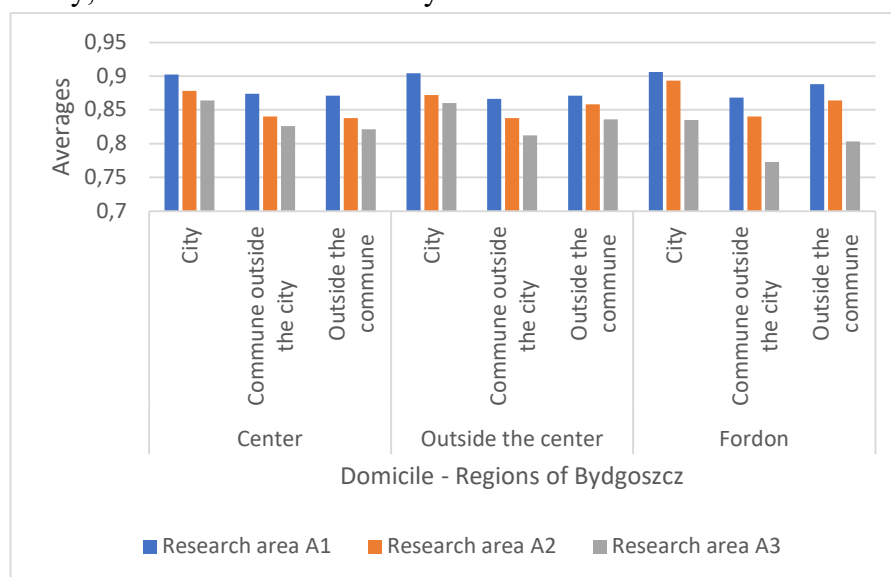


Figure 11. Averages of estimations of people questioned in different regions of Bydgoszcz with the respect of domicile

research, public space plays a significant part in every person's life, regardless of age or education. However, some elements of public space determine its purpose and thus have features that enable it to be used in a specific way. The "very" center of the city, although it offers attractions in the form of preserved cultural heritage, the recreational waterfront of the Brda River, and numerous events, can be overwhelming with an abundance of people staying there. Infrastructure outside the city center requires maintenance, planning, and continuous investment. In particular, it should be adapted to the needs of different age groups so that the local environment serves everyone and does not exclude anyone, especially pensioners, from cultural and social life.

The research showed that respondents staying in the zones use the sports facilities, bicycle paths, and walking areas that are located there. In addition, there are cultural facilities and generally accessible green spaces. We notice that modern society searches for places to regenerate its mental strength. Greenery has a particularly vital impact on health and psychophysical conditions. It is one of the fundamental aesthetic values of humans. Trees also soften the expansiveness of city architecture. Properly shaped and arranged green areas perform vital biological, cultural, social, and recreational functions. They enable the implementation of various mental and physical activities other than those resulting from the duties of everyday life, professional, family, social, or living needs (Jankowski et al., 2013).

Undoubtedly, it is worth mentioning the global 17 Sustainable Development Goals, where the 11th refers to "sustainable cities and communities." The idea is to make cities and

human settlements safe, stable, and sustainable, among others, by implementing effective urban planning and management practices to meet the challenges of urbanization. At the same time, ensure (by 2030) easy and universal access to safe and inclusive green areas and public spaces, especially for women, children, seniors, and disabled people, and also strengthen efforts to protect and safeguard the world's cultural and natural heritage (Sustainable Development Goals, <http://www.un.org.pl/cell1>).

The zones outside the "very" center of Bydgoszcz and Fordon are spaces particularly often used by respondents. Fordon is distinguished by its location on the bank of the Vistula, which provides residents with access to numerous recreational and walking areas and hiking and cycling trails. Contact with nature is favored in the following places Bydgoskie Zakole Wisły, Fordoński Przełom Wisły, Zbocze Fordońskie, Góra Szybowników, Dolina Śmierci and Park Milenijny. Undoubtedly, significant elements of this former industrial center are historical monuments (e.g., the old synagogue and post-industrial buildings) intertwined with modern architecture.

The authors of the study plan to expand and repeat the research to analyze in more detail the perception and use of public spaces (e.g., relating to the identification of the most recognizable places in the presented zones; the main meeting places or social life; the assessment of zones not only in terms of recreation, but also entertainment), and at the same time understand the behavior of the population in this regard and get to know their views on the care of public space.

5. Conclusions

The conducted analysis allows formulating the following conclusions:

1. Public spaces are more willingly used by respondents outside the "very" center of Bydgoszcz. It was probably due to the

reduced impact of noise on the quality of recreation, better accessibility to green areas, and infrastructure allowing for physical activity there.

2. Middle-aged respondents identified themselves less often with the city center zone (which most often stimulates curiosity and arouses emotions with its rich and diverse architecture). Young and older people try more to find fulfillment in their relaxation needs and feel safer in this space. The latter, perhaps due to their greater identity with the city and less mobility, feel more part of these traditional spaces (revitalized in recent years) (which constitute a kind of symbolism for them - memory and culture). In turn, youth, through their individualism, way, and lifestyle, identify with the Center zone as a lively place of meetings (integration) with peers (mainly on Młyńska Island and the Brda waterfront). It should be mentioned here that the needs of young people often dictate patterns related to the age of adolescence, and in the future, their local culture of urban life (needs) may change.
3. Women more often felt more confident in the researched spaces (they also rated the forms of available recreation objects more highly), did not feel any potential anxiety, and were more emotionally attached to them. It may be due to various reasons, namely better knowledge of the space due to their roles related to family life (e.g., mothers with children using them), preferred (including routine) forms of activity, better identification of given places, or a time deficit.
4. The spatial needs of respondents depend on various objective features, such as age or education, interests, and family circumstances. The research showed different needs of the respondents in terms of the examined spaces, identification with them, and a well-perceived cultural capital, which consequently resulted in various recreational activities undertaken in these zones.
5. The fuzzy relation application allows a more comprehensive analysis of complex research areas, sometimes challenging because the respondents do not give direct opinions about them. The different groups of respondents (even children) can appropriately understand a set of simple survey questions. The involvement of experts allows us to determine whether we have a sufficient number of questions and whether their selection ensures a complete reference to the research areas. The presented in the article research areas can be developed more comprehensively because the set of questions was simple and understandable for everybody.

References

- Akyıldız, N. A. 2022. The Importance Of Green Public Spaces In Urban Planning Strategies. [In:] Akyıldız, N. A., Ekici B.B. (Eds.) *Space in Macro and Micro Scales*. Publisher: Livre de Lyon, Lyone, France, 199.
- Arak P. 2017. *Bezpieczne i otwarte miasta*. Wydawca Polska Fundacja im. Roberta Schumana, Warszawa, Polska, 40. ISBN: 978-83-88752-09-4 [In Polish]
- Bierwiazzonek K. 2016. Społeczne znaczenie miejskich przestrzeni publicznych. Wydawnictwo Uniwersytetu Śląskiego, Katowice, Polska, 267, ISBN: 9788380129573 [in Polish, with English Abstract].
- Bogucka E., Sinięcka A. 2016. Poczucie bezpieczeństwa mieszkańców miasta. Przykład Poznania. *Rozwój Regionalny i Polityka Regionalna* 33, 57-71 [in Polish, with English Abstract].
- Bojanowska E. 2021. Środowisko i miejsce zamieszkania w życiu osób starszych. *Polityka Społeczna XLVIII*(11–12), 10-16. DOI: <https://doi.org/10.5604/01.3001.0015.5996> [in Polish, with English Abstract].

- Bożewicz M. 2023. Poczucie bezpieczeństwa i zagrożenia przestępczością. Komunikat z badań Nr 58, Centrum Badania Opinii Społecznej, 1-8. ISSN 2353-5822 [in Polish].
- Chandran S. Kandaswamy G. 2016. A fuzzy approach to transport optimization problem. *Optimization and Engineering* 17, 965–980, DOI: <https://doi.org/10.1007/s11081-012-9202-6>.
- Chojnacka A. 2014. Znaczenie terenów zielonych w przestrzeni publicznej oraz ich wpływ na jakość życia miejskiego. *Rynek - Społeczeństwo - Kultura* nr 1(9), 48-54 [in Polish].
- Das D. 2008. Urban quality of life: A case study of Guwahati. *Social Indicators Research* 88, 297–310, DOI: <https://doi.org/10.1007/s11205-007-9191-6>
- Jankowski K., Sosnowski J., Wiśniewska-Kadżan B., Truba M., Herda D. 2013. Organizacja wypoczynku i rekreacji na terenach zieleni miejskiej, *Zeszyty Naukowe Uniwersytetu Przyrodniczo-Humanistycznego w Siedlcach* Nr 98, Seria: Administracja i Zarządzanie 25, 14-21 [in Polish].
- Jaszek M. 2022. Współczesne funkcje miejskich terenów nadrzecznych, w kontekście zrównoważonego rozwoju w architekturze, na przykładzie Wyspy Młyńskiej w Bydgoszczy. *Builder* 3(298), 48-53, DOI: <https://doi.org/10.5604/01.3001.0015.7365> [in Polish with English Abstract].
- Jerschina J., Lesińska E., Pytliński Ł., Siwek H. 2012. Badania poczucia bezpieczeństwa mieszkańców Prądnika Czerwonego w Krakowie ze szczególnym uwzględnieniem wpływu zmian architektonicznych i technicznych na poziom lęku przed przestępczością [In:] Czapska J. (Ed.), *Zapobieganie przestępczości przez kształtowanie przestrzeni. Teoria. Badania. Praktyka* Wydawnictwo Uniwersytetu Jagiellońskiego, Kraków, Polska 201-247. ISBN: 978-83-233-3245-9 [in Polish].
- Johnson, A. J., Glover, T. D. 2013. Understanding Urban Public Space in a Leisure Context. *Leisure Sciences*, 35(2), 190–197. DOI: <https://doi.org/10.1080/01490400.2013.761922>.
- Konior A. 2021. Zarządzanie dziedzictwem kulturowym w kontekście procesu rewitalizacji obszarów przemysłowych. Wydawnictwo Attyka, Kraków, Polska, 371, ISBN: 978-83-65644-82-4 [In Polish].
- Kurek W. (Ed.), 2007. *Turystyka*. Wydawnictwo Naukowe PWN, Warszawa, 24. ISBN: 9788301152949 [in Polish].
- Kusińska E. 2017. Kształtowanie miejskich przestrzeni publicznych zgodnie z potrzebami lokalnych społeczności. *Przestrzeń Urbanistyka Architektura* 2, 85-94, DOI: <https://doi.org/10.4467/00000000PUA.17.028.7209> [in Polish, with English Abstract].
- Mordwa S. 2016. Subiektywne poczucie zagrożenia a zachowania obronne mieszkańców Łodzi. *Acta Universitatis Lodzensis. Folia Geographica Socio-Oeconomica* 23, 151-170, DOI: <http://hdl.handle.net/11089/18740> [In Polish, with English Abstract]
- Oktay D. 2012. Urban Public Spaces and Vitality: A Socio-Spatial Analysis in the Streets of Cypriot Towns. *Procedia - Social and Behavioral Sciences* 35, 664-675, DOI: <https://doi.org/10.1016/j.sbspro.2012.02.135>.
- Perlik-Piątkowska A. 2022. Bydgoszcz nastrojowa. Wydawnictwo PEJZAŻ Stadnicki s. k., Bydgoszcz, Polska, 176, ISBN 978-83-65819-79-6 [in Polish, with English abstract].
- Rembowicz-Dziekiowska A. 2012. Kultura i działalność twórcza potencjalnym motorem rewitalizacji przestrzeni publicznych Starego Miasta w Bydgoszczy. *Problemy Rozwoju Miast* 9(4), 65-75 [in Polish, with English Abstract].
- Rupa C. K. 2015. Importance of public spaces in cities. Architectural Association Scholl of Architecture, Graduate Scholl Programs. Not publishing thesis, DOI: <https://doi.org/10.13140/RG.2.1.1656.1125>.
- Rutkowski L. 2012. *Metody i techniki sztucznej inteligencji*. Wydawnictwo Naukowe PWN, Warszawa, Polska, 464, ISBN: 978-83-01-15731-9 [in Polish].
- Sołoma L. 2002. *Metody badań socjologicznych. Wybrane zagadnienia*. Wydawnictwo Uniwersytetu Warmińsko-Mazurskiego, Olsztyn, Polska, 209, ISBN: 8372992029 [in Polish].
- Sustainable Development Goals, <http://www.un.org.pl/cell1>, (Date of access: 25.06.2024, 12.00) [in Polish].

- Wiszniowski J. 2016. Czynniki kształtujące przestrzenie publiczne. *Architectus* 2(46), 113-124, DOI: <https://doi.org/10.5277/arc160209> [in Polish, with English abstract].
- Zadeh L. 1965. Fuzzy sets. *Information and Control* 8(3), 338-353, DOI: [https://doi.org/10.1016/S0019-9958\(65\)90241-X](https://doi.org/10.1016/S0019-9958(65)90241-X)