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Resident's preferences for urban brownfield revitalization: Insights from two Czech cities

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Abstract:

Residents' preferences are one of the factors in deciding how brownfields should be revitalized. We compare the views of residents in a city with many brownfields (Karviná) with those in a city with only few brownfields (České Budějovice). We assessed the preferences of residents for four global regeneration alternatives (refurbishment, demolition, open space, (re)development) in three different areas of a city (city centre, inner city, city outskirts). A one percent population sample of two post-socialistic cities in the Czech Republic, was used for the comparison. Positive preferences towards brownfield regeneration were confirmed. We found spatial differences in preferences between refurbishment and demolition of brownfields in each city area: demolition was preferred for inner city brownfields whereas refurbishment was preferred in the city centre and outskirts. Differences were also identified between the two cities: residents of the brownfield rich city preferred demolition, whereas residents of the city with few brownfields preferred refurbishment. Creating new public open space, for residents′ recreation, was given a lower importance within the city centre and a higher significance in outskirts. With the support of a combined ANOVA model, significant differences in residents' preferences were found for distinct types of regeneration with regards to the cities' character, the location of brownfields within the city and residents′ proximity.

Keywords: brownfields; revitalization; recreation grounds; demolition; refurbishment; development

1. Introduction

A brownfield is a site that has been affected by the former uses of the site or surrounding land, is derelict or underused, mainly in fully or partly developed urban areas, requires intervention to bring it back to beneficial use, and may have real or perceived contamination problems (CEN, 2014). In our study, we focus on abandoned and underused, but not necessarily post-industrial or even contaminated, locations or buildings that are awaiting a new use.

Brownfields present significant social as well as environmental problems worldwide (Thornton, Franz, Edwards, Pahlen, & Nathanail, 2007), recognized by the international community (UN, 2015) and the European Union (EC, 2012). Brownfields have diverse origins, are spread throughout the land, but are particularly important topic in densely urbanized areas, especially in cities (Burinskiene, Bielinskas, Podviezko, Gurskiene, & Maliene, 2017). The level of brownfield regeneration reflects the cultural and economic maturity of a country, region, town or village as it reflects the sustainable development strategies of places (Wedding & Crawford-Brown, 2007). However, there are often conflicts of interest (Alexandrescu et al., 2017; Dair & Williams, 2006; Rizzo et al., 2015). Tools to resolve conflicts between stakeholder interests and sustainable development goals are rare (Bartke et al., 2016).

Previous studies have shown that the location of inner-city brownfields influences the type of regeneration (Bjelland, 2004; Temelova, 2007). The regeneration type may, or may not, accord with the opinions of local residents (De Sousa, 2006) and sustainability (Bleicher & Gross, 2010). However the opinions of local residents should be taken into account in planning of brownfield regeneration (Meyer & Lyons, 2000), especially where regeneration is co-funded from public funds (Rizzo et al., 2015).

This **paper assesses** the influence of three spatial factors (location of brownfields within a city; location of inhabitants within a city; cities with different amounts of brownfields) on the preferences of city dwellers for alternative types of brownfield regeneration.

2. Background and hypotheses

We will present main concepts of the issue we are dealing with and state our hypotheses in the following subsections.

2.1 Reuse of brownfields

Brownfields are often seen as barriers in the contemporary city's structure limiting an area's development (Raco & Henderson, 2006). Alternatively they could be viewed as potential sites for demolition through to retaining their current, albeit temporary, form and many options in between (Johnson, Glover, & Stewart, 2009). The most socially convenient option seems to be keeping historically valued brownfields as part of the heritage of a bygone industrial era (Berg & Stenbro, 2015). Other options are demolition and landscaping to create green spaces (De Sousa, 2003) or demolition followed by new development, a common and economically driven option (Kunc, Klusacek, Martinat, & Tonev, 2012). However brownfields in the form of abandoned areas have a cooling effect on the micro climate of a city and their redevelopment can lead to urban densification and a loss of cooling effects (Koch, Bilke, Helbig, & Schlink, 2018).

Therefore, **our first hypothesis (H1) is**: resident preferences for the four basic types of regeneration (refurbishment, demolition for development, demolition for creating green spaces, keeping the current state) are influenced by different factors.

2.2 Brownfield location within city

The variability in the level of brownfield regeneration is viewed differently in various parts of city.

The central parts of a city are often the most attractive and hence the areas where regeneration will most likely involve redeveloping brownfields for housing (Haggett, 2001). This corresponds with re-urbanisation trends in Central and Eastern Europe (CEE) countries (Buzar et al., 2007). After suburbanization (as mentioned above), the gentrification processes occurred in CEE cities (Kovacs, Wiessner, & Zischner, 2013; Marcinczak, Gentile, & Stepniak, 2013). During the late 19th and early 20th centuries industrial sites were established surrounding the city-centre. However the dynamic growth of cities during the 20th century saw them become integrated into the densely urbanised inner city (Frantal et al., 2015). Outside the inner-city (Krzysztofik, Runge, & Kantor-Pietraga, 2012) brownfields covering extensive areas emerged from various former uses, including: brick pits, quarries, transit depots, waste/sludge fields or agriculture.

Our second hypothesis (H2) is: brownfield location within a city affects residents′ preferences for alternative types of regeneration.

2.3 Spatial factors influencing attitudes of residents towards brownfields regeneration

Scholars emphasize public participation in urban planning process for redevelopment of brownfields (Bartke & Schwarze, 2015; Loures, Panagopoulos, & Burley, 2016). Particularly for the reason, that the local residents, who are the foundation of urban democracy, are affected by the redevelopment the most – especially economically (van Duijn, Rouwendal, & Boersema, 2016), socially (Simis, Awang, & Arifin, 2016) or environmentally (Doick,

Sellers, Castan-Broto, & Silverthorne, 2009). Determining residents′ preferences for regeneration alternatives is of great importance for this process (Glumac, Han, & Schaefer, 2015; Haase, Wolff, & Rink, 2018). Opinions of residents or visitors, with the exception of brownfield development into recreational grounds (Zhang & Klenosky, 2016), is mentioned rather sparsely in brownfield redevelopment literature.

In one of the research project, Loures concluded that community attitudes to brownfield regeneration projects are positive and creating multifunctional areas is the most preferred (Loures et al., 2016). While 'hard' redevelopment (i.e. some form of building or infrastructure) is preferred by the investors, 'soft' re-uses of brownfields (i.e. forms of use that do not involve substantial construction) are also sought after and are of wider environmental, social or economic value (Bardos et al., 2016). Nevertheless, any alternative of revitalisation is positively appraised by the respondents (Maliene, Wignall, & Malys, 2012), even though long-term residents can view any 'change' as a potential threat to the existing social relations (Raco, Henderson, & Bowby, 2008).

According to residents, general attributes of regeneration project should be: mobility and accessibility, use of renewable energies, environmental education, economic redevelopment, and safety/security (Loures et al., 2016). The differences in the perception of particular projects were studied on four types of dissimilar megaprojects among groups of residents coming from economically different backgrounds (rich and poor) and also from different geographical (close and far) areas in Rotterdam (Doucet, van Kempen, & van Weesep, 2011a). Spatial proximity was found to be the key factor affecting the perception of particular revitalisation project, similarly to local context (Doucet, van Kempen, & van Weesep, 2011b).

Similarly in the example of ‘industrial forests’ (which means abandoned areas of larger industrial or mining brownfields left free to secondary succession going towards reforestation of this area without removing of facilities) in Germany, Franz and colleagues points out the differences in preferences of ‚identical‘ revitalisations in a single area (Franz, Gueles, & Prey, 2008). In summary, previous studies draw attention to the location impacts as well as the proximity of residents to the revitalised brownfield and also the influence on the specific location within the city (Rink & Arndt, 2016).

Based on these findings we formulated a **third hypothesis (H3)**: place of residence affects the preferences of revitalisation alternatives in different parts of city.

2.4 Brownfields in post-socialistic cities

Brownfields are not a new phenomenon within the cityscape. It is natural that some abandoned sites and buildings appear during an economic cycle, their use no longer corresponds to the needs of the present time and place and uses are continuously replaced by more useful activities (Moss, 2003). This dynamic space utility is apparent in the history of spatial development of towns and cities (Swyngedouw, Moulaert, & Rodriguez, 2002). Specific circumstance sets in, when there is a great increase in abandoned sites in a relatively short time and small space (Ling, Handley, & Rodwell, 2007). This situation arose in CEE countries in the 1990s (Alexandrescu, Martinat, Klusacek, & Bartke, 2014; Frantal et al., 2015; Janeckova Molnarova, Skrivanova, Kalivoda, & Sklenicka, 2017; Kabai, 2017; Krzysztofik, Tkocz, Sporna, & Kantor-Pietraga, 2016; Reisinger, Kecskés, & Czakó, 2017; Van der Horst, Martinat, Navratil, Dvorak, & Chmielova, 2018) as a result in transition from a centrally planned economy into free market economy, which was followed by the collapse of number of ineffective businesses (Frantal et al., 2013). The trend was strengthened by de-

industrialisation trends across the globe as various industrial activities gradually relocated to countries with lower labour costs. Also, since the 1990s, there has been apparent strong tendencies of city residents particularly in large cities to move to the suburbs (Berkes, 2016; Maly & Mulicek, 2016). The result of these trends is, for example in the Czech Republic, the existence of more than 10 thousand unused sites that take up more than 30 thousand hectares of land (Kunc, Martinat, Tonev, & Frantal, 2014).

The distribution of these sites across the country and within individual cities is highly uneven (Frantal et al., 2013). Particular city was found to be important factor regarding perception of brownfield regeneration – the results of a comparative study between same types of brownfields in the UK and Germany (Maliene et al., 2012) showed the same direction of preferences but different levels of 'satisfaction' between cultural environments of UK and Germany. As the number and extent of brownfields varies among cities, the perception of its regeneration varies, too (Kunc et al., 2014). However, testing this differences is still missing (Martinat, Navratil, Picha, Tureckova, & Klusacek, 2017).

Thus our **fourth hypothesis (H4)** is: preferences vary between cities with different level of extent of brownfield regeneration.

2.5 Involvement with brownfield regeneration

The obstacle of brownfield regeneration preference studies is that such preferences are influenced by the residents′ involvement with brownfield regeneration (Rizzo et al., 2015). Despite authors slight disagreement on the involvement definition (Arora, 1982), involvement is usually understood in two levels such as the cognitive notion of information processing and a state of activation (Garcia, Olea, Ponsoda, & Scott, 1996). Thus, it has both affective and

cognitive faces and is related to the personal relevance of an issue (Zaichkowsky, 1986). Involvement has a motivational force, it influences information searching, processing and saving (Bauer, Sauer, & Becker, 2006). It is an important factor in decision-making and behaviour (Peattie & Peattie, 2009). It has been shown that involvement acts as a moderator among the construct of the theory of planned behaviour (Hegner, Fenko, & Teravest, 2017). Different levels of involvement though leads to different preferences. Therefore, if we were to compare preferences, **involvement consistency should firstly be tested**.

3. Material and Methods

Data necessary to comply with set target were acquired through primary research – by direct questioning – as the preferences of local residents were of our main interest for this paper. The data had to be collected to be able to study perception of different types of regeneration (= H1) and to test potential differences for those types among three categories, mentioned in literature, affecting the preference for brownfield regeneration – brownfield location within city (= H2), the place of residence of respondents (= H3), and city where the brownfield is localized (= H4). The approach is summarized in diagram (Figure 1).

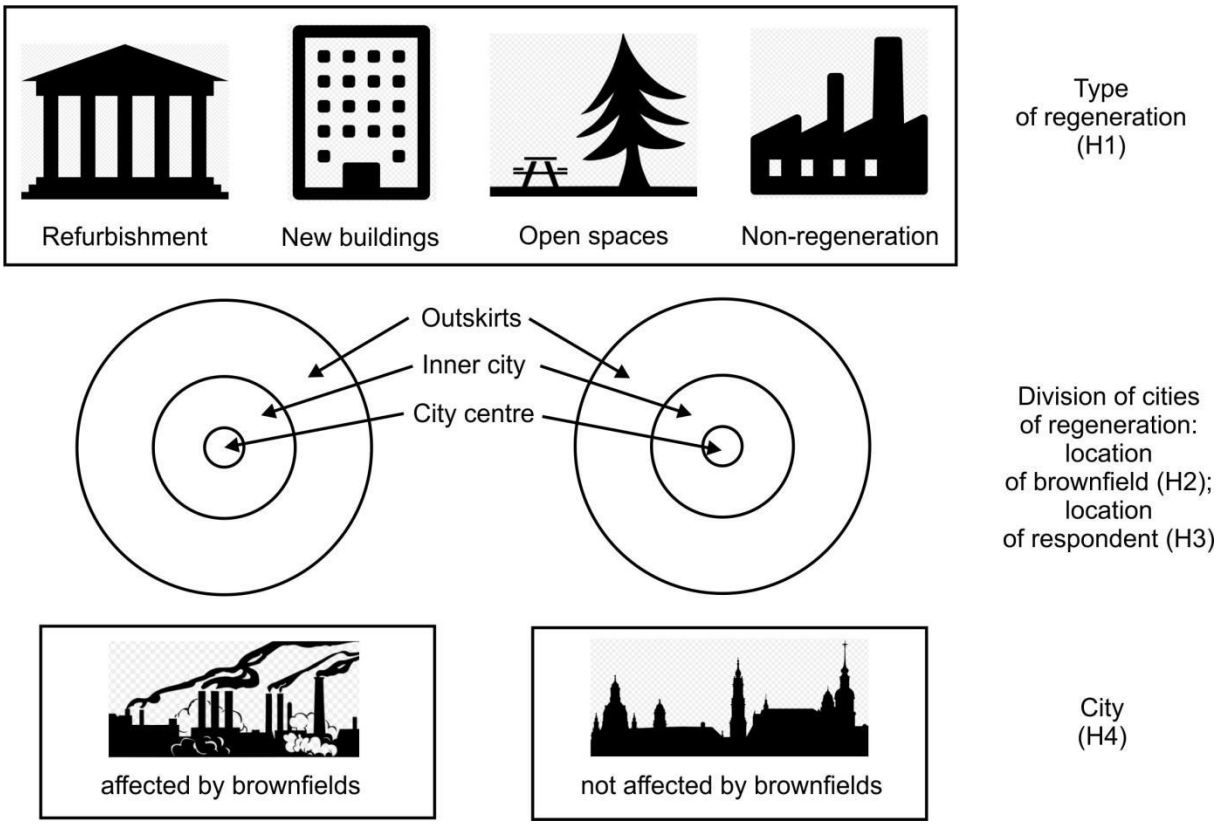

Figure 1. Conceptual visualization of tested hypotheses.

Credits: "Refurbishment" © Paris 16, CC BY-SA 4.0; "New buildings" © Dave Gandy, CC BY-SA 3.0; all other pictures are Public Domain under CC0.

3.1 Questionnaires

Questionnaires consisted of three main parts. The first was dedicated to study of **involvement** with the regeneration of brownfields. Involvement was assessed by using the standardized tool of ten bipolar adjectives measured on a 7-point scale. The revisited Personal Involvement Inventory Scale was used as its advantage is one-dimensionality as well as versatility of use (Zaichkowsky, 1994). The degree of the involvement of respondents was calculated by the mean of responses on all ten bipolar adjectives. Respondents were invited to evaluate their involvement with public financial support of abandoned brownfield sites in cities and surrounding areas.

The second part built up the main part of the questionnaire. Here, four **alternatives of brownfield regeneration (H1)** were identified from the literature (Figure 1, upper part):

- Refurbishment – in build-up areas, renovating buildings to a state close to its historical image, in cases of sites within the city structure re-cultivating them into their 'natural' state.
- Demolition and redevelopment into a new building complex – in built-up residential areas designed as homes, in other areas designed as complexes for industry and logistics use.
- Demolition and keeping open spaces – in cases of sites, demolition of administrative buildings.
- Keeping current state of brownfield with no further use.

The questions were: Do you consider the regeneration '*each alternative from the four bullet points above'* appropriate? The preferences of each brownfield regeneration option were classified for each city area separately into a four level scale of possible answers 1 = certainly not, 2 = most likely not, 3 = most likely yes, 4 = certainly yes. The question on the four regeneration alternative was used three times – for each area of the city separately (to test H2). We have the city divided into three main tapes (Figure 1, middle part):

- city centre (historical centre with the closets surroundings with block of flats going back to 19th century)
- inner city (= areas surrounding the centre, including housing estate)
- urban location on the outskirts blending into rural structures of the city

The questionnaire was completed with third part – **identification questions** of gender, age, and level of education.

3.2 Selection process of respondents

It was decided to gather a representative 1% sample of residents in each city (according to age categories, gender, and part of the city). To ensure validity of sample, a set of rules had to be applied.

The selection of respondents could not be carried out randomly but proportionally, because it is apparent from literature, that the place of residence fundamentally affects the preferred brownfield reuse (Rink & Arndt, 2016). Both cities were divided into three zones – city centre, inner city (= areas surrounding the centre, including housing estate) and urban location on the outskirts blending into rural structures of the city – this division was used to test H3 and is the same as for H2 (see section 3.1). Those zones were further broken down into smaller areas (with statistical data available = city districts). The number of residents approached in each area corresponded with the quotient of the number of residents in each selected area and the population of the city. The selection of respondents was also done by quota to correspond with the structure by gender and age categories limited to the population of 18 and above in both cities.

Questioning in each area was carried out in four randomly selected places in the city centre as well as in the inner city and two places on the outskirts (from a database of car parks and public transport network). Questioning, during work day morning and afternoon period, was carried out by trained interviewers in October and November 2015. Only the residents of each area were questioned.

3.3 Characteristics of Czech case study

Two cities (to test H4) were chosen so both would (1) come from one cultural environment – located in Czech Republic close to the borders, (2) were geographically distant – with insignificant direct links in social and economic matters, but (3) contrasted each other in the scale of brownfield regeneration challenge – first city with substantial numbers of brownfields and a small percentage of regenerated sites, the second city, with fewer brownfields and a high percentage of regenerated sites.

Karviná was chosen as the typical city from the first group. It is a regional centre in hinterlands of Ostrava (Nekolova, Hajek, & Novosak, 2016) with population of 55,000 (2017) located in the mining region in the eastern parts of the Czech Republic. Karviná has been significantly affected by heavy industry and mining during urban and social development for the last 150 years. The very recent development resulted in a massive decline in population (loss of around a third in the last three decades) and a high increase in the number of brownfields that used to provide various economic activities (mainly heavy industry and mining). Karviná is a shrinking city with many environmental problems (e.g. very high dust emissions). Karviná is known for its strong out-migration and high unemployment rate (more than 10 %; the average for the Czech Republic is circa 3 %). Coal mines, near the city, are currently still in operation, but mining should end by 2023. More than 20 brownfields are in almost all parts of the city (post-mining and agricultural brownfields are in distant locations on the outskirt of city, while post-industrial brownfields are located close to large housing estates, abandoned houses are also found within the city centre). There were several attempts to regenerate the local brownfields (e.g. Janeckuv mlyn, educational trails etc.). However, due to limited attractiveness for investors, most local brownfields are still awaiting a new use. In short, Karviná's brownfields are "C" sites using the CABERNET typology (CABERNET, 2006).

České Budějovice was chosen as representative for the second group. It is a city located in an agricultural region of South Bohemia, Czech Republic. Nowadays, it is an important economic and regional centre of South Bohemia (population of 93,500 in 2017). Business activities have been influenced by its geographical location, natural resources and surrounding agricultural production. Since the 19th century, the city has been going through a strong development of light industry (connected with agricultural production in rural surroundings and mining of graphite). Founded as a royal city, it hosted several military bases. Military development also carried on after World War II, during the communist period and throughout the regime of the centrally planned economy. Political and economic changes, after 1989, led to the end of military activities in the city and many large industrial companies closed due to the competitive market economy. Brownfields in České Budějovice comprise mostly former military sites (often very large) and abandoned industrial facilities. Brownfields on the outskirts are mostly former agricultural facilities. Several brownfields have already been successfully redeveloped into new shopping centres, administrative buildings or blocks of flats while others are being currently redeveloped. The population is stagnant. However, there is a slight out-migration to suburban areas or neighbouring villages. The unemployment rate is very low (below 3 %).

During the field research 935 respondents from České Budějovice and 559 from Karviná were asked to answer questions of our questionnaire (described in section 3.1). Refusal rate was 10.9 % in České Budějovice and 9.0 % in Karviná. Final number of collected responses was from 833 residents from České Budějovice and 497 in Karviná (Table 1).

Table 1. Demographics and socio-economic data of respondents in Karviná and České Budějovice.

	České	Karviná

		Budějovice	
n		833	497
gender	female	51.5%	53.9%
	male	48.5%	46.1%
age (mean)		42.18 years	36.65 years
education	elementary	3.6%	5.0%
	secondary	65.3%	73.6%
	tertiary	31.1%	21.3%

3.4 Statistical Analyses

First, the suitability of data was tested; it means the potential differences in the involvement between cities and among location of respondents were tested. Two-factorial ANOVA was used with city (in tables referred as ‘city ‘), location of respondent (in tables referred as ‘respondent‘), and non-additivity of city and location (in table referred as ‘respondent*city‘) as tested factors.

Then we could test the potential influence of the three factors (H2 – brownfield location, H3 – location of respondent, H4 – city) on preferences for each type of brownfield regeneration option (H1). Thus four three-factorial models were calculated – for (1) refurbishment, (2) demolition with development, (3) demolition with recreational grounds, and (4) keeping the current state. Brownfield location (H2), location of respondent (H3), and city (H4), are categorical independent variables, whereas preferences for each regeneration type are dependent variables. Hypotheses H2, H3, H4 were statistically tested for each type of regeneration type. H1 was not hypothesis for direct statistical testing – there was assessed the differences among the four models – if there was no difference, the models should identified the same factor and their combinations as statistically significant.

Combined model of factorial and repeated measures ANOVA was used to those four test. The influence of city and relevant place of residence as separate factors as well as its non-

additivity were analysed. The influence of brownfield location (in tables referred as ‘BFs-location‘) was tested within those model, too. However, it is not possible to consider the location of brownfield in all three locations as mutually independent factor because each of the respondents decided for three areas of city. Therefore this factor was used as simple repeated measure (the degrees of freedom must be lowered). The non-additivity of this factor with the two other factors (city and relevant place of residence of respondent) was also tested. The results of those separate four thee-factorial combined ANOVA models were further tested for each factor and their combinations by the Tukey post hoc test for unequal number of n.

We can summarize the statistical approach as follows:

(A) Variable used:

- independent
    - origin of respondent from the part of the city (3 levels: city centre, inner city, outskirts), in tables referred as ‘respondent‘
    - location of brownfield (3 levels: city centre, inner city, outskirts), in tables referred as ‘BFs-location‘
    - city of respondent (2 levels: Karviná, České Budějovice), in tables referred as ‘city‘
    - combinations of the three previous factors, the non-additivity of each combination is symbolized in tables as ‘*‘ sign
- dependent
    - preferences for four type of brownfield regeneration (4-point scale, each respondent evaluate each brownfield regeneration type separately)

(B) Statistical analyses:

- three-factorial combined ANOVA for each dependent variable (preference of refurbishment; preference of demolition and redevelopment into new buildings; preference of demolition and keeping open spaces; preference of brownfields non-regeneration)

(C) Reporting of results:

- tables
    - SS = sum of squares
    - d.f. = degrees of freedom
    - MS = mean square; which is the ratio between sum of squares and degrees of freedom
    - F = the value of F-test; which is the ratio between appropriate mean squares for each test
    - p = the value of statistical significance of respective value of F-test
- graphs
    - plotted are mean values with 0.95 confidence intervals of means
    - only plots where differences between factor levels by Tukey post-hoc test were found

We will report first the results of the test suitability of data and then in four sections results of the four ANOVA models calculated for (4.1) preference of refurbishment, (4.2) preference of demolition and redevelopment into new buildings, (4.3) preference of demolition and keeping open spaces, and (4.4) preference of brownfields non-regeneration.

4. Results

Personal involvement has no statistically significant differences between the two cities, between the three areas or between the areas and cities combined (Table 2).

Table 2. Testing of differences in involving among location of residence of respondents (= respondent), city of respondents and its combination. Results of factorial ANOVA.

	SS	d.f.	MS	F	p
Intercept	12,182.65	1	12,182.65	9,311.64	< 0.001
respondent	3.89	2	1.95	1.49	0.226
city	3.70	1	3.70	2.83	0.093
respondent*city	2.09	2	1.05	0.81	0.449
Error	1,732.22	1,324	1.31		

Thus, the actual results of opinion evaluation relevant to regeneration in each city, as well as its zones, are not burdened by the level of residents′ prejudice in either city.

4.1 Preference of refurbishment

Preference in building refurbishment or brownfield sites redevelopment vary between the cities and also between the occurrence of location (Table 3). In České Budějovice, the preference for refurbishment is higher than in Karviná. However, in both cases, it is very high and its average preference value reaches the fourth quartile of potentially achievable values (Figure 2, left). Higher preferences of refurbishment solution for brownfield regeneration are in city centres and in inner city structure, whereas on the outskirts, the interest in refurbishment is significantly lower. However, even here, it is relatively high and reaches above average values (Figure 2, right).

Table 3. Differences among studied variables for preference of refurbishment. Results of combined factorial and repeated measures ANOVA (respondent = residence of respondents; BFs-location = location of brownfield).

	SS	d.f.	MS	F	P
Intercept	23,799.22	1	23,799.22	16,364.2	< 0.001

respondent	4.88	2	2.44	1.68	0.187
city	21.09	1	21.09	14.50	< 0.001
respondent*city	7.86	2	3.93	2.70	0.067
Error	1,925.56	1,324	1.45		
BFs-location	64.23	2	32.12	44.71	< 0.001
BFs-location*respondent	3.25	4	0.81	1.13	0.34
BFs-location*city	3.95	2	1.98	2.75	0.064
BFs-location*respondent*city	4.33	4	1.08	1.51	0.197
Error	1,902.17	2,648	0.72		

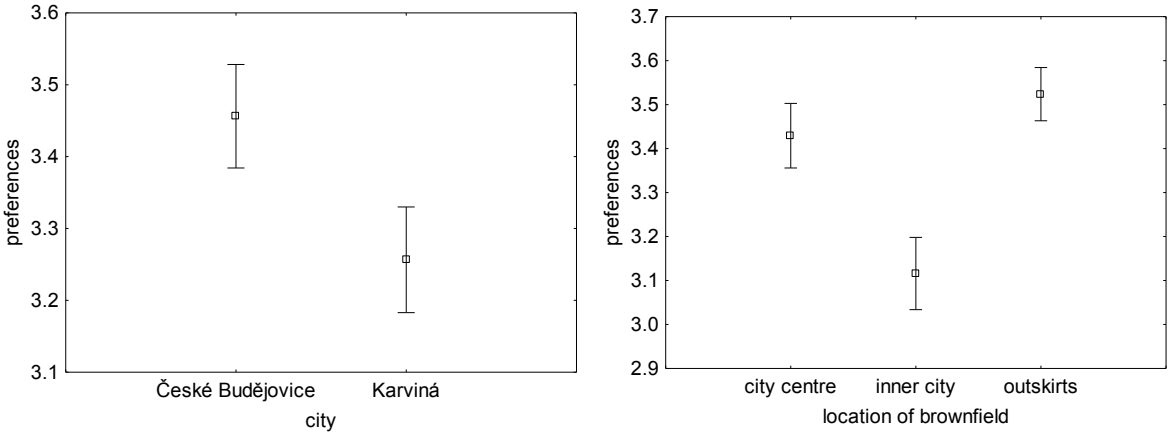

Figure 2. Preference of refurbishment in cities (left) and for location of brownfield (right). Means and 0.95 confidence intervals of responses shown (1 = certainly not preferred; 4 = certainly preferred).

4.2 Preference of demolition and redevelopment into new buildings

Preference for the demolition of derelict buildings and development of new buildings on current brownfield locations is affected by the city, city zone of questioning (respondent), location of brownfield in respective city zone (BFs-location), and a combination of the above aspects (Table 4).

Table 4. Differences among studied variables for preference of demolition and redevelopment into new buildings. Results of combined factorial and repeated measures ANOVA (respondent = residence of respondents; BFs-location = location of brownfield).

	SS	d.f.	MS	F	p
Intercept	17,445.05	1	17,445.05	9,214.028	< 0.001
Respondent	11.24	2	5.62	2.968	0.052
City	22.03	1	22.03	11.634	< 0.001
respondent*city	29.34	2	14.67	7.747	< 0.001
Error	2,506.75	1,324	1.89		
BFs-location	33.28	2	16.64	17.956	< 0.001
BFs-location*respondent	1.09	4	0.27	0.295	0.881
BFs-location*city	3.32	2	1.66	1.791	0.167
BFs-location*respondent*city	11.96	4	2.99	3.226	0.012
Error	2,453.79	2,648	0.93		

In both cities, regeneration by demolition and redevelopment was supported (Figure 3, upper left), although in both cities the support is notably different then in preferences of refurbishment (within third quartile). Karviná's respondents prefer this type of regeneration with statistically higher significance. No statistical differences between respondents place of residence and a particular area was found, although in the combination of city and place of residence of that city was – the lowest interest is in České Budějovice outskirts areas whereas in Karviná's outskirts the interest is the same as in other areas of city (Figure 3, upper left). Demolition and redevelopment is most acceptable in the inner city (Figure 3, down left). The most notable difference between the cities is respondents' preference for demolition and redevelopment increased moving away from the city centre toward the outskirts of Karviná, but decreased in České Budejovice (Figure 3, down right).

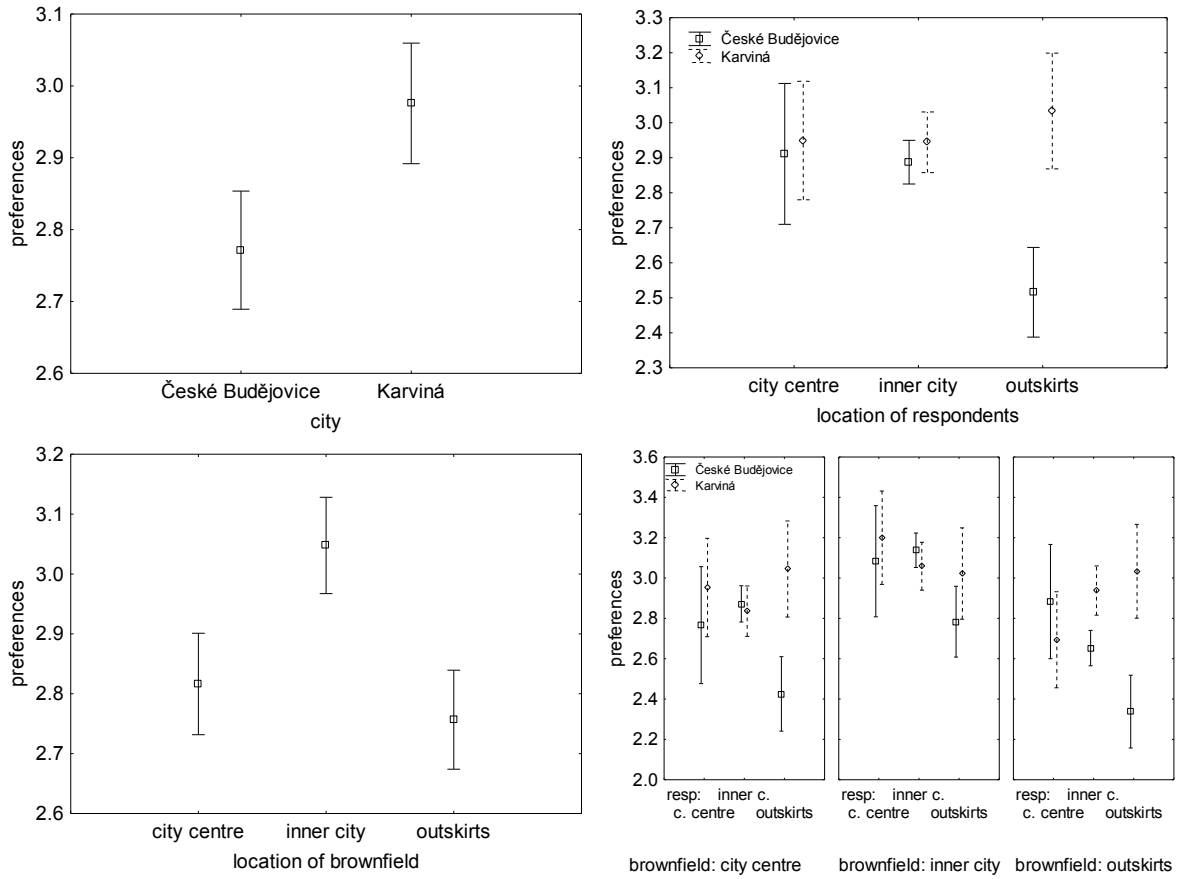

Figure 3. Preference of demolition and redevelopment into new buildings in cities (upper left), for the location of respondents between cities (upper right), for the location of brownfield (down left), and for location of respondents between cities for each location of brownfield (down right). Means and 0.95 confidence intervals of responses shown (1 = certainly not preferred; 4 = certainly preferred). Resp. = location of respondents.

4.3 Preference of demolition and keeping open spaces

Creating open spaces on former brownfields varied at first between the areas of brownfield location (Table 5). The lowest preference for open spaces is in the city centre, higher in the inner-city and the highest on the outskirts (Figure 4, left). City influence is apparent in a higher interest in the inner city and on the outskirts of České Budejovice (although, in post-hoc test there is no statistical significance, Figure 4, right). The average preference level in both cities lies in third quartile. It reaches fourth quartile only in the locations of the outskirts.

Table 5. Differences among studied variables for preference of demolition and keeping open spaces. Results of combined factorial and repeated measures ANOVA (respondent = residence of respondents; BFs-location = location of brownfield).

	SS	d.f.	MS	F	p
Intercept	19,083.33	1	19,083.33	12,874.96	< 0.001
respondent	3.56	2	1.78	1.2	0.301
city	5.11	1	5.11	3.45	0.064
respondent*city	1.79	2	0.89	0.6	0.547
Error	1,962.44	1,324	1.48		
BFs-location	214.53	2	107.26	119.55	< 0.001
BFs-location*respondent	0.64	4	0.16	0.18	0.95
BFs-location*city	7.12	2	3.56	3.97	0.019
BFs-location*respondent*city	6.14	4	1.54	1.71	0.145
Error	2,375.84	2,648	0.9		

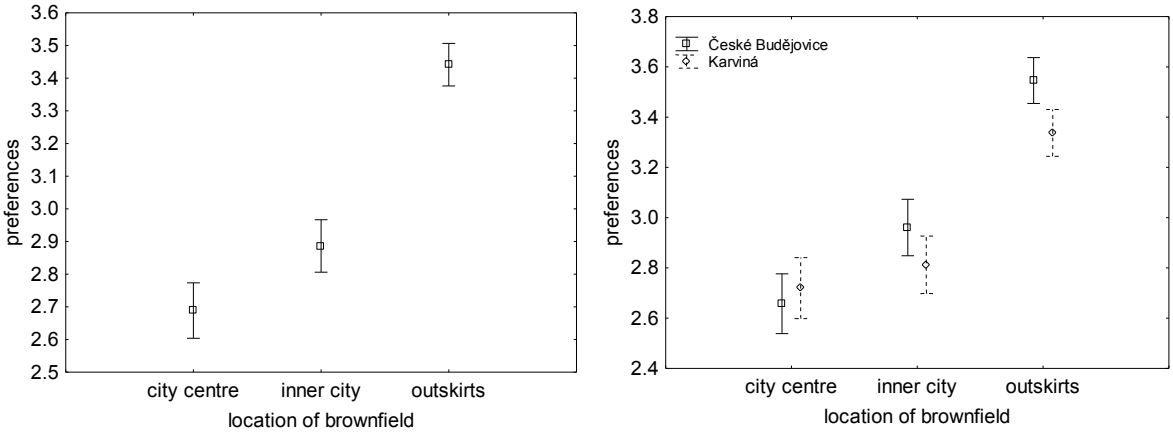

Figure 4. Preference of demolition and keeping open spaces for the location of brownfield (left) and for location of brownfield between cities (right). Means and 0.95 confidence intervals of responses shown (1 = certainly not preferred; 4 = certainly preferred).

4.4 Preference of brownfields non-regeneration

The preferences of keeping the current state of brownfields are low – in each city staying in first quartile and have mutually no statistical difference (Table 6). Even though in the selected factors, there are some apparent differences. Lower is the preference in keeping current state within the city layout (city-centre and inner-city) then on the outskirts (Figure 5, left). The

tendencies have a statistical significance in České Budějovice, whereas there are no significant differences in Karviná (Figure 5, right).

Table 6. Differences among studied variables for preference of brownfields non-regeneration. Results of combined factorial and repeated measures ANOVA (respondent = residence of respondents; BFs-location = location of brownfield).

	SS	d.f.	MS	F	p
Intercept	5,798.92	1	5,798.92	3,184.37	< 0.001
respondent	3.66	2	1.83	1.01	0.367
city	0.51	1	0.51	0.28	0.596
respondent*city	11.57	2	5.79	3.18	0.042
Error	2,411.08	1324	1.82		
BFs-location	8.91	2	4.45	8.48	< 0.001
BFs-location*respondent	2.06	4	0.52	0.98	0.416
BFs-location*city	9.29	2	4.65	8.85	< 0.001
BFs-location*respondent*city	2.02	4	0.51	0.96	0.428
Error	1,390.63	2,648	0.53		

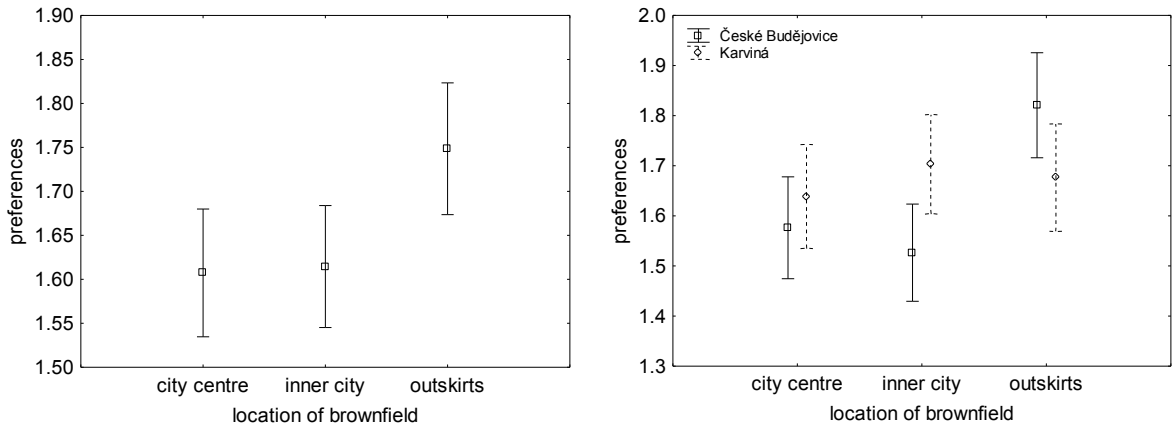

Figure 5. Preference of brownfields non-regeneration for the location of brownfield (left) and for location of brownfield between cities (right). Means and 0.95 confidence intervals of responses shown (1 = certainly not preferred; 4 = certainly preferred).

5. Discussion

Residents were found to have a positive attitude towards brownfield regeneration projects in both cities (Figure 2, 3, and 4), matching results from Western Europe (Maliene et al., 2012).

We have stated four hypotheses for our study regarding the factors influencing the preferences for brownfield regeneration.

Our **first hypothesis** was "preferences for the four basic types of regeneration (refurbishment, demolition with development, demolition with recreational grounds, keeping the current state) are influenced by different factors". This hypothesis was confirmed as our four combined ANOVA models differ in the factors found to be statistically significant for different regeneration types (Tables 3-6). An interesting fact is that the character of differences between three selected factors (city, place of residence, brownfield location) varies considerably between the four studied types of brownfield regeneration (compare the results in Figures 2-5). Thus, the complexity of brownfield regeneration perception was identified as assessed by parts in specific regeneration projects (Doucet et al., 2011a, 2011b; Franz et al., 2008; Maliene et al., 2012). We try to discuss the most interesting issues arising from this complexity in the arms of further hypotheses.

Our **second hypothesis** was "brownfield location within the city's borders and its original use affects the residents′ preferences for regeneration alternatives". Brownfield location ("BFs-location" in tables 2-4) was indeed found to be highly significant in all four ANOVA models. City centres are spaces where refurbishment is highly desired. Demolition and redevelopment into new buildings is most preferred in the inner city, but demolition and creating green spaces or brownfields non-regeneration are most acceptable in the outskirts.

Our **third hypothesis** was "place of residence affects the preferences of revitalisation alternatives in different parts of city." This hypothesis was not confirmed as none of our models found the respondent's origin ("respondent" in tables 2-4) to be significant factor.

However, the respondent's location was found to be statistically important in the model regarding demolition and redevelopment into new buildings. No additivity was found between the location of respondent, city of respondent and location of brownfield.

Our **fourth hypothesis,** "preferences vary between cities with different level of extent of brownfield revitalisation", was only partly confirmed. The city was found to be an important factor for only two models: refurbishment in České Budějovice and demolition and redevelopment into new buildings in Karviná.

5.1 Refurbishment versus demolition

The decision of whether to rebuild or demolish, in what area and to what extent, should be the result of a negotiation between investors, local government and representative of various stakeholder groups. It is understandable that premises or sites that have an important historical value represent a specific type of brownfield regeneration opportunity. In areas with a high concentration of brownfields, the decision on the fate of each site follows a slightly different logic due to competition between the brownfield locations.

Non-regenerated brownfields affect house prices in an area (de Vor & de Groot, 2011; Mihaescu & Vom Hofe, 2012). It is most effective to demolish the current premises and prepare the sites as open areas for marketing or further use. Other authors (Greenberg, Lowrie, Solitare, & Duncan, 2000) warn about higher concentrations of socio-pathological events such as crime near brownfields. Brownfields are usually aesthetically unattractive (Gandy, 2013). Demolition of historically valuable premises should be minimised and the focus should be on their refurbishment to preserve the genius loci of the place. In contemporary cities, cleared brownfields could be used for new open green spaces within the

cityscape, thereby benefitting the health and general quality of life of local residents (De Sousa, 2006). Such green infrastructure can mitigate the tendency of concrete and tarmac surfaces to shed water and cause flooding elsewhere. Green space, after brownfield demolition in cities, should also help avoid urban heat islands by cooling the city down.

Respondents from Karviná preferred brownfield demolition (Figure 3) whereas respondents from České Budějovice preferred refurbishment (Figure 2) – possibly reflecting different socio-demographic constitutions and environmental consciousness in the two cities. Differences in preference for demolition or refurbishment were also found within the cities. Refurbishment was preferred in the city centre and in the outskirts, but demolition was preferred in the inner city. Perhaps subconsciously reflecting appreciation of the historically valuable brownfields located there. Support for refurbishment of brownfields in the outskirts is relatively surprising given how remote they are from the daily movements of residents. This could reflect a preference for brownfield reuse rather than the current trend of building industrial zones on greenfield sites beyond the urban edge.

5.2 Brownfield regeneration into open space

Urban greenery has been shown to have a positive effect on a city's biodiversity, residents quality of life (Irvine, Warber, Devine-Wright, & Gaston, 2013), and housing (Liebelt, Bartke, & Schwarz, 2018a, 2018b). Conversion of brownfields within residential areas into parks and other types of recreational facilities is most desired (Loures, 2015) and welcomed by residents (De Sousa, 2006) since it presents "a human solution to a human problem – one that can promote both human and environmental health" (Vogt, Klenosky, Snyder, & Campbell, 2015). Even an unregulated urban green space can be highly valued by residents (Unt & Bell, 2014), in particular, if ruderal species are replaced with aesthetically attractive

ornamental species (KoppIer, Kowarik, Kuhn, & von der Lippe, 2014) increasing the interest of the place (Hofmann, Westermann, Kowarik, & van der Meer, 2012). The result of leaving brownfield sites to become overgrown is called 'post-industrial nature' revitalisation (Franz et al., 2008). With regards to long-term targets and low pace economic returns, some projects aim to transform brownfields into controlled green areas with public sector funding (De Sousa, 2003). Even though the perception of revitalisation of brownfields into parks is a positive one (De Sousa, 2006), it is not always positively accepted by the public, particularly if the regeneration plan includes privatisation of council property (Johnson et al., 2009). This can be interpreted as the general feeling of residents' lack of connection with any specific regeneration and, surprisingly, low interest in redeveloping public spaces for sport and relaxation in the inner city and city centre, lower then refurbishment and almost at the same level as demolition and rebuilding.

Lower interest in the centre and inner city for open spaces could reflect a general lament of the lack of space in high-profile city centre areas for service and residential functions, leaving the possibility for developing only small or very small parks (Peschardt & Stigsdotter, 2013). Those areas more likely offer space for relaxation then sport (Nordh & Ostby, 2013). A higher number of smaller areas in cities is visited more often by local residents and decreases human separation from nature (Soga et al., 2015) – a vital role in the life of residents. On the other hand, some cities have a surplus of such abandoned spaces and their greening is a pragmatic interim use (Rall & Haase, 2011). Within the city centre, an opinion of the importance of job creation instead of park creation could also prevail (Loures, 2015).

In the outskirts however there is high interest in converting brownfields into open spaces for recreation. The link between interest in developing recreational urban green spaces on

brownfield sites and the location of those brownfields is similar both cities but significantly above average in the outskirts. This is contrary to the study results in which the support of regeneration projects into parks was desired in residential areas (Siikamaki & Wernstedt, 2008). This could be related to the perception of outskirts as recreational grounds with extensive use – in that area, the highest preferences are towards keeping the brownfields in its current state. That could relate to the habit of brownfield regeneration in suburban areas where there is "low population density and … a greater supply of green spaces" (Frantal et al., 2015). Brownfields on the outskirts are often transformed into public recreational grounds for environmental and social reasons (Nastran & Regina, 2016).

5.3 Non regeneration of brownfields

It is possible to leave the brownfield undeveloped (Koch et al., 2018). Quite surprisingly no difference in preference was found between the two cities (Figure 5). However, we have tested more factors and the non-additivity of city and location of brownfield was found. The location of brownfields was found to be a significant sole factor. Respondents can envisage non-regenerated brownfields only in the outskirts. City margins are perceived as less developed (Jansen, Wunnemann, & Roost, 2017). In České Budějovice there is no commutation of brownfields. On the other hand in Karviná, where there are many no statistical difference for the location of brownfields was found. In the inner city, České Budějovice residents were much less keen on unregenerated brownfields than Karviná's, perhaps reflecting the amount of brownfield in each city.

5.4 Limitations of the study

Our research was designed as a comparative study of perceptions of brownfields in two cities with different trajectories of brownfield regeneration. In České Budějovice, most brownfields

have already been regenerated, whereas in Karvina large tracts of brownfield await regeneration. We built on the work of Pizzol et al. (Pizzol et al., 2016) and Alexandrescu et al. (Alexandrescu et al., 2017), who developed a tool for prioritisation of brownfield regeneration projects. Such a tool allows investors to evaluate individual brownfield sites from the point of view of their location or development potential thereby increasing the possibility of success of regeneration. Limasset et al. report on the items that a tool for regional brownfield prioritisation should consider (Limasset et al., 2018). However Harclerode et al. warn that if we want to increase success of particular types of regeneration, social concerns need to be included (e.g. communication with stakeholders and then taking their opinion into consideration) (Harclerode et al., 2015). Here we have identified which aspects of brownfield regeneration are important for a local population in areas where regeneration has already been done and in areas where regeneration is expected.

We have simultaneously taken into account three factors influencing perception of brownfield regeneration that have been studied only separately before (cities with different economic backgrounds, inhabitants of different parts of the city, locations of brownfields). Previous studies suggested that these factors are not purely additive. Our method allowed us to study not only the individual factors but also interactions among them.

However, our approach possesses some disadvantages. The main limitation of the study is the assessment of only generic types of brownfield regeneration rather than specific types of regeneration preference for which could vary significantly among residents. The types of regeneration we used are hypothetical, not ‘real‘. That is why respondents could not express the attachment to explicit revitalization. It was shown before, that the attachment to particular

regeneration is important for attitudes of respondents in such studies (Rink & Arndt, 2016). Future studies should compare larger sets of ‘real‘ regeneration projects.

We analysed four ‘global‘ regeneration types separately. It is evident from our results that some regeneration is complementary and some is not. A multivariate approach based on large sets of ‘real‘ regeneration projects would provide stronger conclusions.

A further limitation is this research was confined to a single legal, economic and cultural context and cannot reflect inter-cultural variability in preferences. Selecting two economically and culturally different cities overcame some of this limitation but only within the context of the Czech Republic.

6. Conclusions

The attitudes of city residents towards alternative types of brownfield regeneration depend on (1) the extent of brownfields in a city, (2) brownfield location within a city’s borders, (3) place of residence and (4) type of regeneration. Generally positive preferences were confirmed for: refurbishment, demolition with new development, demolition and keeping green spaces. In contrast, leaving premises and sites as brownfields is not preferred, particularly in the city centre and inner city. Spatial differences were identified: refurbishment is preferred in the city centre and on the outskirts while demolition is preferred in the inner city. Residents of a city with many brownfields prefer demolition more than those of a city with few brownfields. Preference for development of green spaces for recreational use is lowest in the city centre and highest in the outskirts.

Policy makers would do well to reflect on residents preferences for alternative brownfield reuses in different parts of a city and different types of city. Proactive and protracted citizen engagement will help identify city specific preferences, help avoid controversy and maximise the likelihood of brownfield reuse being recognised as a "force for good".

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