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Do people adapt to where they live? A comparative analysis of perceived physical urban pleasantness using a quantitative model

As pessoas se adaptam ao local onde vivem? Uma análise comparativa da agradabilidade urbana física percecionada usando um modelo quantitativo

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João Monteiro [a]
Coimbra, Portugal
[a] University of Coimbra

Patrícia da Silva Santos [b]
Belo Horizonte, MG, Brasil
[b] Universidade Federal de Minas Gerais (UFMG)

Nuno Sousa [c]
Coimbra, Portugal
[c] Institute for Systems Engineering and Computers of Coimbra (INESCC)

Eduardo Natividade-Jesus [c]
Coimbra, Portugal
[c] Institute for Systems Engineering and Computers of Coimbra (INESCC)

JM is PhD in Spatial Planning (Civil Engineering - Spatial and Transport Planning), e-mail: joaopedromedinamonteiro@gmail.com
PSS is PhD in Ecology, Conservation and Wildlife Management, e-mail: patriciads80@gmail.com
NS is PhD in Physics, Mathematics and Computer Science, e-mail: nuno.sousa@uab.pt
EN-J PhD in Civil Engineering, e-mail: ednativi@isec.pt
JC-R PhD in Civil Engineering, e-mail: coutinho@dec.uc.pt
LKO Doctor in Education, e-mail: leise@etg.ufmg.br

João Coutinho-Rodrigues [c]
Coimbra, Portugal
[c] Institute for Systems Engineering and Computers of Coimbra (INESCC)

Leise Kelli Oliveira [b]
Belo Horizonte, MG, Brasil
[b] Universidade Federal de Minas Gerais (UFMG)

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Abstract

This article examines the question of whether people perceive their own urban environment more favourably than people from other urban environments, i.e., whether residents, in a sense, adapt to where they live. To analyse this question, a quantitative statistical model that uses geometric and land use elements was applied to a case study of Belo Horizonte, Brazil, to estimate the perception of physical pleasantness of the urban environment using two calibrations: a global one and one obtained from a survey carried out in Belo Horizonte. The article then contrasts findings specific to Belo Horizonte with global perceptions, highlighting that local residents tend to evaluate their city's geometry and land use more positively than a worldwide audience. This difference suggests that familiarity and acclimatisation to the urban environment can significantly influence residents' perceptions of their physical living environment.

Keywords: Urban environment. Urban physical pleasantness. Statistical modelling. Belo Horizonte.

Resumo

Este artigo aborda a questão de saber se as pessoas percecionam o seu próprio ambiente urbano de forma mais favorável do que pessoas de outros ambientes urbanos, ou seja, se os residentes, de certa forma, se adaptam ao local onde vivem. Para analisar esta questão, um modelo estatístico quantitativo que utiliza elementos geométricos e de uso do solo foi aplicado a um estudo de caso de Belo Horizonte, Brasil, para estimar a percepção de agradabilidade física do ambiente urbano usando duas calibrações: uma global e outra obtida de pesquisa realizada em Belo Horizonte. O artigo compara as percepções específicas dos habitantes de Belo Horizonte com as percepções globais, destacando que os residentes locais tendem a avaliar a geometria e o uso do solo de sua cidade de forma mais positiva do que um público mundial. Esta diferença sugere que a familiaridade e a aclimatação ao ambiente urbano podem influenciar significativamente as percepções dos residentes sobre o seu ambiente físico de vida.

***Palavras-chave**: Ambiente urbano. Agradabilidade urbana física. Modelagem estatística. Belo Horizonte.*

Introduction

Urbanization and urban planning are fundamental for the development of cities, as social movements have led people to urban conglomerations. Cities attract people by providing more social interaction opportunities, a wider range of job opportunities and higher levels of accessibility to everyday destinations (Bruinsma & Rietveld, 1998; J. B. Cullen & Levitt, 1999; Handy, 2002; Jacobs, 1992; Talen, 1999). However, the quality of urban life sometimes follows a different trend. Urban pleasantness, defined as public spaces that can be comfortable, safe, and with easy access to points of interest, providing adequate quality of life and well-being to their users (Gehl & Rogers, 2013), has proven to be an important concern for both citizens and public managers (De Guimarães et al., 2020; Meng & Xing, 2019; Nuvolati, 2009; Riffat et al., 2016). Urban pleasantness can be associated with satisfaction to the physical environment, social environment, and accessibility (Skifter Andersen, 2011). Thus, for city planning to be truly successful, it is necessary to consider functional aspects, such as infrastructure and accessibility, as well as subjective aspects, such as beauty and comfort, so as to meet the needs and desires of the population and not to be trapped by market logic or technical demands. And for success to be measured, it is essential to understand how residents perceive the cities where they live, always aiming to develop public policies that improve the quality of urban life.

Geometric and land use elements present in the built environment play an important role in the perceived physical pleasantness of this environment. Quantifying their impact has provided important results that can contribute to a better understanding of urban pleasantness and gather knowledge that can be used to produce actions that can improve that pleasantness (Sousa et al., 2023).

Research on the perception of urban physical pleasantness, understood as the concept of an enjoyable physical environment, began with qualitative studies by Lynch, 1960; Stamps, 1998, which became landmark references in urban planning. The human perception of the urban environment has also been addressed in areas such as spatial planning, environmental psychology and architecture. (Alexander et al., 1977; Cullen, 1995; Jacobs, 1992). In recent years, most of the developed research focused on more specific,but still subjective aspects, such as the aesthetical perception of urban street form (D'Acci, 2019), the perception of rural-urban fringe areas (Sullivan, 1994), the effects of the built environment on urban vitality (Zhang et al., 2021), the impact of human perception of the built environment aesthetics on walking for exercise (Ball et al., 2001; Humpel et al., 2004), the aesthetics of skyscrapers in the urban landscape (Yaran, 2016) or the dereliction perception of parks and neighborhoods (Hofmann et al., 2012).

The first quantitative definition was presented by (Zube et al., 1982) and from then on quantitative progress was made, although many studies focused on only one specific urban element, e.g., oppressiveness due to building height (Asgarzadeh et al., 2012), skyline influence (Karimimoshaver et al., 2021), walking path geometry (D'Acci, 2019), visual quality of urban water landscapes (Li et al., 2021; Luo et al., 2022), and building aesthetics (Nasar, 1994). Broader research includes the aesthetics of urban-rural fringes (Sahraoui et al., 2016), street quality indexes (Balasubramanian et al., 2022; Hu et al., 2020; LI et al., 2022), neighborhood satisfaction (Hur et al., 2010), urban vibrancy based on landscape elements (Meng & Xing, 2019) and a walkability analysis (Park et al., 2013). The research of Sousa et al., (2023) was one of the first attempts to relate the perception of urban physical pleasantness with multiple features of the urban environment in a quantitative manner. In that article, the impact of geometric and land use elements on perceived pleasantness was estimated using a cumulative link mixed model (CLMM), calibrated using data from a worldwide survey.

This article follows on previous research by Sousa et al. (2023) and Monteiro et al. (2023) and attempts to better understand how the perception of urban physical pleasantness might change from city to city. The research question that it aims to study is: “Do people adapt to where they live?” In other words, is the perceived pleasantness of local inhabitants of their urban area different from the perception of outsiders? To answer this question, the city of Belo Horizonte, Brazil, is presented as a study case, for which the CLMM model of Sousa et al. (2023) is recalibrated using survey data from residents of Belo Horizonte exclusively, to capture the local perception of pleasantness. The results of the local survey are then compared with the global results of Sousa et al. (2023) to see whether locals perceive their city as more (or less) pleasant than outsiders. To the best of the authors’ knowledge, this is the first attempt to gauge local effects on the perception of urban physical pleasantness from a quantitative model.

General considerations on urban design in Brazil

The urban design of Brazilian cities was influenced by economic, political, social and cultural aspects, as well as technical and land use changes (Santos et al., 2013). The different phases and transformations throughout this process resulted in a complex and diverse urban configuration. The first stage of urbanization in Brazil was marked by the concentration of activities in coastal cities, driven by the exploration of colonial territory. According to (Paulino & Santos, 1996), the first urban centers emerged in port areas as a result of the agricultural-export economy. Coastal cities served as bases for colonial expansion towards the interior of the country.

Industrialization and mass migration from the countryside to the city marked the second stage of urbanization, resulting in a growth boom in urban areas (Guimarães, 2016). The peripheries started to develop due to the spatial segregation and exclusion of the workforce, clusters of self-built houses located in spaces far from economic resources and political decisions (Guimarães, 2016).

However, this growth was not accompanied by adequate planning, resulting in significant challenges for Brazilian cities. Social inequality and spatial segregation became striking characteristics, with the formation of favelas and peripheries that lack infrastructure and basic services. Brazilian cities have the characteristics of global south metropoles, i.e., generalized low-income, culturally, or politically marginalized regions, where many live in overcrowded informal settlements (Dados & Connell, 2012; Mitlin & Satterhwaite, 2012). The dramatic reality of cities of the global south is that they face the same challenges as cities in the global north, in the likes of climate change, gentrification, and growing inequality (Redclift & Sage, 1998; Rigolon et al., 2018; Shin et al., 2016; United Nations, 2022), and also additional challenges, such as violence and crime, extremely high population density, uncontrollable urban growth, human rights violations and large informal settlements, among others (Duport et al., 2016; Leichenko & Solecki, 2008; Miraftab, 2009; Rigolon et al., 2018; Shatkin, 2007; Simone, 2020; Xiao et al., 2017).

Brazilian urbanization has caused environmental problems, such as the degradation of natural resources, pollution, and making cities vulnerable to natural disasters and pandemics (Ahmed et al., 2022; Bertucci et al., 2016; Haddad & Teixeira, 2015; Monteiro, et al., 2023; Rodrigues et al., 2021; Young, 2013). Thus, the lack of planning in the development of metropolises accentuated social and environmental problems due to precarious urban infrastructure, pollution, intense traffic, occupation of risk areas, among others (Júnior, 2014). Nevertheless, despite the development of most Brazilian cities occurring naturally, with problems associated with disorderly growth and inadequate planning (Monteiro, et al., 2023), Belo Horizonte is one example of good urban planning, chosen as a case study.

Belo Horizonte – The Case Study

Belo Horizonte, the first planned city in Brazil, was created at the end of the 19th century, during the expansion of the mining cycle in Minas Gerais. Its construction occurred differently from most other Brazilian cities, as it had a strong state intervention, aiming for modernization and inspired by the urban experiences of European and North American cities (Passos, 2009).

Belo Horizonte was planned and designed by engineer Aarão Reis and architect Francisco Bicalho, following the principles of modern urbanism at the time (Barreto, 1995), and is known for its modern architecture and structured urban planning. Belo Horizonte's urbanism was influenced by different currents and historical contexts, which shaped its landscape and contributed to its spatial organization.

Aarão Reis was inspired by Washington D.C. and the idea of a Garden City (Howard, 2010), with the design plan prioritizing spatial organization, with wide avenues, tree-lined squares, and well-defined residential areas (Duarte, 2007), creating a city with modern lines and modern buildings in concrete, with the aim of providing beauty and comfort to citizens. The construction required interventions from different fields of knowledge, such as legal, medical-sanitary and statistics, seeking solutions to social, public health and infrastructure problems. The concept of Garden City, which still influences urban planning today (Monteiro et al., 2022), is reflected in the structure of Belo Horizonte today in the city center (Figure 1, red contours) inside Contorno Avenue. This central region would meet the needs of 30,000 inhabitants and be divided into sectors, in which each area had its specific function, such as residential, commercial, industrial, and administrative (Barreto, 1995) – again following the Garden City concept.

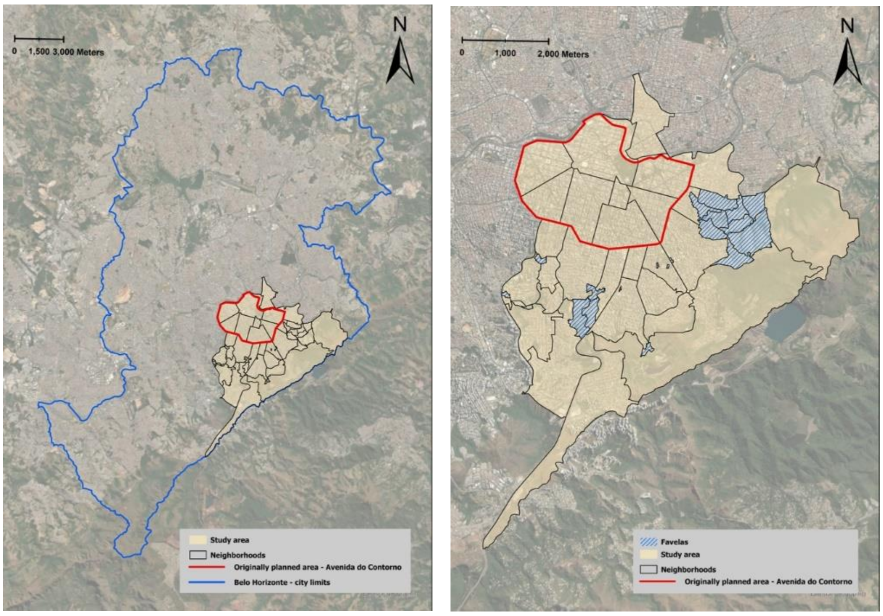

Figure 1 – Belo Horizonte: complete urban area and study region (left); zoom in on the study region with Contorno Avenue and the location of the favelas (Monteiro et al., 2023) (right).

However, a city planned to house at most 40,000 residents already had 55,000 in 1920. As a result, despite initial planning, the city faced challenges with regard to disorderly expansion. The city plan that allocated the inner area of the perimeter of Avenida do Contorno to specific functions, expelled the popular classes to suburban and rural areas (Passos, 2009). The city continued to develop and face challenges inherent to urban growth, currently reaching a maximum of 283,776 inhabitants in study region, filling 107,565 households (*IBGE | Censos*, 2010), and divided by 47 neighborhoods, of which 19 are favelas (slums, blue in Figure 1) (*Síntese Da História de Belo Horizonte*, 2018).

Another important influence on Belo Horizonte's urbanism was the Brazilian modernist movement, which reached its peak in the 1940s and 1950s. The appointment of Juscelino Kubitschek as mayor was decisive for the definitive installation of modernism in the capital of Minas Gerais (Bahia, 2005). Architects such as Oscar Niemeyer and Lúcio Costa left their mark on the city with iconic projects, such as the Pampulha Architectural Complex, which includes the Church of São Francisco de Assis, the Pampulha Art Museum, the Casa do Baile and the Yacht Tennis Club. These constructions were designed in an innovative and revolutionary architectural language at the time. This modernist influence brought a new look to the urbanism of Belo Horizonte, incorporating organic forms and exploring the relationship between man and urban space (Freitas, 2019).

Transport infrastructure and urban mobility influenced urbanism in Belo Horizonte. This influence occurred more effectively with the development of the Belo Horizonte Urban Mobility Plan (PlanMob-BH) between 2003 and 2010 and was implemented in 2013 (Henriques, 2016). The main strategies adopted to manage urban mobility in the city were the creation of BRT corridors (Gonçalves & Peres, 2015), but evidence exists that cycling could be an excellent alternative (Lobo & Pinto, 2023) (see also Monteiro et al., 2023 for a methodology to estimate the maximum cycling potential).

Belo Horizonte is a large metropolitan area, as shown in Figure 1 (left), and it would not be feasible for the purpose of this research to survey the whole city. Therefore, the case study was limited to the center-south region, representing the original project for the city and its south/southeastward extensions. Most of the cultural, architectural, and historical heritage of Belo Horizonte is located within the study area, which is characterized mainly by a high concentration of economic activities and a standard of occupation, with tall buildings and vertical development. However, this pattern is not homogeneous and differences exist that are quite meaningful for the purpose of this article.

Research approach

The methodological approach revolves around the CLMM model of (Sousa et al., 2023) for estimating the perception of urban physical pleasantness. This regression model is capable of estimating pleasantness scores on the neighborhood scale from the geometric and land use elements of that neighborhood.

Like most regression models, the CLMM model requires data for calibration (i.e., to determine regression coefficients and other parameters), which can be obtained from field surveys. Since surveys inherently reflect the point of view of its respondents, if the model is used to estimate the pleasantness of a study area with two different calibrations, two of the evaluations will emerge which can be compared.

In Sousa et al. (2023), the CLMM model was calibrated resorting to a worldwide online survey. Applying the model with that calibration to the neighborhoods of Belo Horizonte yields the perception of pleasantness that a random person from anywhere in the world would have of those neighborhoods, i.e., the perception of an outsider to the city. To compare outsider perception vs. the perception of city residents requires recalibrating the model using survey data collected exclusively from those residents and applying the recalibrated model to the same neighborhoods. Consequently, in the present research the same survey of Sousa et al. (2023) was repeated for people living in Belo Horizonte.

Before further exploring the case study, some details of the CLMM model are now given. This model considers five geometric and land use elements to characterize the urban environment at the neighborhood scale, described in Table 1. The field survey of Sousa et al. (2023) asked respondents how they would feel about living in 25 examples of urban environments, shown to them as bird-eye view pictures, on a 1-5 Likert scale (response variable; 5 = most happy). See Sousa et al. (2023) for questionnaire details and neighborhood pictures. Each of those environments could then be described by the geometric and land use elements mentioned above (explanatory variables), on the scale of Table 1.

Table 1 - Geometric and land use elements considered in the analysis.

Variable	Definition	Measurement Unit	Scale	Level
Green Area	Publicly available green area in the study neighborhood	Percentage (%)	0 - 5	None
			6 - 25	Small
			26 - 60	Medium
			> 61	High
Street Width	Average street width, including cycle lanes, parking space and sidewalks	Meters (m)	0 – 8	Narrow
			9 – 18	Wide
			> 19	Very wide
Floors	Average floor number of all buildings in the study neighborhood	Integer	1 – 2	House
			3 – 5	Short
			6 – 11	Medium
			12 – 37	Tall
			> 38	Skyscraper
Building distance	Average building side setbacks	Meters (m)	0	Compact
			1 – 14	Spaced
			> 15	Sprawled
Green private area	Average private green area	Squared meters (m^2)	0 – 10	Not relevant
			> 11	Backyard

Source: (Sousa et al., 2023).

The CLMM is suitable when the response variable is of a discrete ordinal nature and the explanatory variables are categorical. Its mathematical formulation is shown in Eq.1.

$$\text{logit}[P(Y_i \leq j)] = \theta_j - \sum_k \beta_k X_{ki} - u_i\,, \qquad \text{logit}(p) = \ln\left(\frac{p}{1-p}\right), \tag{1}$$

$$i = 1 \dots, N,$$

$$j = 1, \dots, J - 1,$$

$$k = 1, \dots, K$$

Once a new urban environment, or neighborhood i is evaluated according to Table 1, the logit function represents the cumulative probability of its perception falling at or below level j of the response variable (recall: 1-5 Likert), with θ_j threshold coefficients, β_k regression coefficients for the k explanatory variables, X_{ki} the values of k for neighborhood i, and u_i the random effect of the person rating i; $u_i \sim N(0, \sigma)$. Average values for neighborhood i can then be obtained from $\bar{r}_i = \sum_{j=1}^{5}(p_{ij} \cdot j)$, with p_{ij} the probability of i being perceived as belonging to category j, considering a judgement bias $u_i = 0$ (the p_{ij} can be obtained from Eq. 1 after β_k and θ_j are known). In a logistic regression model, there is a reference scenario against which other levels compare. This reference is arbitrary and is usually set automatically by the software. For the CLMM, this is high green area, narrow streets, house-like number of floors, compact distances, and existence of backyard, and no regression coefficients exist for these settings. The model and statistical calculations were carried out in package 'ordinal' in R environment.

The parameters, β_k and θ_j, characterize the CLMM model and depend on input data (calibration). Contrasting global (outsider) perceptions with those of local inhabitants can then be done in two ways: (*a*) by comparing the two sets of model parameters and (*b*) applying both model calibrations to the neighborhoods of Belo Horizonte and comparing results. The results of the CLMM model of Sousa et al. (2023) can be summarized as follows: people tend to prefer urban environments with generous percentages of green areas, wide streets, short buildings with small setbacks, and private green areas. The regression coefficients that express these preferences can be found in Table 2 (next section).

Returning to the case study, on what concerns data collection and curation, the survey specific to Belo Horizonte was carried out using the same online questionnaire and images of Sousa et al. (2023), the link being broadcast only to residents born and raised in the study region. To avoid biases, people who moved to the study region at some stages of their life were not surveyed. The survey resulted in 204 responses, all validated. To capture the geometric and land use elements of the neighborhoods of Belo Horizonte, a square grid of 282 m $\times$ 282 m (400 m diagonal, a walkable range) was laid over the study area. Each square represented a neighborhood and the level of variables in Table 1 was evaluated for every square by visual inspection of Google Earth images.

Results – regression coefficients

After preparing the necessary datasets, the two models were constructed and applied to the Belo Horizonte study area.

Table 2 presents the CLMM regression coefficients and threshold coefficients for the two model calibrations. Regression coefficients are the most important piece of data and read as follows: the more positive (negative) a regression coefficient is for a given level of a variable, the higher (lower) the probability is that a neighborhood with that level is perceived as pleasant when compared with the reference scenario. Examining the numeric values of these coefficients for the two models reveals how perceptions of residents of the study region compare to those of outsiders and allows deriving conclusions.

The sample size of the local model (204) was smaller than that of the global model (1327), but still led to a quality model, as can be seen by the Nagelkerke pseudo-R2 value, a goodness-of-fit indicator, of the local model, which is actually better than that of the global one.

Table 2 – CLMM regression coefficients and threshold coefficients.

Variables	Global	Local (Belo Horizonte)
Green Area: None	-0.916***	-2.079***
Green Area: Small	-0.964***	-1.015***
Green Area: Medium	-0.379***	0.425***
Green Area: High	Ref	Ref
Street Width: Narrow	Ref	Ref
Street Width: Wide	0.174***	0.209*
Street Width: Very wide	0.823***	0.570***
Floors: House	Ref	Ref
Floors: Short	-0.737***	-1.758***
Floors: Medium	-0.844***	-1.327***
Floors: Tall	-0.960***	-1.243***
Floors: Skyscraper	-1.347***	-1.012***
Building distance: Compact	Ref	Ref
Building distance: Spaced	-0.223***	0.260***
Building distance: Sprawled	-0.270***	-0.907***
Private Green Area: Not relevant	-0.674***	-0.093
Private Green Area: Backyard	Ref	Ref
Threshold coefficients		
1|2	-3.060***	-3.367***
2|3	-1.677***	-2.011***
3|4	-0.392***	-0.571***
4|5	-0.674***	0.873***
Random effects std. deviation	0.812	0.955
Log-likelihood	-48,005.95	-7147.55
Nagelkerke pseudo-R2	14.3%	26.1%
AIC	96045.89	14329.11
Sample size	1327	204

Significance codes p-values: *** < 0.001; ** < 0.01; * < 0.05.

Comparing the local model calibration regression coefficients for the Belo Horizonte study region with the global one, it is seen that, with respect to green areas, inhabitants of the study region show less tolerance for absence of green areas (-2.079 vs. -0.916) and a slight preference for medium percentages of green areas (+0.425 vs. -0.379). This suggests that local inhabitants prefer to have some form of green area in their neighborhoods, whereas globally the more green area, the better. This could be due to Belo Horizonte's garden city layout of the center having accustomed residents to seeing a considerable number of medium-sized green areas. Furthermore, their slight dislike for the neighborhood with a high percentage of green area might be associated with the unsafety felt in those spaces due to vegetation shading nocturnal lights and lack of security personnel. This effect does not appear in the global model calibration and could be a consequence of high crime rates, as is the case of Belo Horizonte.

Moving to the street width coefficients, these are similar for both calibrations, albeit globally people tend to have a higher preference for very wide streets than Belo Horizonte study region residents (0.570 vs. 0.823). Although Belo Horizonte has some very wide streets, most of the environment is considerably compact, and this could be the reason why locals are more forgiving of the lack of wide streets and avenues.

Concerning building height, the preference of residents of the Belo Horizonte study region for small buildings is similar to the global calibration, as all levels have negative regression coefficients. However, globally the taller the landscape, the higher the penalty, whereas in the study region there is a tendency to be less avert to height as buildings get taller (regression coefficients are less negative with height). A possible explanation for this difference is this: the 3-5 floor level is a common height in urban dwellings worldwide, but in Belo Horizonte it is often associated with slums (favelas), which might be the reason why it is particularly penalized (-1.758). On the contrary, tall buildings may be associated with prosperous neighborhoods, which might explain the less disdain of locals for this type of landscape.

Regarding the distance from the building, globally people tend to prefer very compact environments. In the Belo Horizonte study region, there is a tendency for residents to prefer moderate spacing between dwellings and dislike more sprawled environments, possibly due to personal safety concerns. Note also that compact building distances can be associated with informal settlements (slums), which justifies the preference for moderate spacing.

Finally, with respect to the private green area, there is a lack of statistical significance for this variable in the study region, reflecting that its presence or absence does not change the perception of satisfaction of local inhabitants. This fact is not easy to interpret, but it could be a result of the life experience of a population that is used to the urban lifestyle which, for many, does not include private green areas, making it a commodity that would not affect their perceived neighborhood pleasantness. Non-significance suggests this variable could be removed from the model for Belo Horizonte, but a likelihood ratio test shows that removing it leads essentially the same model (likelihood test p-value: 0.43), so it was kept in the analysis. In addition, the alternative model with no private green area yields just about the same regression coefficients for Belo Horizonte.

Since all the participants in the Belo Horizonte sample lived during their childhood and still live in the Belo Horizonte study region, the hypothesis is that this might lead to a better acceptance of spatial planning characteristics that are mostly observed in dense urban environments, such as tall vertical construction. When comparing regression coefficients of local and global model calibrations, differences are seen that can be argued to validate this hypothesis. However, one must tread carefully, as the interpretations put forward for the differences are at this point mostly indicative and require additional validation.

Results - Perceived neighborhood pleasantness in Belo Horizonte

Another argument, perhaps equally as compelling as regression coefficients, to clarify whether locals have a better perception of their city is to explicitly calculate neighborhood pleasantness scores for locals and outsiders. Figure 2, a color-coded map ranging from red [worse] to green [better], shows the CLMM-predicted pleasantness scores for both sets of regression coefficients of Table 2. For comparison, it is, however, easier to map the differential between pleasantness scores [local calibration minus global calibration]. This is done in Figure 3.

Figure 3 shows more blue areas [better perception by locals], providing further evidence that locals tend to adapt to where they live.

A closer look at this figure, together with a check of the characteristics of the neighborhoods, as measured by Table 1, is elucidative: the Belo Horizonte study area includes the original planned area, inside the Contorno Avenue [red contour at the top of Figure 1], which has many green areas and tall buildings. Since the local model calibration strongly dislikes absence of green areas and penalizes tall buildings less than the global calibration, the area inside the Contorno Avenue turns out to be better perceived by locals than outsiders, hence the blueish tones. This urban landscape is also present in the south region of the study area, near the red tip at the bottom of Figure 1, and that is why this region is also better perceived by locals than by outsiders.

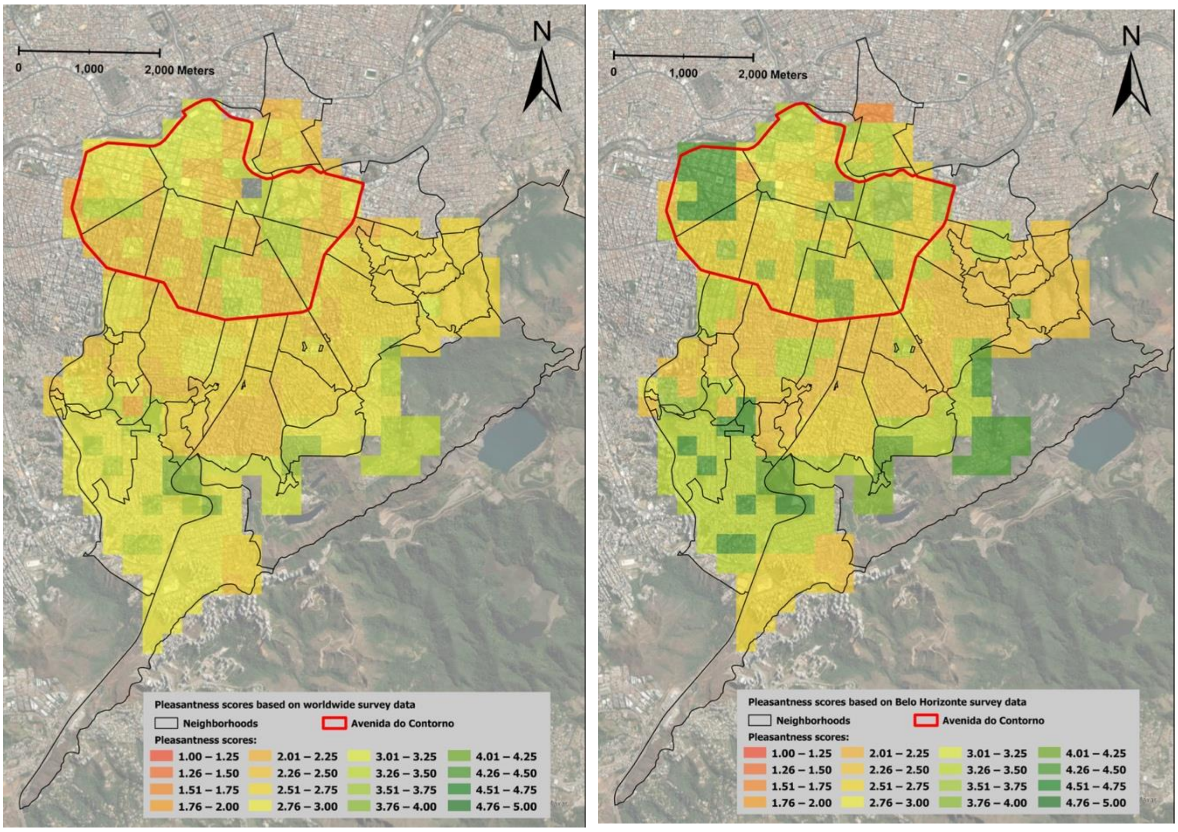

Figure 2 – Pleasantness of Belo Horizonte: based on world survey data (left), based on Belo Horizonte survey data (right).

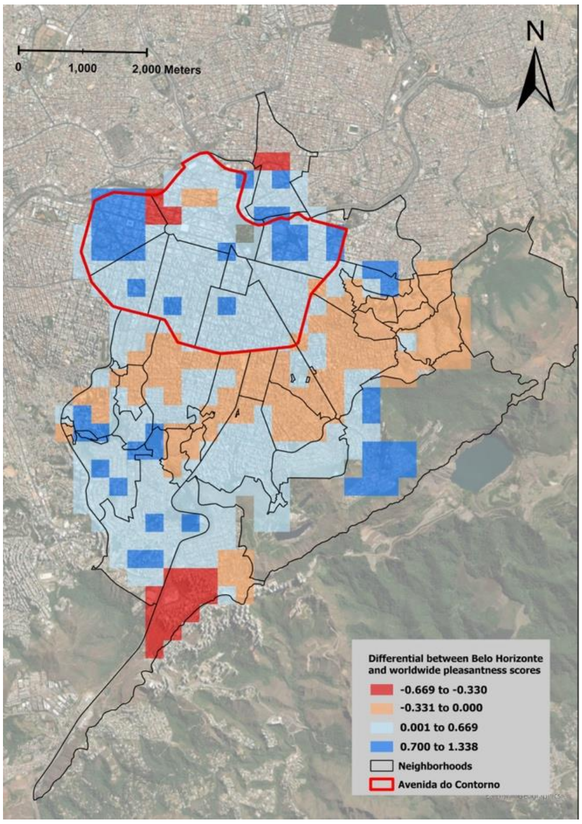

Figure 3 – Difference between the pleasantness scores in the Centre-South district of Belo Horizonte (blue/red: better perception by residents/outsiders).

Neighborhoods where the local perception is worse than the global one are situated just south/southeast/east (S/SE/E) of the Contorno Avenue (middle of the figure), and at some spots to the north and south. The region just S/SE/E of Contorno Avenue has few green areas and plenty of short-sized buildings, both of which get more penalized in the local calibration. The lack of green areas is also the reason why the northernmost red spots appear. The southernmost red tip is an arid area, with very few buildings, leading to a sprawled environment, which is more penalized in the local calibration.

It should be noted that the presence of a backyard slightly decreases the discrepancies between the local and global calibrations [it improves global scores and does little to local scores], but this effect is not very strong.

Table 3 provides summarizing statistics on the pleasantness scores for both model calibrations.

Table 3 – Comparison of pleasantness scores

Score	Global	Local (Belo Horizonte)
Minimum	2.12	1.61
Average	2.78	3.02
Maximum	3.98	4.42
Standard deviation	0.35	0.65

A Wilcoxon signed-rank test for paired samples was carried out over the two sets of scores, results showing the score differences have statistical significance (p-value ≈ 0%). This validates the hypothesis that the calibration of the local model leads to a better overall urban pleasantness score. In other words, people from the Belo Horizonte study region assess the elements of geometry and land use that exist in the city more positively than people from other parts of the world. It is also interesting to note that locals seem to have more extreme views of their city, with scores dispersing more than those of outsiders. This difference in dispersion also has statistical significance (two variance F-test; p-value ≈ 0%).

Discussion

The results from both the model calibrations and pleasantness score statistics point in the same direction: local residents tend to perceive their city more positively than outsiders when it comes to physical pleasantness of their built environment.

It is not surprising to see people becoming accustomed to their environment, thus feeling better about it than outsiders, but this is often due to factors that go beyond physical pleasantness. Factors such as the social environment, urban vibrancy, and accessibility also play an important role in the satisfaction of residents (Andersen, 2011). In particular, social factors create a sense of attachment, which residents have, but outsiders do not (Ær∅, 2006; Altman & Low, 1992; Brown et al., 2015; Hashemnezhad et al., 2013; Lewicka, 2011). This familiarity allows the creation of memories and associations to different city characteristics and areas, contributing to explain why people tend to like their neighborhood. What might be new or feel out of place for a visitor can be natural and normal to local residents.

What the present research shows is that this sense of attachment is likely to extend to the physical characteristics of the urban environment, showing that acclimatization is most likely the reason for the differences in perception between residents and outsiders. This has also been reported in other studies of physical pleasantness, but in a qualitative manner (Carp et al., 1976; Cuba & Hummon, 1993; Ujang, 2012). The main novelty of the present research is to provide *quantitative* evidence in that direction, thus cementing previous claims.

The political implications highlight the importance of the local context in urban planning. Municipal and regional planning may sometimes favor the easier route of replicating solutions and strategies that have proven effective elsewhere. However, as this study shows, perceptions of the built environment can vary depending on the location of an individual. For example, what may be considered a small urban park by someone accustomed to expansive green spaces and national parks could feel ample for someone living in a dense and compact urban area where greenery is scarce. Not taking into account local preferences can lead to less effective and/or less efficient responses to the needs of populations, and the CLMM methodology allows decision makers to estimate the extent of this inadequacy.

Much of the research and policy development takes place in countries in the Global North, which often face distinct challenges compared to those in the Global South. With urban populations steadily rising, countries of the global south need to create sustainable and resilient urban environments. The need for equitable spaces becomes pressing, and considering the perceptions of local residents can help optimizing urbanization strategies.

However, while this research shows that people do adapt to their urban environment to some extent, such adaptability should not be seen as a free hand for planning projects. Indeed, the perceptions of residents and outsiders may differ, but they are not radically different. There will always be some dislike for unpleasant environments; it is the degree of tolerance toward them that varies.

Summary and conclusion

This article presented a comparison between the perceived physical neighborhood pleasantness of the city of Belo Horizonte, Brazil, using two calibrations of a quantitative model of pleasantness based geometric and land use elements. The two calibrations represent perceptions of pleasantness by local residents of a study region and people from all over the world. The main objective was to understand whether locals have a different perception compared to a larger audience. In short, the study aimed to unravel whether people adapt to where they live and, consequently, perceive the built environment surrounding them more positively than outsiders. To the best of the author's knowledge, this is the first research to quantitatively attempt to understand the differences in the perception of physical pleasantness by residents and non-residents.

Results showed that the residents of the Belo Horizonte study region actually have a more overall positive perception of their city compared to a worldwide audience. This outcome could be understood from the model calibrations, with regression coefficients for the local calibration being more favorable to the actual layout of the city than those for the global calibration, and from statistical tests that were performed on the scores predicted by both calibrations. Familiarity and acclimatization to the urban built environment are probably the main reasons for the differences between the perceptions of locals and outsiders.

These results suggest that the answer to the original question "Do people adapt to where they live?" would be "yes". Or rather, "yes, but...", as this is just one case study and therefore one should be careful not to generalize the conclusions too hastily. More data and case studies must be analyzed before making bolder claims. The authors intend to further address this question in future research, ensuring that the study will be replicated in more cities and countries around the world. Regarding planning policies, this research suggests that those policies should consider local perceptions, rather than uncritically accepting solutions proven elsewhere.

Data availability statement

The dataset that supports the results of this paper is available at SciELO Data and can be accessed via https://doi.org/10.48331/scielodata.DEA9NQ.

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