

Perception and preferred reuse of vegetated vacant lots along main streets in a shrinking city

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Abstract

Vacant land in cities is linked to generating insecurity and urban decline. However, vegetated vacant lots offer easy opportunities for reuse and have ecological, economic, and social potential. Four medium-sized vacant lots (0,7-1,5 ha) with spontaneous vegetation located along main streets in Ostrava (Czechia) have been purposefully selected for this study. Structured interviews (n=383) were collected to assess the perception of passers-by and their reuse preferences for these lots. Structural equation models were then performed to test the effect of sociodemographic variables. This paper aims to evaluate whether vegetated vacant lots in a historic urban fabric are perceived as an asset or liability by visitors and to assess the prospects for a publicly-accepted reuse of such spaces in a shrinking Central European city. Results indicate that the selected lots are perceived ambivalently. Older visitors show a more positive perception of the vacant lots, while no significant gender differences were identified. Educated respondents visited the vegetated vacant lots less often and perceived them more negatively compared to their less educated counterparts. Policy implications are provided in the end.

Keywords: vacant lots, perception, informal green space, smart reuse

Introduction

Vacant lots in cities include unused land that has remained free of structures, land with abandoned or partially destroyed structures (Bowman and Pagano, 2000), or unused land covered with spontaneous vegetation (Newman et al., 2018). They are usually concentrated in low-income neighborhoods (Anderson and Minor, 2017; Kremer et al., 2013), however, they may also be present in shrinking city centers (Bontje, 2004; Rink and Siemund, 2016). Their perception, defined as an opinion, attitude, or impression (Botzat et al., 2016; Mathey et al., 2018) is usually negative (Hollander et al., 2009; Kim, 2016), being associated with issues of health, increased fire hazards risks, and higher incidences of crime and illegal activities (e.g., drug use), lowering community well-being, and resulting in real estate price decreases (Garvin et al., 2013; Nassauer and Raskin, 2014). Nonetheless, the literature attests that vacant lots represent a land reserve that, when reused, can have ecological, economic, and social benefits, fitting smart city development agendas (Anderson and Minor, 2017; Burkholder, 2012; Hollander and Németh, 2011; Kim, 2016).

The ecological benefits of vegetated vacant lots are derived from considering them as part of urban green infrastructure systems, improving air quality, reducing noise, carbon dioxide, and the urban heat island effect (Aram et al., 2019; Bolund and Hunhammar, 1999; Kim et al., 2018; Schilling and Logan, 2008), restoring biodiversity (e.g., Bonthoux et al., 2014; Gardiner et al., 2013; Kowarik, 2011), contributing to better ecosystem connectivity (Anderson and Minor, 2017; Herbst and Herbst, 2006), or offering flood protection (Kim et al., 2018). Economic benefits are derived when well-managed vacant lots as public or green spaces attract higher-skilled workforces seeking enhanced well-being (Power et al., 2010); building up the vacant lots can increase property prices, support further economic development (Accordino and Johnson, 2000; Anderson and Minor, 2017; Heckert and Mennis, 2012), or lower infrastructure maintenance costs through increasing urban compactness (Hudeček et al., 2019). Social benefits are derived from properly managed vacant lots that support recreation, and whose aesthetic value and biological diversity prove valuable for local communities' health and well-being (Anderson and Minor, 2017; Fuller et al., 2007), which may reduce local crime incidence (Branas et al., 2011; Hadavi et al., 2021), or that become a catalyst for community involvement and personal attachment (Németh and Langhorst, 2014). Concerning 'unattended sites with vegetation' (Kim et al.,

2018), potential reuse solutions revolve around better-maintained green spaces, community gardens (Kremer et al., 2013; Németh and Langhorst, 2014), or infill developments (Eichhorn et al., 2021). However, limiting factors in reuse projects include insufficient time and money allocated for participatory planning or the residents' negative perceptions of vacant lots (Németh and Langhorst, 2014; Padiaditi et al., 2010).

The transformation and potential reuse of vacant lots are research subjects mostly connected to shrinking cities in the USA (see e. g. Newman et al. 2018). Although some research has been started in Western or Central Europe (Bontje, 2004; Macháč et al., 2022; Mathey et al., 2018; Syrbe et al., 2021), the potential value and importance of using vacant lots as informal urban green spaces (UGS) are still not sufficiently given attention in post-socialist countries (Kronenberg et al., 2020; Sikorska et al., 2020). Particularly, in Central and Eastern Europe, there is insufficient research concerning the residents' attitudes towards (vegetated) vacant lots, and with this, a limited uptake in policymaking (Kronenberg et al., 2020).

To address some of these gaps, we hence focus on assessing the perception and preferences for the future reuse of medium-sized vegetated vacant lots in a shrinking city in Central Europe to discuss thereafter whether their presence in historical urban fabric represents an asset or a liability. Given the limited literature on the residents' attitudes towards vegetated vacant lots, we base our initial hypotheses on the research conducted on formal or informal UGS. We build on the work of Phillips et al. (2021), arguing that, besides physical characteristics, people's values, use patterns, and sociodemographic characteristics matter in ecosystem services analysis, particularly for cultural ecosystem services like recreation, personal attachment, cultural identity, or enhancing psychological well-being. Derived from similar UGS literature, participation in vacant space reuse can potentially enhance social interaction among residents (Stewart et al., 2019), and increase practical knowledge about the place (cf. Bosák et al., 2020). Analogically, one could hypothesize that more frequent visits may lead to increased personal attachment and hence to a preference for reuse types enhancing social and ecological values (e.g., increasing greenery, building community gardens, or creating children's playgrounds, etc.) over utilitarian reuses (building parking lots or retail facilities). Further literature shows that the perception of vacant lots (and of landscape in general) differs significantly among various sociodemographic groups (e.g., Liu et al., 2022; Wang and Zhao, 2017). Particularly, males vs. females show differences in the perception and valuation of ecosystem services (see Zavattaro, 2019). On the one hand, females may generally have higher safety concerns about vacant lots or UGS (Jorgensen et al., 2002; Mowen et al., 2005). On the other hand, females may tend to use UGS more actively than males for their recreational and health benefits, appreciating their naturalness more (Caula et al., 2009; Dade et al., 2020; Kaczynski et al., 2009; Ode Sang et al., 2016; Schipperijn et al., 2010).

How age affects the UGS perception and use is not straightforward. Some authors found a negative association between age and frequency of park visits (Payne et al., 2002). Others documented a positive one (Wang et al., 2021), while some (Jorgensen and Anthopoulou, 2007) did not observe any relationship. Whether youth, adults, or elderly are more tied to the locality they live in or prefer more distant places for recreation is also not agreed upon (Kaczynski et al., 2009; Kienast et al., 2012; Mowen et al., 2005). Higher education has been associated with a higher appreciation of UGS (Chen et al., 2020; Kim, 2016; Macháč et al., 2022; Syrbe et al., 2021) due to a better understanding of socio-cultural benefits (linked to informal meetings, individual creativity, spiritual purposes, etc.), and of environmental benefits (better grasping the meaning of biodiversity, water retention, microclimate regulation, etc.). However, better-educated people and also higher-income groups may tend to visit small UGS in their neighborhoods less often due to reduced leisure time or a preference for more distant places (Pescharadt et al., 2012; Wang et al., 2021). Furthermore, whether certain groups would

prioritize utilitarian rather than socio-cultural or ecological reuses has not been fully explored in the literature.

The frequency of visits and the actual UGS use (not only for transit) is usually positively associated with perceived attractiveness but not previously tested in the context of vegetated vacant lots. However, taking UGS for reference and considering the sharp distance decay in the use of UGS (Schipperijn et al., 2010), frequent visitors are likely to be the locals (Syrbe et al., 2021), usually emotionally attached to their neighborhoods and the UGS in proximity. While better-educated people would use and appreciate the availability of UGS in general (Schipperijn et al., 2010), it is not clear whether they perceive neighborhood UGS positively when having alternatives of more attractive, though more distant, UGS. In addition, Zanon et al. (2013) identified income as the most significant factor constraining park visits in the sense that high-income citizens are often constrained by a lack of time. Moreover, having children in the household appears to positively affect the frequency of use, perception, and valuation of local UGS, especially concerning females (Kaczynski et al., 2009; Phillips et al., 2021).

Considering all these untested assumptions or partly contradictory results in UGS literature, our specific analytical aims are therefore: 1) to evaluate the perception of vegetated vacant lots in the inner city of Ostrava (in Czechia); 2) to assess the preferred future reuse of vegetated vacant lots among visitors (passers-by), and 3) to particularly determine the effects of certain sociodemographic variables ('Gender', 'Age', 'Education', 'Children' and 'Income'), on the current use, perceived attractiveness, and preference for the future reuse of these lots.

As for the structure of this paper, we present below a short description of Ostrava - our case study city, followed by the methodology and research results. We then discuss the significant sociodemographic factors influencing the vacant lots' perception and preference for future reuse, highlighting our contribution to knowledge, and concluding on implications and recommendations for managing vegetated vacant lots in shrinking cities.

Contextualization: The city of Ostrava

In the Central European context, vacant lots emerged due to the demolitions of damaged buildings at the end of WWII (Musiaka et al., 2021), large renewal projects undertaken in the process of building socialist cities (e.g., Sailer-Fliege, 1999; for Ostrava, see Strakoš, 2018), or city center depopulation as an effect of the socioeconomic transition from socialism to capitalism. During socialism, urban planners aimed to equalize housing conditions for all, gradually demolishing pre-socialist urban structures and eradicating the commercial character of dwellings, which often resulted in large vacant lots in city centers (Sailer-Fliege, 1999).

Ostrava is the third-largest Czech city (approx. 280 000 inhabitants in 2021; ČSÚ, 2021), part of the country's second-biggest urban agglomeration after the capital Praha (Rumpel and Slach, 2012). It is a relatively young city located in eastern Czechia, whose main growth took place during the 19th and 20th centuries as a result of industrialization and development connected with heavy industry (metallurgy and chemical industry) and hard coal mining (Bosák et al., 2018). However, political decisions related to the urban planning directives in the late 1940s and 1950s in Ostrava led to depopulation, neglect, and even completely demolished city parts (Slach et al., 2019). Demographic causes of constant depopulation since the 1990s include low birth rates or migration, but also major economic causes, such as economic restructuring of heavy industry (Bosák et al., 2018; Ženka et al., 2021), besides highly concerning environmental pollution (Rumpel and Slach, 2012; Slach et al., 2019). Following deindustrialization and the demolition of former industrial structures, Ostrava has remained with the largest share of brownfields (8.4% of its total urban area) among Czech cities with over 100 000 inhabitants (Kunc et al., 2014). Vegetated vacant lots may be connected to similar causes (i.e.,

demolitions, unfinalized renewals, land use changes) but are not contaminated or as large as brownfields; however, they have been largely understudied in the given context.

Data and methods

Vacant lots' selection for analysis

To study citizens' attitudes towards vacant lots, we selected four medium-sized lots covered with periodically cut grass and some trees (see Fig. 1), which represent 'unattended sites, with vegetation' (as per the categorization of Kim et al., 2018). The vacant lots were selected from a database of 151 unattended sites with vegetation in the inner city of Ostrava (a result of field mapping performed by some of this paper's authors).

The four lots (Fig. 2) were selected based on the following criteria:

- 1) area size (between 0.7 and 1.5 ha), since according to Lee and Newman (2019), medium-sized vacant lots are more likely to be re-developed compared to small or large ones;
- 2) vegetation (see Fig. 1), as according to Kim et al. (2018) they have a high potential for reuse and depending on the vegetation quality, a medium to high ecological value;
- 3) proximity to main streets in the inner city, hence found in locations with a potentially higher significance and footfall;
- 4) openness (not walled or fenced), allowing for an open entrance;
- 5) no significant environmental pollution; and
- 6) no concentration of criminal activity.

Fig. 1: Studied vacant lots



Vacant lot 1



Vacant lot 2



Vacant lot 3



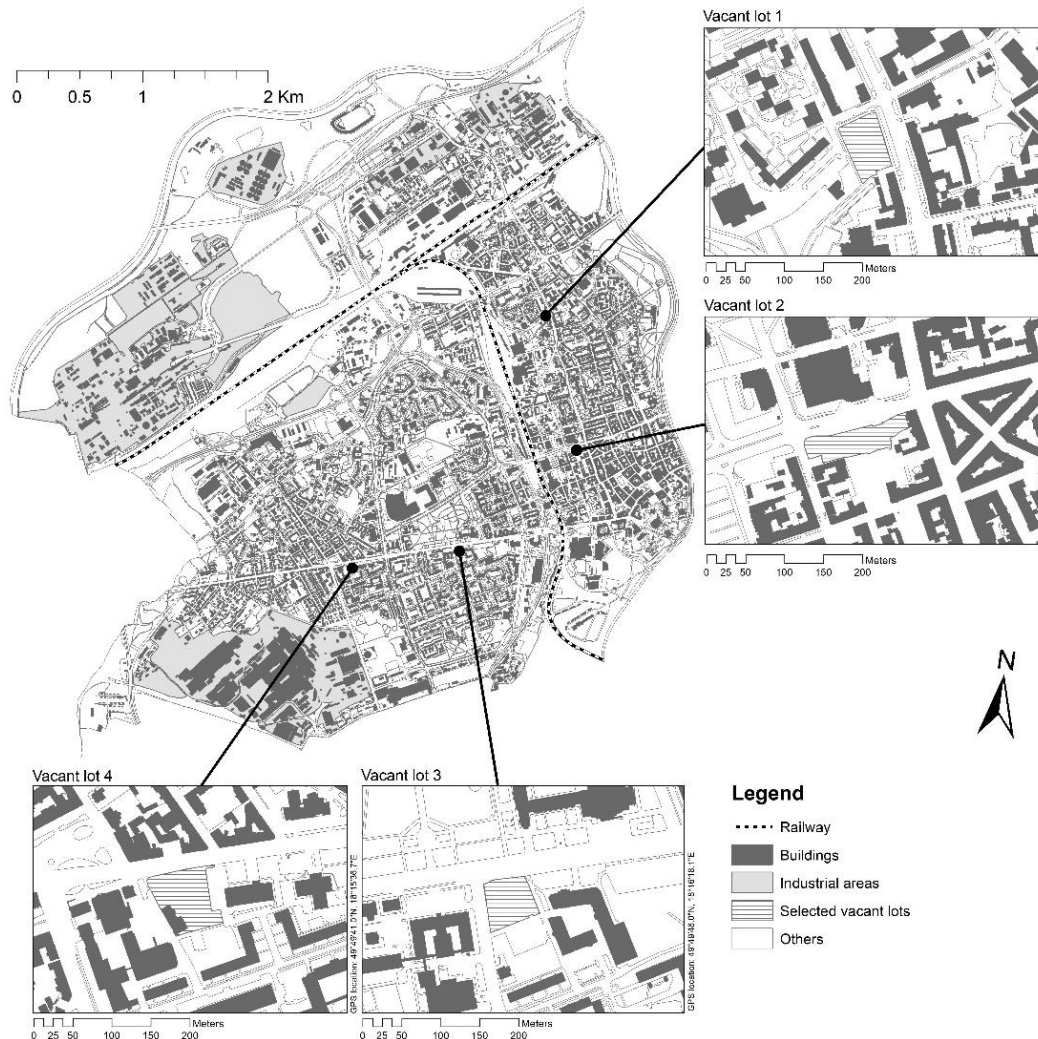
Vacant lot 4

Photo credits: The Authors

The four vacant lots are not known by any specific names. In terms of location, vacant lots 1 and 2 are flanking Nádražní Street, and vacant lots 3 and 4 are flanking 28. října Street. These two streets form historical development axes in Ostrava, hence the lots can be considered to have prime locations. Both streets feature major transport lines, including buses, trams, and 2-3 car lanes, as well as shops and/or commercial centers on both sides. The buildings surrounding these lots are mostly residential, but there are also some buildings of public interest, such as the Regional Council of the Moravian-Silesian

Region next to Lot 3, and Janáček Conservatory opposite Lot 2. Lots 1, 3, and 4 resulted from demolitions after WW2 or later during the socialist period for renewal purposes, and Lot 4 emerged as a result of road widening in 2008. They are otherwise surrounded by historic urban fabric. The four vacant lots have a medium to low potential for biodiversity and are located in areas with sufficient access to greenery (Aubrechtová et al., 2022).

Fig. 2: Location of the four selected vacant lots in the inner city of Ostrava



Source: The Authors

Data collection

Structured interviews were designed with open-ended and close-ended questions (formulated as dichotomous, multiple-choice, or scale questions), all presented in a logical order. The questions concerned how passers-by felt about these specific vacant lots and their attitude towards various reuse options.

We instructed research assistants over a 90-min lecture on how to conduct a structured interview with passers-by and provided them with accurate materials to identify the correct location of the four vacant lots. The assistants were instructed to stand near the vacant lots and approach passers-by at any hour during the daytime, resulting in a convenience sample. The interviews were conducted in person: the assistants read out loud an informed consent specifying that all answers to interviews were anonymous and confidential and that the participants were free to withdraw from the study at any time. Then, they read out loud the content and choices for each question and filled in the respondents'

	5= cultural facilities 6 = other; please specify...
Preference_greenery (answers' coding)	What type of better-maintained greenery would you prefer? 1 = green park 2 = flower meadow 3 = community garden 4 = other; please specify...
Participation	Would you be willing to participate/personally get involved in improving this place? How? 1 = financial contribution 2 = come up with new ideas 3 = participate in planting trees/flowers 4 = help with regular maintenance 5 = I am not willing to participate 6 = other; please specify...

We developed our hypotheses based on the theoretical assumptions derived from the existing literature, which are:

(for 'Perception')

- that neither females nor elderly would be seriously discouraged by safety concerns in using the four lots, considering their size, their partial or low enclosure, the low-to-zero tree density, and the thin grass (see also Jorgensen et al., 2002).
- that females and older respondents would appreciate more the selected vacant lots than males and younger respondents according to the wider gender and age-related literature on UGS, in addition to considering the insignificant age differences linked to the fear of crime in urban woodlands (Hegetschweiler et al., 2022; Jorgensen and Anthopoulou, 2007; Kaczynski et al., 2009; Ode Sang et al., 2016; Schipperijn et al., 2010).
- an expected positive association between the education level and the vacant lots' perceived attractiveness (considering insights provided by Schipperijn et al., 2010, Chen et al., 2020, Syrbe et al., 2021; Macháč et al., 2022)
- an increase in perceived attractiveness associated with an increased frequency of visits and usage of vacant lots for recreational or social activities (e.g. rather than just as a shortcut), based on the UGS valuation of Chen et al. (2020) linked to environmental/health benefits.

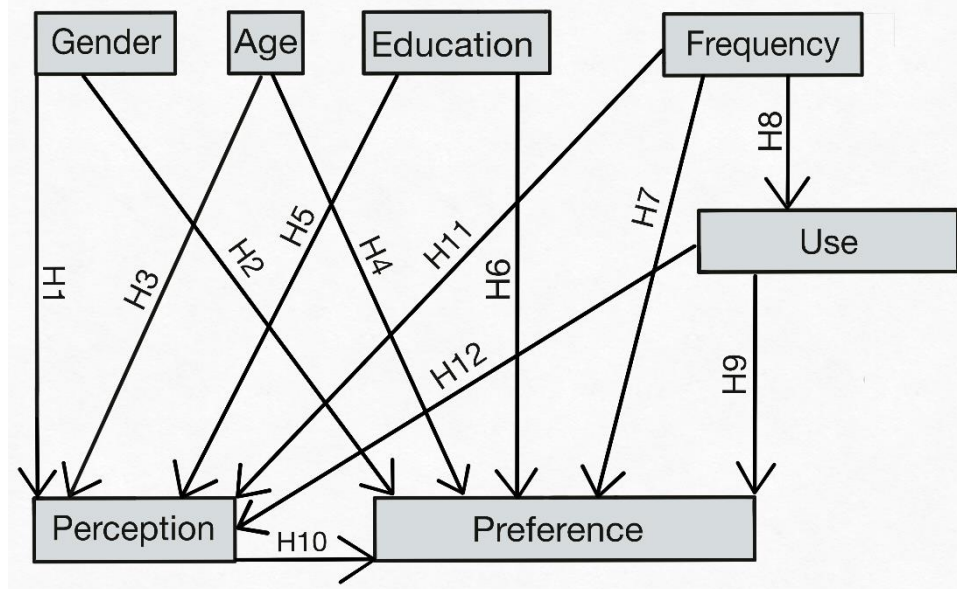
(for 'Preference')

- that people perceiving the vacant lots as attractive would prefer keeping them unchanged. Respondents who consider them unattractive are expected to prefer building the lots up, while respondents considering them of medium attractiveness might prefer better-maintained greenery. Overall, respondents who would likely perceive the vacant lots as more attractive (females, the elderly, the better educated, and frequent visitors) are expected to prefer keeping the lots unchanged or with better-maintained greenery rather than building them up.

In the hypotheses formulation, we hence expect direct effects of 'Gender' (H₁), 'Age' (H₃), and 'Education' (H₅) on the 'Perception' of vacant lots (Fig. 3). We also expect direct effects of 'Gender' (H₂), 'Age' (H₄), and 'Education' (H₆) on respondents' preferences for the lots' future use. The effects of these sociodemographic variables on 'Preference' are also assumed to be mediated by the 'Perception' of the lot's attractiveness (H₁₀). While we hypothesized the effects of 'Gender', 'Age', and 'Education' and included them in the initial structural equation models, (having) 'Children' and 'Income' were considered supplementary variables. The variable 'Children' was then omitted from the models

because it yielded no significant results (see Table 3). The variable 'Income' was excluded to avoid multicollinearity issues.

Fig. 3: Hypotheses formulation



Correspondingly, the current 'Use' of the lot has direct effects on 'Perception' (of the lot's attractiveness) (H₁₂) and 'Preference' (for its future reuse) (H₉). The 'Frequency' of visits would affect the 'Perception' (H₁₁) and 'Preference' (H₇) directly and indirectly - i.e., mediated by the current 'Use' of the lot (H₉).

All descriptive statistics were performed in SPSS (v. 23). Structural equation models were computed in SPSS Amos (v. 28). In the first step, we constructed a variable 'Perception', calculated as an arithmetic mean of the nine dimensions assessed through semantic differential scale (see Tab. 1). Reliability was tested using MacDonal's omega ($\omega=0.788$). The Kolmogorov-Smirnov test showed that the distribution of the variable 'Perception' is very close to normality, allowing us to use parametrical statistical tests. Frequencies were calculated for each variable of interest (Tab. 2), for the four lots altogether.

We tested the effects of socio-demographic indicators on the perceived lot attractiveness, current use, preference for potential changes in the lots' functions (including the type of greenery and built-up areas), and willingness to participate in the lot improvement or reuse (the variables 'Perception', 'Use', 'Preference', 'Preference_greenery', 'Preference_buildings', 'Participation', Tab. 1). To estimate the effects of the variables 'Gender' and 'Children' on 'Perception', we used an Independent Samples T-test (Tab. 3). The ANOVA test was performed to measure an association of 'Perception' with the variables 'Age', 'Education', and 'Income'. Finally, an association between the sociodemographic indicators and the remaining dependent variables ('Use', 'Preference', 'Preference_greenery', 'Preference_build', 'Participation') was measured using Cramer V, calculated from crosstabs.

In the next step, we aimed to explain the selected dependent variables ('Preference', 'Perception') in structural equation models (SEM). While it would be possible to employ only a single model, we decided to run two models: the first for estimation of 'Preference' only, and the second for 'Perception'. 'Preference' as a categorical dependent variable requires Bayesian estimation, which is the primary

reason why we ran a model estimating the 'Perception' separately. Besides, only one model would be too complex and difficult to interpret for an overview of results. In Model 1 (Fig. 6) we tested the direct effects of 'Gender', 'Age', 'Education', 'Frequency', and 'Use' on 'Perception', using a SEM with the Maximum Likelihood estimation.

Model 2 (Fig. 7) tested the direct effects of 'Gender', 'Age', 'Education', 'Frequency', 'Use', and 'Perception' and the mediation effects of 'Perception' and 'Use' on 'Preference'. 'Preference' was transformed into three dichotomous dummy variables. Statistical tests showed non-significant differences among the respondents' preferences to keep the lot unchanged or to improve the greenery. The respondents who preferred to develop the place differed in their sociodemographic characteristics from the respondents who wished to keep the lot unchanged or with better-maintained greenery. Therefore, the respondent's 'Preference' to develop the lot was selected as a dummy dependent variable in Model 2. To estimate the effects of the above-mentioned predictors, Markov Chain Monte Carlo (MCMC) estimation was used.

Finally, we also considered the possibility that 'Perception' and 'Preference' might differ among the four selected vacant lots. All statistical tests in Table 3 were conducted not only for the entire sample of 383 respondents from all four vacant lots but also for each lot separately. Differences in the overall perceived attractiveness of vacant lots were tested with ANOVA. As a side note, a high share of missing values did not allow us to run regression models with 'Preference_greenery' and 'Participation' as dependent variables.

Results

Altogether, 383 structured interviews have been considered valid and included in statistical analyses (44 from Lot 1, 107 from Lot 2, 96 from Lot 3, and 136 from Lot 4); descriptive statistics are presented in Tab 2. Lots 1 and 3 are generally less frequented by people, which is the primary reason for the lower responses associated with these lots. Males and females have nearly equal representation. 58% of all respondents were young (18-34 years old). More than 80% of respondents had either secondary (vocational or with A-level exam) or tertiary education, which corresponds to the sociodemographic structure of the city center and the inner city of Ostrava. Over half of the respondents used the lots as a shortcut. 37% reported "other use", and of these, 54.7% stated they did not use the lots at all. Therefore, the analyzed vacant lots are used rather rarely for sports, cultural, social, or other activities. Concerning their preferences, 56.9% of respondents would prefer better-maintained greenery, and 10.4% would keep the lot unchanged. When asked about their preference for different types of greenery, almost 40% would prefer a park; significantly less popular options were the flower meadows or community gardens. A relatively high share of respondents (32.6%) suggested building up the vacant lots, and the most preferred functions were parking lots, shops, and services. 57.4% of respondents were not willing to actively participate in the lot reuse or improvement. Those willingly preferred contributing with ideas or planting trees.

Tab. 2: Descriptive statistics to structured interviews (n=383)

	Frequency	Share (%)
<i>Gender</i>		
male	193	50.4
female	190	49.6
<i>Age</i>		
18-24	127	33.2
25-34	95	24.8
35-44	58	15.1
45-54	41	10.7
55-64	33	8.6
65+	29	7.6

<i>Education</i>		
elementary	31	8.1
secondary (vocational)	39	10.2
secondary (with A-level exam)	182	47.5
tertiary	131	34.2
<i>Children</i>		
having children	141	36.8
not having children	242	63.2
<i>Income</i>		
<14,600 CZK ¹	107	27.9
14,600-34,000 CZK ¹	141	36.8
>34,000 CZK	50	13.1
no answer-	85	22.2
<i>Use</i>		
shortcut	203	53.0
sport activities	17	4.4
walking a dog	21	5.5
other	142	37.1
<i>Place preference</i>		
keep the place unchanged	40	10.4
better maintained greenery	218	56.9
build-up	125	32.6
<i>Greenery</i>		
park	148	38.6
flower meadow	35	9.1
community garden	24	6.3
other	13	3.4
no answer	160	41.8
<i>Building up the place</i>		
parking lot	35	9.1
children playground	12	3.1
flats	20	5.2
shops and services	34	8.9
cultural facilities	18	4.7
other	9	2.3
no answer	255	66.6
<i>Willingness to participate in reuse</i>		
financial contribution	8	2.1
provide ideas	76	19.8
take part in planting trees/other greenery	57	14.9
regular maintenance	16	4.2
not willing to participate	220	57.4
other	6	1.6

Note: ¹14,600 CZK corresponds to the minimum wage, and 34,000 CZK to the mean wage in Czechia at the time of data collection.

The association between sociodemographic predictors and dependent variables is presented below (Tab. 3). The variable of having 'Children' showed no significant relationship with any dependent variable. The variable 'Preference_build' showed an association only with 'Income': higher-income respondents showed a higher preference for reusing the sites for car parking or building flats. The variable 'Perception' was associated with 'Age', 'Education', and 'Income', of which 'Education' shows the strongest association. Respondents over 65 years old considered the vacant lots more attractive compared to the rest (Fig. 4), while no major differences between responses of those aged 18-24, 25-34, 35-44, 45-54, and 55-64 years old were recorded. The higher the formal education, the more negative the perception of the lot's attractiveness was found. Correspondingly, respondents with higher income view vacant lots slightly more negatively than those with lower income.

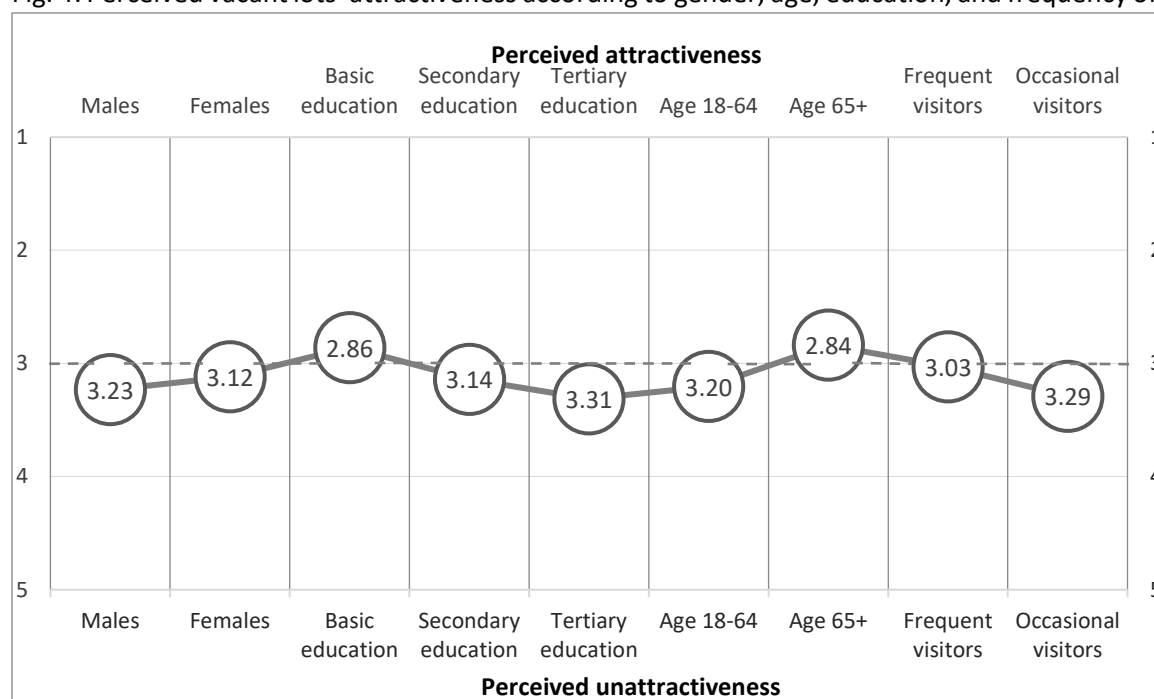
Tab. 3: Effects of sociodemographic and mediating variables on the dependent variables of 'Perception', 'Use', 'Greenery', 'Buildings', and 'Participation'

Predictor	Dependent variable in the statistical test	Statistical test	Results	P-value/Approx. Sig.	Summary
Gender	Perception	Independent-Samples T-test	t=1.587	0.113	Males consider vacant lots slightly less attractive than females do.
	Use	Cramer V	0.046	0.847	not significant
	Preference		0.126	0.047	Females show a higher preference for better-maintained greenery compared to males.
	Preference_greenery		0.225	<0.001	Females show a higher preference for community gardens compared to males.
	Preference_build		0.162	0.124	not significant
	Participation		0.215	0.003	Females were more willing to physically participate in improvements than males were.
Age	Perception	ANOVA	F=3.037	0.011	The elderly people consider vacant lots more attractive than younger people do.
	Use	Cramer V	0.128	0.218	not significant
	Preference		0.128	0.248	not significant
	Preference_greenery		0.105	0.664	not significant
	Preference_build		0.119	.0610	not significant
	Participation		0.110	0.559	not significant
	Education		Perception	ANOVA	F=4.191
	Use	Cramer V	0.120	0.057	Better-educated respondents use the vacant lots less often or not at all.
	Preference		0.161	0.003	Better-educated respondents show a higher preference for building up the site, while the less educated preferred keeping the site unchanged.
	Preference_greenery		0.098	0.529	not significant
	Preference_build		0.135	0.284	not significant
	Participation		0.162	0.012	Better-educated respondents are more willing to participate in vacant lots' maintenance or development.
	Children		Perception	Independent-Samples T-test	t= -0.703
	Use	Cramer V	0.078	0.510	not significant
	Preference		0.041	0.720	not significant
	Preference_greenery		0.035	0.977	not significant
	Preference_build		0.090	0.792	not significant
	Participation		0.061	0.923	not significant
	Income		Perception	ANOVA	F=3.534
	Use	Cramer V	0.136	0.012	Higher-income respondents use the vacant lots less often or not at all.
	Preference		0.120	0.086	Higher-income respondents show a higher preference for building up the lots compared to the lower-income ones.
	Preference_greenery		0.134	0.057	Lower-income respondents show a higher preference for community gardens and flower meadows compared to the higher-income respondents.
	Preference_build		0.153	0.078	Higher-income respondents show a higher preference for reusing the sites as parking lots or flats compared to the lower-income respondents.
	Participation		0.112	0.491	not significant
	Frequency		Perception	ANOVA	F=2.845
	Use	Cramer V	0.183	<0.001	Frequent visitors use the vacant lots mainly as a shortcut.
	Preference		0.129	0.120	Frequent visitors show a higher preference for better-maintained greenery compared to less frequent visitors.
	Use		Perception	ANOVA	F=7.144
	Preference	Cramer V	0.122	0.077	Respondents using the vacant lots for walking a dog prefer better-maintained greenery compared to those using the lots for other purposes.

Perception	Preference	ANOVA	17.853	<0.001	Respondents preferring building up the place up consider the vacant lot less attractive than those with other preferences.
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The current 'Use' of vacant lots is related to 'Education' and 'Income'. Better-educated and higher-income respondents often reported not using the vacant lots nearly at all, while the less educated/lower-income respondents used them more frequently as a shortcut or for walking dogs. The 'Preference' for the lot's future reuse is associated with 'Gender': females preferred better-maintained greenery, while men preferred more frequently keeping the lot unchanged or building it up.

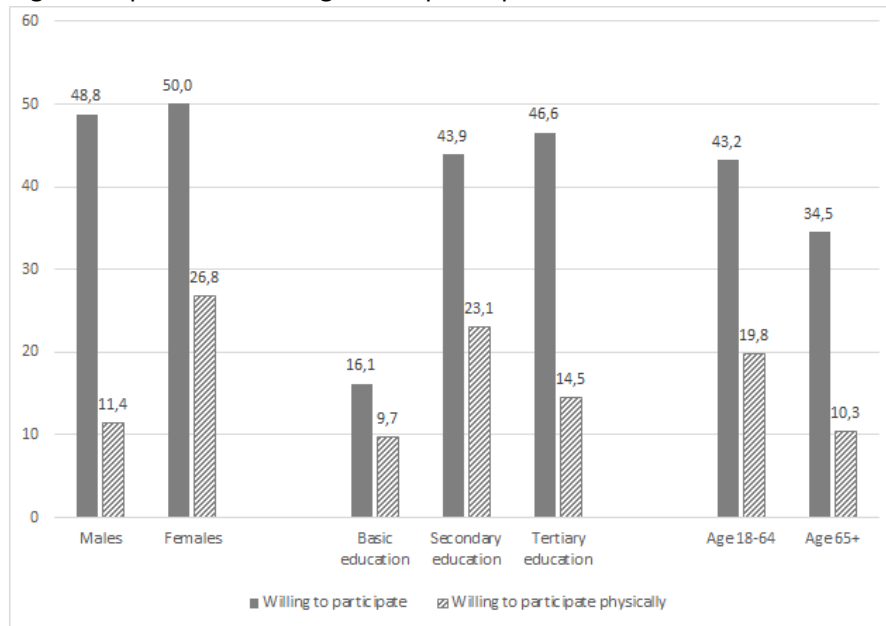
Fig. 4: Perceived vacant lots' attractiveness according to gender, age, education, and frequency of visits



Note: Frequent visitors are those visiting the vacant lots at least once a week; the others are considered to be occasional visitors; Perception ranges from 1 (maximal) to 5 (minimal perceived attractiveness).

The better-educated respondents suggested building the lots up, while the lower-educated preferred keeping the lot unchanged. Despite initial expectations, the respondents with tertiary education showed no significant preference for better-maintained greenery. Concerning the willingness to participate in preparing the lots for reuse (Fig. 5), the differences between females and males were small, but slightly higher differences emerged between the better-educated compared to the less-educated. Females were particularly more eager to participate physically in planting trees and in regular maintenance than males.

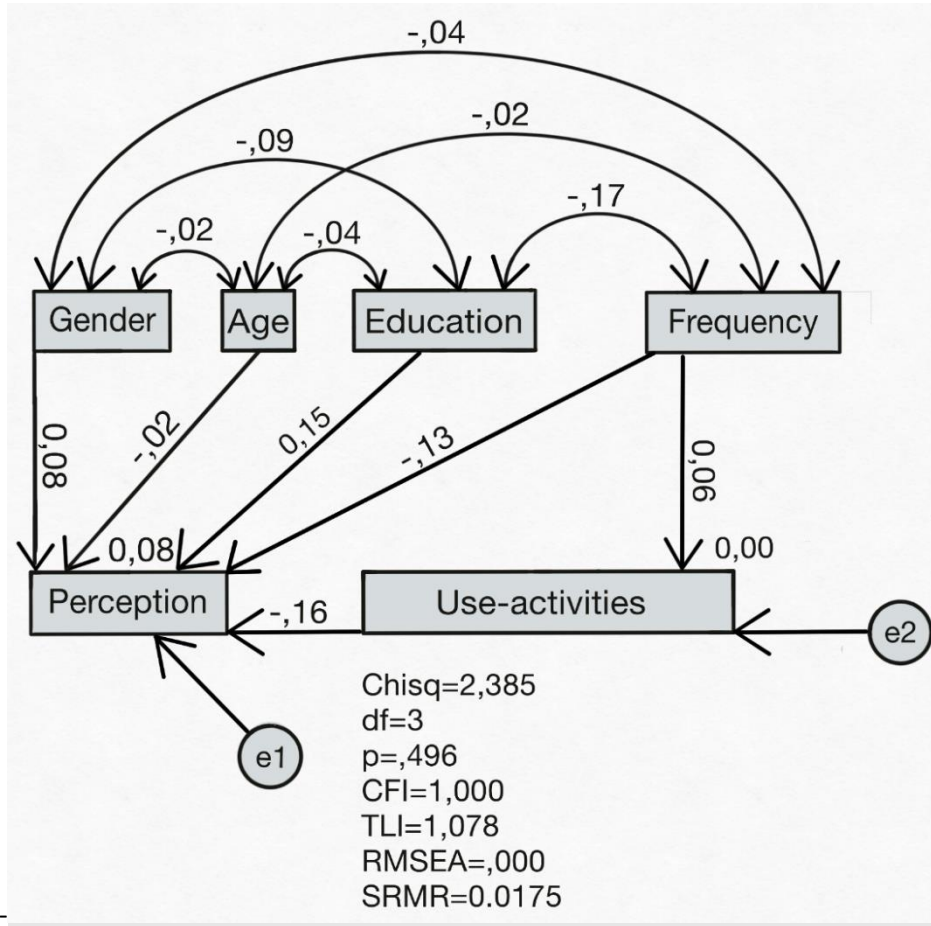
Fig. 5: Respondents' willingness to participate in vacant lots' maintenance, reuse or development



Note: 'Willing to participate' refers to any kind of participation (including financial donation or brainstorming); while the category 'Willing to participate physically' refers to tree planting, regular maintenance, and other physical activities.

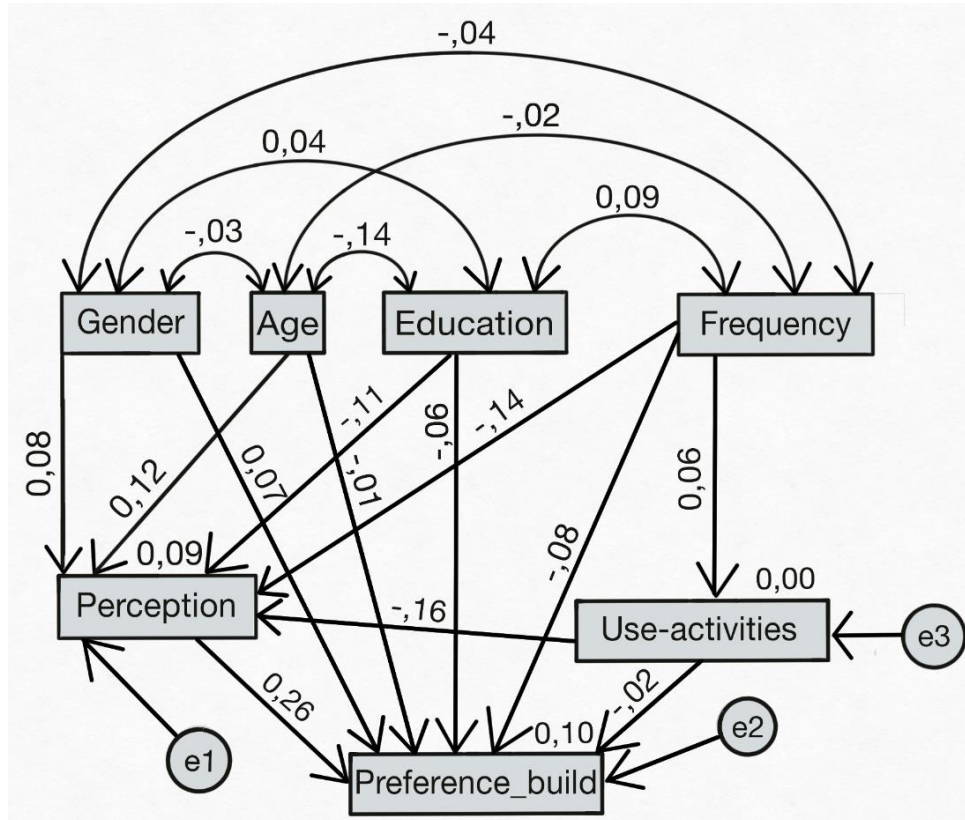
We next aimed to estimate the hypothesized effects of the 'Use', 'Frequency' (recoded as a dummy variable, value 1 given for high frequency), and of sociodemographic predictors on the 'Perception' variable (Fig. 6). Model 1 shows standardized regression estimates, and we listed the Goodness-of-Fit indicators below. While the effects of 'Age' were negligible, 'Use' and 'Education' were the key predictors. Respondents who use the vacant lots for some activities like sports or walking a dog view the lots more positively than respondents who use them only as a shortcut. Frequent visitors view the lots as more attractive compared to occasional visitors (an average of 3.29 for those visiting the place several times annually compared to 3.03 for those visiting them at least twice a week). In addition, 'Use' mediate the effects of 'Frequency' on 'Perception'. There are no major gender differences, but males view the selected vacant lots as slightly less attractive than females (mean score 3.23 for males; 3.12 for females). The effects of predictors (except for 'Age') are statistically significant but weak (R^2 of Model 1 is 0.08).

Fig. 6: SEM with 'Perception' as a dependent variable (Model 1; ML Estimation)



Finally, while in the first model we used 'Perception' as a dependent variable, in the second model (Fig. 7), employing the Bayesian MCMC estimation, we tested standardized direct and indirect effects of predictors on 'Preference'. The 'Perception' showed by far the strongest (positive) direct standardized effect (0.263), meaning that respondents who considered the vacant lot as less attractive showed a higher preference to develop (build up) the lot compared to respondents that perceived them more positively.

Fig. 7: SEM with 'Preference' as a dependent variable (Model 2; MCMC estimation)



Males and occasional visitors prefer building the lot up more often than females and frequent visitors, respectively. Younger and better-educated respondents indicated a higher preference for lot development compared to the elderly and the less educated, who preferred keeping the lot unchanged. The indirect effects of all variables are very weak, working in the same direction as the direct effect. People who use the vacant lot for some activity (sports, walking a dog) prefer more often to keep the lot unchanged or with better-maintained greenery.

Finally, we found minor but statistically significant differences in 'Perception' among the four selected lots: Lot 2 was viewed as the least attractive (mean score of 3.52), while Lot 3 was the most attractive (mean score of 2.81). These results probably reflect the aesthetic quality of the vacant lots rather than the socioeconomic status of surrounding neighborhoods. While Lot 2 is located very close to the city center and Lot 3 in a less attractive location, Lot 3 is more aesthetically pleasing in itself (Fig. 1). More importantly, statistical tests conducted separately for each vacant lot showed no significant and systematic differences in the effects of predictors on the dependent variables.

Discussion

We started from the assumptions that frequent visits may give rise to personal attachment, practical knowledge of the lot, and reuse preferences that enhance social and ecological values over utilitarian reuses; and that frequent visitors would be more willing to participate in the reuse and improvement of the selected lots. These assumptions were supported by some findings (although statistically non-significant), e.g., that less frequent visitors would more likely agree with building up the lots (Tab. 3; Model 2), since there are no direct benefits to them from the current state of the lots. Additionally, respondents with more frequent visits (at least twice a week, or once/several times per month) perceived the lots as more attractive (Tab. 3, Tab. 4), and were more willing to participate in the reuse

process compared to less frequent visitors. This corresponds with the conclusion of Chen et al. (2020) that visit frequency correlates positively with the valuation and willingness to pay for UGS. Furthermore, females were more willing to participate in the vacant lot improvement than males (corroborating Caula et al., 2009). Similarly to the effect of frequency, more intensive uses of lots (e.g. for sports) increased perceived attractiveness. It seems our initial assumption that frequent visits may give rise to personal attachment, practical knowledge of the lot, and reuse preferences that enhance social and ecological values over utilitarian reuses was valid.

Tab. 4: Hypotheses testing summary and decisions

hypothesis number	hypothesis scheme	empirical support for the hypothesis ($\alpha=0,05$)	statistical significance (p-value)	summary
H ₁	Gender → Perception	No	0.113	Minor gender differences in 'Perception'
H ₂	Gender → Preference	Yes	0.047	Females prefer greenery; men prefer building the lots up.
H ₃	Age → Perception	Yes	0.011	Younger people view vacant lots less attractive than other respondents.
H ₄	Age → Preference	No	0.248	No significant relationship
H ₅	Education → Perception	Yes	0.006	Better-educated people perceive vacant lots less positively.
H ₆	Education → Preference	Yes	0.003	Better educated people prefer to build up the vacant lots.
H ₇	Frequency → Preference	No	0.120	Frequency of visits increases the preference for better-maintained greenery.
H ₈	Frequency → Use	Yes	<0.001	Frequent visitors use the lots mainly as shortcuts.
H ₉	Use → Preference	No	0.077	Respondents using the vacant lots for walking a dog prefer better-maintained greenery compared to those using the lots for other purposes.
H ₁₀	Perception → Preference	Yes	<0.001	Respondents who consider the vacant lots attractive prefer less often to build them up.
H ₁₁	Frequency → Perception	Yes	0.024	Frequent visitors perceive vacant lots more positively.
H ₁₂	Use → Perception	Yes	<0.001	Respondents using the sites for sports view them as more attractive than those using them for other purposes.

Note: Tab 4 is a summary of Tab 3.

Surprisingly, minor (and statistically non-significant) differences between males' and females' perceptions of the four vegetated vacant lots (Tab. 3) correspond neither with the assumption that females would perceive them more negatively due to safety concerns (Jorgensen et al., 2002; Mowen et al., 2005) nor with previous findings that females appreciate and use UGS more often than males

(e.g., Kaczynski et al., 2009; Ode Sang et al., 2016). The former may be explained by a relatively high frequency of (pedestrian) traffic around the selected vacant lots, their openness, visibility, and rather safe locations, while the latter can probably be explained by their lower aesthetic quality and maintenance. Significant gender differences were found in respondents' preferences: males preferred keeping the place unchanged or building it up. Females were more interested in (better maintained) greenery, which corresponds with previous conclusions of Ode Sang et al. (2016) or Caula et al. (2009). We found no significant age effects on '*Frequency*', '*Use*' (unlike Wang et al., 2021), and '*Preference*'; only '*Perception*' was associated with '*Age*' (Tab. 3; Model 1). The elderly (65+) showed a more positive perception of vegetated vacant lots (Tab. 3). This corresponds with previous findings of a highly positive and active attitude of older adults toward UGS, especially for older females (Ode Sang et al., 2016). On the other hand, Macintyre et al. (2019) argued that small UGS are unlikely to increase the well-being of older adults, who prefer larger parks. These findings are not necessarily in contrast: while the elderly prefer larger urban parks, those living close to spontaneously vegetated vacant lots may still appreciate the proximity to greenery. The effect may be amplified by lower levels of mobility among the elderly.

It also emerged that the current '*Use*' of vacant lots is related especially to '*Education*' (Tab. 3). Although it was previously found that higher education is associated with a higher appreciation of UGS in general (e.g. Macháč et al., 2022), we found that better-educated respondents were most often not using the vacant lots at all (in line with Peschardt et al., 2012 or Wang et al., 2021), while the less educated used the lots primarily as a shortcut or for walking dogs. The available literature shows that vacant lots are used by those living in the area, indicating an everyday use of informal greenery (Rupprecht, 2017; Sikorska et al., 2020) and that the less educated and lower-income residents are more likely to live in the vicinity of vacant lots (e.g., Kremer et al., 2013). Moreover, due to the informal nature of vegetated vacant lots and fewer use restrictions (compared to formal parks), vacant lots are benefitting especially the socially weak and marginalized population (Rall and Haase, 2011; Rupprecht, 2017). In other words, higher-income groups may appreciate UGS, but use formal parks more often, while low-income groups may be more dependent on the use of informal green spaces in vacant lots. Moreover, we found that over 40% of low-income respondents were willing to participate in reuse activities. Hence, there is an opportunity that participation may ensure outcomes benefitting such vulnerable groups rather than exacerbating existing inequalities (van Maasackers et al., 2020), although capacity building for the active participation of low-income residents can be further recommended (see also Kim et al., 2020). Specifically, temporary uses are considered affordable participatory solutions for administrations in shrinking cities to turn negative externalities of vacancy into positive influences on the locality (Bragaglia and Caruso, 2022; Mallach, 2012; Sikorska et al., 2020). On the other hand, among those willing to participate (41% in total), only a low share would participate financially (2%) and in regular maintenance (4%). The responsibility for such reuse expenses would lay with the local administration. Given the observed preferences for utilitarian benefits of vacant lots among higher-income groups, as well as local governments (Kronenberg et al., 2020), temporary use presents an opportunity for engaging low-income groups and thus appreciating the non-utilitarian benefits preferred by the latter group. The preference of higher-income respondents for lots' redevelopment in our study corresponds with the predominantly sought material values (Kantor and Savitch, 2005) and pro-growth orientation of urban development in shrinking cities (Rink et al., 2014), stressing the logic of "the-more-the-better" (see Zhou et al., 2022, p. 422). This direction of building up the vacant lots as soon as possible on the main streets in Ostrava has been previously stated by local policymakers (Ostrava, 2016). Our findings suggest that while letting spontaneous vegetation grow on vacant lots in shrinking cities may be an effective (or the only affordable) way to convert land from larger brownfields in the inner city or suburban areas (Butzin et al., 2006), vacant

lots with vegetation on main streets can be perceived by some as a symptom of neglect, or even urban decline.

Limitations

There are several limitations of this study: First, the validity of our results is limited to vegetated medium-sized vacant lots (our study's focus). According to our results, a significant share of passers-by perceived smaller vegetated vacant spaces as less attractive for recreation and more suitable for building them up (which might also subconsciously relate to the lots' being built previously). Under different conditions, such as in larger urban green spaces, the valuation of environmental, social, and recreational benefits could be more positive, although higher safety concerns might occur (Jorgensen and Anthopoulou, 2007). Second, it is necessary to consider the potential bias stemming from the convenience sampling. Our ability to collect data depended on people's willingness to take part to the study and answer the questions. We interviewed all those interested and willing to participate to this research; it is, however, possible that less educated visitors were underrepresented. Third, the interviews took place during a short period in the month of October. We cannot exclude the possibility that the perception of vacant lots might differ between the seasons. Fourth, through in situ interviews, we captured only the perception and preferences of in-person visitors during the data collection time. Non-visitors, who may perceive the lots differently, were thus not considered; at the same time, this allowed us to focus our study on those visitors that had some lived experience of at least passing through the sites. Fifth, we did not distinguish between respondents living closer or further from the vacant lots, and hence we cannot infer on this matter. The frequency of visits and mode of using the particular vacant lot were instead used as proxies. However, as a sharp distance decay was observed in the use of UGS (Schipperijn et al., 2010), it is unlikely that many visitors from distant neighborhoods would visit the four (not too attractive) sites. Finally, the generalizability of respondents' perceptions and preferences is limited to vegetated vacant lots on main streets in medium-sized, shrinking cities that share similar urban form and socioeconomic status as Ostrava: lower population and building densities, and high availability of urban green spaces (but often in poor condition). The valuation of vegetated vacant lots on main streets could be higher in larger and denser cities (Hossain and Zaman, 2022), that are performing better economically. Generally speaking, our results indicate that two-thirds of the passers-by preferred keeping (better maintained) greenery in place, and one-third preferred building up the sites. Nonetheless, qualitative interviews are further recommended to substantiate residents' motivations through more in-depth documented attitudes towards vegetated vacant lots.

Conclusion

This study addresses an important knowledge gap concerning the residents' attitudes towards vegetated vacant lots in shrinking cities. We specifically aimed to analyze the residents' perception and preferred reuse for vegetated vacant lots in Ostrava, a shrinking Central European city. The study was conducted via structured interviews with passers-by in four medium-sized vegetated vacant lots adjacent to main streets. First, the four vegetated vacant lots were found to be perceived ambivalently, which corresponds to the majority of visitors using them only as a shortcut. Second, concerning their future reuse, most respondents preferred keeping better-maintained greenery in place, one-third suggested building the lots up, and only 10% preferred leaving the vacant lots unchanged. Thus, better maintenance and adding street furniture would likely lead to more frequent and intensive use of greenery in vacant lots by visitors. Third, concerning specific sociodemographic variables, better-educated respondents visited the vacant lots less frequently and perceived them more negatively than the less-educated respondents. And while older respondents evaluated the vacant lots positively, no significant gender differences were observed in the respondents' perception.

Our findings have important implications for urban planning, city governance, and policymaking. It indicates that vegetated vacant lots are seen as a potential asset from the point of view of vulnerable groups but as a liability from the perspective of the better-educated residents in a shrinking city. To capitalize on vegetated vacant lots as assets, temporary uses with low costs would be a first step forward. From here, better-maintained greenery or more sophisticated reuses can be considered along with consideration for the sociodemographic profile of the area and the better integration of vacant lots within the city center fabric. This will be the primary responsibility of local authorities, but it needs to be stressed that successful reuse is only possible through more active participatory planning, particularly including those vulnerable groups (lower-income or older) that are often misrepresented in such actions, but with prominent or growing shares in populations of shrinking cities (see Rink et al., 2014).

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