

The Role of Neighborhood Origin in the Residential Satisfaction of Residents of Low-Income Areas in Bogotá, Colombia



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Abstract Cities in developing countries house low-income communities either in large areas developed as informal settlements or in social housing formally offered and delivered through municipal initiatives and/or the open housing market. City governments strive to address the 11th Sustainable Development Goal set out by the United Nations of making cities inclusive, safe, resilient, and sustainable (SDG, Goal 11. <https://www.un.org/sustainabledevelopment/cities/>) in developing countries, yet often without a clear understanding of what should or what can be sustained in low-income residential areas. This study focuses on residential satisfaction (RS), specifically on the views and experiences of residents of two kinds of neighborhoods, those of formal origin and those of informal origin. The purpose of the study is determine based on an analysis of the effects of neighborhood origin the extent to which residents of low-income areas in Bogotá, Colombia, report experiencing RS and the nature of the RS they report. An original dataset, yielding a total sample of 531 participants, collected from four formal origin and three informal origin low-income neighborhoods in Bogotá is used as the primary data. According to the results obtained, in the case of Bogotá, neighborhood origin does have an impact on RS. In particular, the results indicate the aspects of low-income urban environments perceived by residents as desirable and worth sustaining, which may be relevant to low-income urban environments both in Bogotá and in other countries as well.

Keywords Urban housing · Residential satisfaction · Sustainable development

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1 Introduction

In endeavoring to create sustainable urban environments, cities around the world need to draw on extensive research in adapting their policies and subsequent planning efforts. In the face of rapidly growing low-income urban populations, providing a high-quality urban environment constitutes a significant challenge, which sustainability research is called on to help address. Cities in developing countries provide a rich and complex field for sustainability research where environmental, economic, and social aspects intertwine with urban phenomena such as informality, expressed through living environments referred to as slums, favelas, or shanty towns. Such environments are defined by poverty and may also be present in other urban contexts. For Latin American cities, 20–70% of urban land has been informally developed to provide housing for the lowest-income urban populations (UN Habitat 2004). A small percentage of low-income housing has been built through formal housing delivery processes by governments and more recently through private–public partnerships (Ruiz 2006). Interest in the difference between planned (formal) and unplanned (informal) neighborhoods and the residents' perspectives on these is what drives the present research.

An extensive body of literature has been published on informally produced residential environments (Amin 2014; Dovey 2016) based on the well-established connections between the social and physical manifestations of cities (Tonkiss 2014). Even though the social aspects of residential environments have been acknowledged as key contributors to sustainability, research on the linkages between residential environment features and sustainability has been characterized as limited (Dempsey et al. 2011). A recent study considers residential satisfaction (RS) along with social capital and a sense of community as crucial social outcomes contributing to social sustainability.

It is our contention that low-income residents of neighborhoods of formal origin and low-income residents of neighborhoods of informal origin differ both in terms of their perceptions of the residential features of their neighborhoods and in terms of the residential features that contribute most to a sense of RS. This study focuses on RS, particularly on the views and experiences of residents of formal origin neighborhoods and likewise of residents of informal origin neighborhoods. Based on this user-centered approach, we are able to advance the field's understanding of objective measures of residential environments such as density, tenure, and mix of land uses.

2 Background

2.1 Residential Satisfaction

The field of RS research emerged as a scientific response to assumptions made about the quality of residential areas provided for low- and moderate-income people. Based

on the idea that all people have a fundamental right to housing, social housing was the product of governmental policies put in place with the goal of guaranteeing exactly that. In order to create effective policies, a comprehensive assessment was implemented, including an examination of residents' perceptions in addition to objective measures of the environment, such as density, cost, unit size, and neighborhood layout. On this basis, RS has become a vehicle through the demand-and-supply mechanisms of the market for expressing residential preferences, choices, and expectations of people who lack the means to engage directly with that market.

Researchers typically pursue one of three approaches to RS studies. In one approach, RS functions as a measure to evaluate the quality of a given residential area by identifying and analyzing the factors that best explain variations in the extent to which and the ways in which residents are satisfied with a given area. In this approach, RS is treated as a criterion variable, or the dependent variable. Some examples of studies in which this approach is implemented are Marans and Rodgers (1975), Galster and Hesser (1981), and Cutter (1982). A second approach takes RS as an independent variable to predict a specific behavior, particularly residential mobility. The model presented by Speare (1974) is a good example of this approach. A third option is described as a comprehensive approach in which RS is considered both as a criterion variable to assess housing quality and as a predictor of certain behaviors. The models presented by Weidemann and Anderson (1985), Francescato et al. (1989) and Amérigo and Aragones (1990) are good examples of this approach.

RS is operationalized through the examination of three interrelated factors: satisfaction with the dwelling, satisfaction with the neighborhood, and satisfaction with the community. Each of these factors has objective and subjective components that define residents' attitudes toward their residential environment.

A recent study by Arundel and Roland (2017) includes RS as an essential aspect of the *sustainability of the community* concept (Bramley and Power 2009). Thus, RS (i.e., stability and evaluation of current conditions), social capital (i.e., social interaction and mutual reciprocity), and sense of community (i.e., psychological attachment) are seen as key conditions for achieving collective involvement and community well-being.

2.2 Residential Satisfaction and Social Sustainability

In attempting to operationalize social sustainability in relation to the built environment, researchers have developed a series of variables related to two broad underlying concepts: *social equity* and *sustainability of the community* (Bramley and Power 2009).

Among these variables, three crucial indicators of sustainability of the community are highlighted in recent research: social capital, sense of community, and residential satisfaction. These indicators are used to examine the effects of urban form on social sustainability at the neighborhood level, eliciting the relationship between community and neighborhood features. The positive aspects of developing a strong

community are deemed worthwhile and remain an important goal of policy and planning (Dempsey et al. 2011).

RS is a holistic measure of the extent to which residents perceive a sense of contentment or even enjoyment of the environment in which they live, which includes their neighborhood and community. Thus, a high level of RS is a prerequisite for the sustainability of a community and provides a basis for identifying collective aspects of social life that are worth preserving and promoting.

2.3 Neighborhood Origin

Urban form is a result of a complex synthesis of factors that vary in terms of relative weight and thereby make every city unique. In developing countries, a tendency toward rapid urbanization entails informal occupation and development of large parts of the city in the form of slums, shanty towns, barrios, or favelas (UN-Habitat 2004). Referred to as informal settlements, these areas are unplanned, consist of unauthorized housing and, therefore, usually lack adequate basic services and/or are located in hazardous areas. Most of these informal settlements house low-income populations with limited access to city services (water, public transportation, health) and opportunities (employment, cultural activities).

However, low-income populations in cities of developing countries also live in housing produced and delivered through the formal sector. Many cities have moved from state to private housing provision such that low-income housing has become another tier in the housing market (Hardoy and Satterthwaite 2014). Others have implemented a mixed strategy through land banks (city owned) and private construction companies with subsidies for both buyers and developers (Hardoy and Satterthwaite 2014). Regardless of the strategy, the idea is to regulate and formalize housing production and delivery to keep city growth under control and within planning constraints while fulfilling the goal of providing safe and adequate housing to low-income groups.

The assumption from the city-planning perspective is that formal housing delivery is preferable because it guarantees the provision of public services, controlled land allocation for public and private use in neighborhoods, controlled density, adequate land use mix, and overall alignment with the vision for the city and the policies associated with it. However, given the high percentage of neighborhoods developed as informal housing in the cities of developing countries, it is not feasible to replace all informal settlements with formal housing. Yet, we are not advocating for the informal development of cities. Instead, we see that neighborhoods of formal origin and those of informal origin differ in terms of what they provide as residential environments and that these differences are worth examining from the perspective of the residents. Overall, we are pursuing this line of inquiry to achieve a better understanding of the nuances of formal and informal neighborhoods, thereby providing a basis to help cities more effectively address the challenge of becoming more sustainable than is presently the case.

2.4 Sustainable Development Goals

As established in the United Nations' 11th Sustainable Development Goal, city governments are challenged to ensure that their cities are inclusive, safe, resilient, and sustainable. The challenge is even more formidable for cities in developing countries where rapid urbanization has resulted in large populations settling in informal origin neighborhoods. As the physical and social characteristics of these settlements vary between cities and within them, government efforts to foster sustainability require community participation if a stronger understanding of the rights and responsibilities of living in urban areas is to be achieved.

However, there is an intrinsic distance between informal settlements and the formal structures of the city. Given that this is the case, working toward sustainable urbanization in developing countries where a high percentage of the population live in unplanned, unauthorized, and/or inadequately serviced residential areas requires identifying features that can help bridge the gap between informal and formal low-income settlements.

To address this challenge, it is useful to explore the concept of social sustainability given its strong connection with issues of accessibility and sense of community. Researchers have conceptualized social sustainability in terms of two components: *social equity* and *sustainability of the community*. Social equity means having equitable access to community services, whereas sustainability of the community relates to the ability of a community to continue living as a healthy, functioning, collective entity (Bramley and Power 2009).

Transitioning from informality to formality in urban areas goes beyond granting people access to services (Ward et al. 2015). As social sustainability by definition is concerned with the viability of urban societies in the future, it is fundamental to ensure that all people feel both that they belong and that they have a role to play in defining that future (James 2014). To find out what people wish for the future as urban residents, it is necessary to ask people directly. Participatory processes in housing delivery have a long history with varying levels of success (Lara 2012). However, it is reasonable to assume that if people are to feel that they are part of a community it is better to encourage participation than to restrict it.

A community-centered approach can be useful in assessing neighborhood sustainability. Whereas a healthy community supports the preservation of social aspects, RS helps to identify the connections between built environment characteristics and social aspects that for a given community are either worth sustaining or in need of addressing in some way. In the present study, the results presented derive from a community-centered approach to assessing RS by capturing residents' perceptions of their lives in relation to the residential environment in the context of low-income housing in formal origin and informal origin neighborhoods.

3 The Study

The relationship between urban form and social outcomes such as social sustainability, resident satisfaction, and social capital has been examined in several studies (Bramley and Power 2009; Howley et al. 2009; Addo 2016; Brueckner and Largey 2008), with the overall conclusion that the built form has a significant effect on all these outcomes. In some studies, positive correlations have been found between residential satisfaction and aspects of urban form such as density (Bramley and Power 2009). However, other studies show that it is not high density per se that is the source of dissatisfaction for respondents, but rather related factors such as poor environmental quality, a high level of noise, a high level of traffic, a lack of community involvement, and a lack of services and facilities (Howley et al. 2009). Even though RS in low-income areas in developing countries has been examined in some studies (for example Addo 2016), we did not find any such studies that compare the effects of the specific urban form of formal housing or informal housing in developing countries.

As informal settlements provide housing for the majority of low-income groups in developing countries and as governments are also involved in the provision of low-income housing through the formal sector, in this study we are principally interested in residents' views of and experiences in neighborhoods of both formal and informal origin. We used a validated self-report tool, the Perceived Residential Environmental Quality Indicators (PREQI) (Fornara et al. 2010) to capture the participants' perceptions of their residential environment. This tool measures subjective environmental quality reflecting a user-centered approach intended to complement objective measures such as density, land use, tenure, and mix of land uses.

Specifically, we present an analysis of the effects that neighborhood origin (formal/informal) has on RS in low-income areas in Bogotá, Colombia. We hypothesize that a difference in RS exists between residents of low-income neighborhoods of informal and formal origin. We hypothesize further that of these two groups, residents of neighborhoods of informal origin should report a higher RS due to the community participation intrinsic in the production of their neighborhoods. Thus, we designed the study to address two research questions:

1. Does neighborhood origin have an impact on RS in low-income communities in Bogotá, Colombia?
2. If it does, what are the main factors of formal origin neighborhoods and informal origin neighborhoods that impact RS?

We base our analysis on primary data collected in 2017 from four formal origin and three informal origin low-income neighborhoods in Bogotá for a total sample of 531 participants.

3.1 Study Site and Context

In order to study low-income communities in Bogotá, it was necessary to use selection criteria that would guarantee variability and comparability. To fulfill this goal, the sample was drawn from neighborhoods identified by the city government as low-income through a stratification system (Fig. 1).

In Bogotá, a system of stratification was implemented by the city government in 1994 that required utility companies to bill customers based on neighborhood. The system included a subsidization strategy so that the wealthy would pay in excess of the actual cost of the services they received in order to subsidize the cost of services for the poor. However, the system had a significant impact on many aspects of urban life, such that it has become a marker of socio-economic and spatial classification.

The stratification system has six strata. Low-income citizens live in strata 1, 2 and 3, which together represent 87.7% of the city’s population. We selected stratum 2 as the population of interest for the following reasons: First, this stratum represents 41.3% of the city’s population. Second, although the neighborhoods are all low-income, there is variability in regard to the features of their built environments and in regard to neighborhood origin (informal vs. formal). Third, the neighborhoods are located throughout the perimeter of the city, thereby offering a variety of environmental and functional urban conditions. Bogotá’s stratification system classifies dwelling plots across the city. Consequently, people living in those dwellings are also assigned to the corresponding stratum.

For this study, seven neighborhoods from Stratum 2 in the city of Bogotá were selected for the analysis, three of informal and four of formal neighborhood origin (Fig. 2). In selecting the neighborhoods, we considered the following criteria in order to provide a valid sample for examining the impact of built environment features on RS: neighborhood origin (formal/informal), variability of the built environments’ features, and locations within the city.

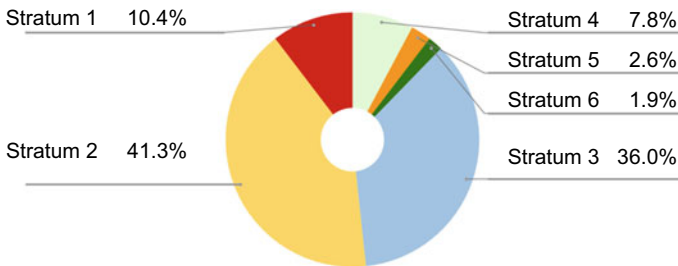


Fig. 1 Residential population per stratum in Bogotá

	Neighborhood Name	N'hood Origin	Participants
1	Nueva Gloria	Informal	84
2	Santa Cecilia	Informal	85
3	Los Almendros	Informal	84
1	Ciudad Bachue I Etapa	Formal	74
2	Nueva Tibabuyes	Formal	75
3	Ciudadela El Recreo II	Formal	64
4	Osorio II	Formal	65
	Total (n)		531

Fig. 2 Neighborhoods selected for the study

3.2 Methods

Research design This study relies on survey methodology to examine participants’ RS and their perceptions of features of their residential environment in selected low-income households in Bogotá, Colombia. For this purpose, RS is measured as the combined index of the residents’ responses to questions about their satisfaction with their respective dwellings (units), their neighborhood, and their community.

Instrument Data were collected through an instrument composed of distinct validated items to measure the RS construct. The survey consisted of the following sections: demographic information pertaining to variables from the Social Life Questionnaire (James 2014) (10 items) (Fig. 3), RS (3 items from the Social Life Questionnaire) (Fig. 4), and perceived environmental features (37 items from the PREQI) (Fig. 5).

The perceived environmental features section relies on the PREQI (Fornara et al. 2010), an instrument developed, tested, and validated by a group of researchers from Italy in a variety of urban environments across Europe, Asia, Australia, and South America (Bonaiuto et al. 2015). We used the short version of the PREQI, which consists of 4 general categories, 11 scales, 19 factors, and 62 items (Fig. 5). We used

1	Education	6	Enough money for health
2	Age	7	Household composition
3	Gender	8	Household size
4	Household financial situation	9	Time in neighborhood
5	Self assessed health	10	Identified community

Fig. 3 Demographic items. Social life questionnaire (James 2014)

1	How satisfied are you with being part of your community?
2	How satisfied are you with the place where you live? (house, apartment, room)
3	How satisfied are you with the environment where you live? (neighborhood)

Fig. 4 Residential satisfaction items. Social life questionnaire (James 2014)

Category	Scale	Factor
Spatial	Architectural and town-planning spaces	Building aesthetics Building density Building volume *
	Organization and accessibility of roads	Internal practicability External connections
	Green spaces	Green areas
Human	People and social relations	Security Discretion * Sociability *
	Welfare services	Education services Social health services
Functional	Cultural-recreational services	Sport services Socio-cultural activities Commercial services
	Commercial services	Public transport
	Transportation services	Relaxing/distressing *
	Pace of life **	Stimulating/boring *
Contextual	Environmental health	Environmental health
	Maintenance and care	Upkeep and care

Notes: ** scale not included in the study; * factor not included in the study.

Fig. 5 Perceived environmental quality indicators (PREQI). Fornara et al. (2010)

10 scales consisting of a combined total of 14 factors to keep the questionnaire within practical size because this paper is part of a larger study for which other data were collected.

The independent variables in the study are seven-point Likert-type scale measurements from the PREQI questionnaire for a total of 37 questions. These questions were compiled first by factor and then by scale to obtain a total of 10 PREQI variables (Fig. 6).

Site To study the effect of neighborhood origin on RS, we used a case study approach. A total of seven neighborhoods (three of informal origin and four of formal origin) were selected to guarantee that a range of physical and location characteristics within the city would be represented. Each block in each neighborhood was assigned

1	Architectural and town-planning spaces	6	Cultural-recreational services
2	Organization and accessibility of roads	7	Commercial services
3	Green spaces	8	Transportation services
4	People and social relations	9	Environmental health
5	Welfare services	10	Maintenance and care

Fig. 6 PREQI scales used in the study. From Fornara et al. (2010)

an ID number. With the use of an online randomizer tool, between five and seven blocks were selected in each neighborhood. A number of households was defined to survey from each block (10–15) to obtain a combined total of 65–85 participants per neighborhood. The final sample size across all seven neighborhoods was 531 participants.

All the neighborhoods included in the analysis are designated as Stratum 2 (low-income) in the city of Bogotá. This information is publicly available from the District Administrative Department of Planning (DAPD) in Bogotá and managed using Geographic Information Systems (GIS). The DAPD also provided information (graphic and numeric data) about neighborhood origin, which we used to define two groups of households: informal origin and formal origin.

Participants The participants recruited from the Stratum 2 neighborhoods in Bogotá represent a population of households living either in houses or apartments located in neighborhoods of informal or formal origin. Through a screening process, potential participants who were under-age were excluded from the sample, and the data were collected using a door-to-door/drop-off pick-up strategy. Details pertaining to the composition of the sample are given in Fig. 2.

3.3 Statistical Analysis

This section presents the analysis of the data intended to answer the questions posed in the section titled “The Study” about the effect of neighborhood origin on RS in Bogotá. The full sample ($N = 531$) was used to run the tests. We selected cases by neighborhood origin as required by the test.

From the total sample of 531 participants, 254 (47.8%) belong to informal origin neighborhoods and 277 (52.2%) to formal origin neighborhoods. The mean RS for the sample is 10.08 ± 2.28 ; the informal subset mean RS is 9.58 ± 2.61 ; and the formal subset mean RS is 10.55 ± 1.82 . The data are normally distributed, as assessed by a Q–Q Plot.

3.3.1 Effect of Neighborhood Origin on RS

In order to find out whether there is a difference in mean RS between residents of informal origin neighborhoods and residents of formal origin neighborhoods, we ran a Welch *t*-test because the assumption of homogeneity of variances was violated, as assessed by Levene's test for equality of variances ($p \leq 0.001$). Data are mean \pm standard deviation, unless otherwise stated. There were 254 participants from formal origin neighborhoods and 277 from informal origin neighborhoods. There were no outliers in the data, as assessed via a boxplot, and the RS scores for each level of neighborhood origin were normally distributed, as assessed by the Shapiro-Wilk's test ($p > 0.05$). Residents of formal origin neighborhoods had higher residential satisfaction ($M = 10.55$, $SD = 1.82$) than did those living in informal origin neighborhoods ($M = 9.58$, $SD = 2.61$), which constitutes a statistically significant difference: $M = 0.97$, 95% CI $[-1.35, -5.75]$, $t(529) = -4.89$, $p \leq 0.001$.

Of the two kinds of neighborhoods under investigation, we expected the informal origin neighborhoods to score higher on RS because we hypothesized that for low-income people, community ties and social networks would be fundamental to the needs of everyday life (Addo 2016; Amérigo and Aragones 1990). Residents of informal origin neighborhoods usually share the same struggles, settle with extended family nearby, and develop a strong sense of pride in and belonging to the residential environment that they have built themselves (Lara 2012). However, we had expected higher satisfaction with community and neighborhood to result in overall higher RS for residents living in informal origin neighborhoods relative to those living in formal origin neighborhoods. Yet, our results do not support this hypothesis.

3.3.2 Examining Built Environment Features that Contribute to RS

The *t*-test revealed a significant difference in RS between those living in formal origin neighborhoods versus those living in informal origin neighborhoods, with residents in the former group enjoying significantly higher RS. In the next step, we focused on determining the features of the built environment that contribute to RS for the residents of each kind of neighborhood. We ran a Multiple Linear Regression (MLR) on informal origin neighborhoods and formal origin neighborhoods separately to compare the models and identify the variables that contribute to RS in both formal origin and informal origin neighborhoods. We used the backwards¹ variable selection method, as this analysis was exploratory in nature. Through this method, we were able to find the best fit for each group of participants (formal origin and informal origin) by choosing from all the environmental features examined (PREQI variables).

¹Even though the backwards selection method is not usually considered valid because it relies on computer algorithms rather than theoretical input, in this case all the variables had already been validated in other studies as highly correlated with the dependent variable RS. The purpose was not to find the best predictive model of RS. Instead, the models highlight the differences and commonalities between the groups of interest.

3.3.3 Informal Origin Neighborhoods

The MLR was run to predict RS in informal origin neighborhoods from all the PREQI variables (10) using the backwards variable selection method. The results of the regression model indicated that five variables (PREQ_Upkeep, PREQ_Unsafe, PREQ_Transerv, PREQ_ArqPlan, and PREQ_OrgAccRoads) explained 51.2% of the variance in the mean RS for residents of informal origin neighborhoods (adj. R2 = 0.501, F(5, 229) = 48.002, p < 0.001). The regression coefficients and standard errors are presented in Table 1.

The residents of informal origin neighborhoods considered *Upkeep* (PREQ_Upkeep) to be an important contributor to RS. As per the PREQI, *Upkeep* has to do with the maintenance of streets, adequate signage, cleanliness, and the overall care taken of the residential environment. It may be that residents of informal origin neighborhoods hold *Upkeep* in high regard due to the extended time that it takes for such neighborhoods to materialize and the sense of belonging, pride, and care associated with informal origin neighborhoods (Richards et al. 2007).

In terms of security, perceptions of the relative safety or lack of safety of a neighborhood (PREQ_Unsafe) contribute to RS. Residents of informal origin neighborhoods pointed to the possibility of vandalism and of experiencing a dangerous encounter at night as defining elements of satisfaction (or dissatisfaction). Not feeling safe after a certain hour of the day in their own neighborhood limits people’s freedom, which ultimately leads to changes in customs and in urban culture overall.

Transportation Services (PREQ_Transerv) is defined by the PREQI in terms of bus comfort, frequency of routes, and bus stop distribution across the neighborhood. It also includes how well the public transport system connects the neighborhood with other areas of the city. For informal origin neighborhoods, *Transportation Services* is a crucial aspect of RS because most of these neighborhoods have an underdeveloped infrastructure and/or are located in areas that are not yet considered part of the city (Camargo and Hurtado 2013). As a consequence, access to welfare (health, education) and recreational services is usually dependent on public transportation for residents of informal neighborhoods (Duarte and Rojas 2012).

Table 1 Informal origin neighborhoods (summary of multiple regression analysis)

Variable	<i>B</i>	<i>SE_B</i>	<i>B</i>
Intercept	-1.388	1.299	
PREQ_Upkeep	0.168	0.055	0.175*
PREQ_Unsafe	-0.164	0.057	-0.137*
PREQ_Transerv	0.158	0.051	0.178*
PREQ_ArqPlan	0.362	0.05	0.371*
PREQ_OrgAccRoads	0.14	0.041	0.197*

Note * $p < 0.005$; *B* = unstandardized regression coefficient; *SE_B* = standard error of the coefficient; *B* = standardized coefficient

The *Architectural and Town-Planning* (PREQ_ArqPlan) variable accounts for people’s perceptions of two aspects of the environment: building aesthetics and building density. In the PREQI, this variable is used to examine perceptions pertaining to the “beauty” of buildings, how close together they are in the neighborhood, street width, and the overall spatial quality of the residential environment. This variable has the greatest effect on RS for informal origin neighborhoods, which means that the residents place a high value on the look, feel, and density of their neighborhood. A closer examination of building aesthetics and density in informal origin neighborhoods in Bogotá is warranted to more fully understand which architectural and planning characteristics residents value most.

Finally, the MLR model includes *Organization and Accessibility of Roads* (PREQ_OrgAccRoads) as a significant variable contributing to RS. As per the PREQI, this variable is used to examine residents’ perceptions of how easy it is to move around their neighborhood by walking or cycling and how adequately it is connected to important parts of the city. For informal origin neighborhoods, this offers an insight into the availability and accessibility of alternative transportation modes given that most low-income people in Bogotá do not have a car such that they rely on public transportation, bicycle and/or walking to work, to school, and to access most of the other activities of daily life (Duarte and Rojas 2012).

3.3.4 Formal Origin Neighborhoods

The MLR was run to predict RS in formal origin neighborhoods from all 10 PREQI variables using the backwards variable selection method. The results of the regression model indicate that four variables (PREQ_Unsafe, PREQ_ArqPlan, PREQ_Green, and PREQ_RecServ) explain 19.8% of the variance in mean RS for residents of formal origin neighborhoods (adj. R2 = 0.185, F(4, 244) = 15.028, p < 0.001). The regression coefficients and standard errors are presented in Table 2.

For formal origin neighborhoods feeling *Unsafe* (PREQ_Unsafe) negatively contributes to RS. The sampled neighborhoods are gated communities, which by definition are intended to address precisely this matter of safety and security. However, residents still feel that they may face issues with vandalism and dangerous encoun-

Table 2 Formal origin neighborhoods (summary of multiple regression analysis)

Variable	<i>B</i>	<i>SE_B</i>	<i>B</i>
Intercept	3.625	1.51	
PREQ_Unsafe	-0.157	0.065	-0.139*
PREQ_ArqPlan	0.246	0.06	0.238*
PREQ_Green	0.165	0.059	0.177*
PREQ_RecServ	0.126	0.037	0.213*

Note * $p < 0.005$; *B* = unstandardized regression coefficient; *SE_B* = standard error of the coefficient; *B* = standardized coefficient

ters in their neighborhood, which means that this design “solution” contributes only marginally to addressing the problem.

The *Architectural and Town-Planning* (PREQ_ArqPlan) variable has the greatest impact of all the variables on the RS of formal origin neighborhoods. Given that the spatial features of these neighborhoods are the result of regulated, planned, and approved design and construction processes, the aesthetics and neighborhood/complex layout met with a high level of acceptance.

The variable *Green Spaces* (PREQ_Green) is designed to elicit perceptions of the quality, availability, and accessibility of areas for relaxation and contemplation. Formal origin housing developments are required to include green areas as part of the housing project (DAPD, Bogotá, nd), and residents see them as an important feature of their neighborhoods. Green spaces in formal neighborhoods can be public or private in nature. A closer examination of the nuances of residents’ perceptions in this regard, therefore, is necessary.

Finally, the MLR model of residential satisfaction includes *Recreational Services* (PREQ_RecServ) as a significant contributing variable for formal origin neighborhoods. As per the PREQI, this variable accounts for the number, variety, and accessibility of sports facilities as well as the entertainment and/or cultural activities offered at venues designed for this purpose. Community centers and sports facilities are generally offered among the amenities in formal origin housing developments, which means residents of such neighborhoods generally expect them to be available.

4 Discussion and Conclusion

The analysis showed statistically significant differences between the mean RS of informal and formal origin neighborhoods. Yet, the explanatory power of the models differs greatly. On the one hand, RS was higher in formal origin neighborhoods ($M = 10.55$) but only 19.8% of the variation in RS was explained by the model. On the other hand, for informal origin neighborhoods ($M = 9.58$), 51.2% of the variation in RS was explained by the model. The fact that the best fit model found using the backwards variable selection method for each group showed such a large difference in explanatory power strongly supports the hypothesis that there is a difference in the perceptions of environmental features, which, in turn, contributes to RS in formal origin versus informal origin neighborhoods.

The considerable difference in explanatory power shown by the models (formal origin versus informal origin) suggests that for residents of each group different aspects of the residential environment contribute to RS. From the architecture and planning perspective, every variable of the final regression model of RS for formal origin neighborhoods (*Unsafe, Architectural and Town-Planning, Green Spaces, and Recreational Services*) are at the core of formal housing delivery processes. This could be interpreted as a good result, but the fact that it accounts for only 19.8% of the variance in RS is cause for concern. Given this result, it can be inferred that for this group other variables need to be considered in the model. We put forward

the argument that the variation in RS explained by the model for formal origin neighborhoods is low because of the standardization process embedded in formal housing delivery. In this regard, research has shown that standardized delivery models often result in developments with houses constructed of permanent materials and with infrastructure provided, but that these developments may lack character, giving rise to descriptions of them as sterile (Bond and Tait 1997).

Yet, given the greater explanatory power of the model of RS for informal origin neighborhoods at 51.2%, a closer examination of the nuances and potential differences between the three selected neighborhoods in this category might be beneficial to better understand the results. However, that direction is beyond the scope of the present study. It is interesting to find that of all the selected variables of the model, *Architectural and Town-planning* has the greatest effect on RS for this group. The three informal neighborhoods included in the sample differ from each other significantly in terms of physical characteristics. Yet, the residents consider physical characteristics to be quite important to RS. *Architectural and Town-Planning* as conceptualized in this study deals with building aesthetics and building density, two aspects most people would assume are best handled by experts. Yet, these aspects show a greater impact on RS in informal origin neighborhoods than in formal origin neighborhoods. It would, therefore, be beneficial for future research to address how residents conceptualize building aesthetics and building density in order to better understand their impact on RS.

Two variables are common to both models of RS: (i) *Architectural and Town-Planning*, and (ii) *Unsafe*. This is consistent with the literature that defines both the physical built environment and social aspects of residential areas as the overarching categories contributing to RS (Amérigo and Aragonés 1997). The perception of being unsafe in formal origin neighborhoods can be interpreted as a failure of formal housing delivery for which safety has been and continues to be a focal concern. In Latin America, gated communities have become the common simplistic response to safety concerns (Coy and Pöhler 2002). In the case of Bogotá, the trend toward low-income gated communities is intended to match the residential features offered to affluent citizens under the assumption that doing so solves issues pertaining to vandalism and other crimes. However, given the low impact of the regression model for formal origin neighborhoods, the perception of being unsafe becomes less important in the context of all the variables used to explain RS for residents of these neighborhoods.

The perception of feeling *Unsafe* had more impact on RS for informal origin neighborhoods ($B = -0.164$) than for formal origin neighborhoods ($B = -0.157$). The fact that the variable *Unsafe* was important in both models of RS underscores the significance of social aspects as contributors to RS (Amérigo and Aragonés 1997). Moreover, the greater contribution of this variable to RS in the informal origin neighborhoods as compared to the formal origin neighborhoods corroborates research that has established the importance of social factors in informal housing (Chavis and Wandersman 1990).

However, even though social factors are important, the fact that *Unsafe* contributed more to the model in informal origin neighborhoods indicates that participatory processes associated with the development of this kind of neighborhood in Bogotá does

not translate into a feeling of safety. As we did not specifically examine the process of settlement development, the relationship between informal housing delivery and safety requires further research.

The main take away from this study is that governments need to follow a nuanced approach to policy that seeks to improve sustainability of and satisfaction with housing in formal versus informal settlements. This study illustrates that a different set of factors (physical and social) contribute to RS in formal and informal settlements respectively. Furthermore, since the factors considered in this study explain RS in informal settlements better than those in formal settlements, this underscores the need for further studies of determinants of RS and sustainability in formal low-income settlements.

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