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Local accessibility inequalities and willingness to walk in Latin-American cities: Findings from Medellín, Colombia

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ABSTRACT

As planning for accessibility is becoming a priority for most cities, policies encouraging short-distance traveling and the use of active modes of transport are gaining force. Emphasizing short-distance travel and localized practices can produce positive sustainable outcomes, but in order to design proper public policies, a deeper understanding of the determinants of this mobility of proximity is still needed. This paper uses mobility data from the city of Medellín, Colombia, to examine the role of local accessibility and the proximate scale in the city's everyday mobility. The analysis aimed at testing whether significant efforts on improving local conditions and fostering local mobility would help to improve social exclusion and transport disadvantage situations by alleviating the need of motorized and long-distance transport. Unlike most traditional analysis, proximity is not defined by Euclidian distance but instead using travel and modal choice variables. Results show the relevance of socioeconomic variables at determining travel behaviors as well as the importance of local accessibility for social groups in situations of transport disadvantage.

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Local accessibility; Local travel; Proximity; Walking; Medellín

1. Accessibility inequality and social exclusion in Latin America

The links between transportation, social inequalities, and exclusion have been well documented worldwide. Research projects in the current literature concur on the importance of transport and accessibility as integral parts of our actual societies (Currie et al., 2009; Lucas, 2012; Preston & Rajé, 2007; Schwanen et al., 2015). There is also an agreement on the fact that transport-related social exclusion is particularly prevalent in developing countries and in Latin-American cities (Hidalgo & Huizenga, 2013; Gomez et al., 2015; Teunissen, Sarmiento, Zuidgeest, & Brussel, 2015). However, these dynamics, although being widely recognized, still remain overwhelmingly understudied (Cordoba, Stanley, & Stanley, 2014).

In the Latin-American urban context, transport-associated negative externalities are exacerbated by the prevalence of social inequalities and the growth of urban areas in an unplanned manner (Blanco, Bosoer, & Apaolaza, 2014; McGuirk, 2014, p. 26). The high rate of rural–urban migration, which occurred during the period of 1950–1980, has created complex metropolis often characterized by high population densities and land use segregation within which transport is 30 essential to gain access to daily needs and destinations (Figueroa & Reyes, 1996). After a first period characterized by motorization growth, the congestion issue and the concerns on the environmental impacts of private vehicle mobility forced most governments in the area to switch toward investments in public transport infrastructure. These changes were also motivated by an emphasis on governance, and good government oriented toward providing egalitarianism and better living conditions for all (Brand & Dávila, 2012).

In recent years, public investment in transport infrastructure has been used as a catalyst for social and environmental improvements, and due to budget restraints, Latin America has seen a growth in innovative public transport schemes and low-budget initiatives such as the Metrocable in Medellín, Colombia (Brand & Dávila, 2012) and BRT systems as in Curitiba, Brazil (Hidalgo & Gutiérrez, 2013), the Transmilenio in Bogotá, Colombia (Bocarejo, Escobar, Oviedo, & Galarza, 2016; Munoz-Raskin, 2010), and the Transantiago in Santiago, Chile (Figueroa & Orellana, 2007). Despite being highly innovative and well intentioned, not all these projects have succeeded in their search to promote accessibility for everyone. Public spending on traditional transport infrastructures can end up working against the needs of the more vulnerable groups by deepening their dependence on private or motorized modes of transport (Grieco, 2015).

Topical discussions from the transport sector, often try to solve transport inequality by focusing on accessibility or affordability of the transportation system. From a person-based perspective, such approaches are at risk of mistaking accessibility to the transport system itself by true accessibility to goods and services. As described by Geurs & van Wee (2004), providing access to the transport system is just one part of personal accessibility, the other being the individual, temporal, and land use components. Personal accessibility can be improved by not only infrastructure-based measures but also, and most importantly, the improvement of service distribution and land uses. According to Lucas, van Wee, & Maat (2015), the isolation of a specific social group can either be compensated by an investment in transport infrastructure (focusing on the transport

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dimension of accessibility) or an improvement on local services and amenities (focusing on the land use and personal components of accessibility). Now, although it is highly unlikely that all travel needs can be satisfied by the local and proximate scale of the city, being able to locate a number of traveling needs within a near distance might allow bigger personal investments in terms of time/money for other specific traveling needs that cannot be fulfilled within the proximity range (Marquet & Miralles-Guasch, 2014). Further, while investing in transport infrastructure can boost accessibility for a specific social group while generating inaccessibility for others, investing in good service distribution and urban walkability maximizes the equity of the distribution of accessibility gains throughout all social groups.

As noted by Scheiner (2010), travel distances are an extremely important part of travel behavior, as they are directly responsible for most of the negative externalities derived from transport. Besides improving accessibility, planning for small distances and non-motorized modes of transport can achieve other positive externalities. Among the most relevant ones, there is the preservation of the environment and the promotion of healthy mobility habits. On the one hand, the environmental issue will be gaining relevance in Latin America as the rise of the economy increases the potential for an upcoming boost in motorization levels (Calderón et al., 2015).

In addition, promoting walkable urban environments has the potential of increasing the total amount of physical activity that is gained from transportation. With the epidemiologic transition toward non-communicable diseases already taking place in Latin America (Martínez, Saldarriaga, & Sepúlveda, 2008), promoting active traveling behaviors becomes a priority for urban public health. As Gomez et al. (2015) have proven, there are now plenty of initiatives across the continent, such as the *ciclovias* or bike-sharing programs, oriented toward promoting the use of active travel modes. There is now strong empirical evidence that living in compact and diverse urban environments has direct positive outcomes in terms of health (Durand, Andalib, Dunton, Wolch, & Pentz, 2011; Marquet & Miralles-Guasch, 2015a).

2. Local accessibility: Small distances and slow modes

With this scenario in mind, improving the conditions of the urban environment to promote local accessibility, proximity, and within-neighborhood dynamics can reduce the need for long-distance travel and alleviate some of the pressure on the motorized transport system. However, to do so, it is necessary to evaluate how people in Medellín are currently using their immediate urban environment and to analyze how the different social groups extend their preferences and travel needs toward slow and short-distance travel modes like walking and cycling.

The widely different socioeconomic conditions present in cities like Medellín make it difficult to adopt uniform standards toward social sustainability without first analyzing the specific travel preferences and behaviors of each social group. Each social group develops its own attitudes and travel needs (Cerin, Leslie, du Toit, Owen, & Frank, 2007) and as proved by Jaramillo, Lizarraga, & Grindlay (2012), socioeconomic aspects such as age, occupation, or educational level play a predominant role in the explanation of the social transport needs.

The socioeconomic drivers of travel behavior, despite being increasingly analyzed in the European and the US contexts (Limtanakool, Dijst, & Schwanen, 2006; Pitombo, Kawamoto, & Sousa, 2011; Van Acker, Mokhtarian, & Witlox, 2011), have drawn much less attention in the Latin-American context (Mihyeon Jeon, Amekudzi, & Vanegas, 2006). To date, the literature on Latin-American cities has paid more attention to the built environment determinants of travel behavior (Cervero, Sarmiento, Jacoby, Gomez, & Neiman, 2009; Hino, Reis, Sarmiento, Parra, & Brownson, 2011; Sarmiento et al., 2010) either as a catalyst of healthy mobile behaviors (Parra et al., 2010) or to evaluate policy interventions strategies (Gomez et al., 2015; Velásquez-Castañeda, 2013). From the social perspective, there has also been some interest in observing how personal values shape travel behavior in the Argentinean (Jakovcevic & Steg, 2013) and Colombian contexts (Jakovcevic, Díaz-Marín, Moreno, & Tonello, 2014). Finally, we can also find some valuable studies on the social appraisal of the proximity environments such as those conducted by Lazo (2012), Jouffe (2011) and Jouffe & Lazo (2010), together with a territorial analysis of the lifestyles in the peripheries of Latin-American cities (Lindon, 2002). However, these sociological analyses, although useful, tend to fall short when analyzing modal choice, habits, and travel decisions.

Understanding the local activity patterns for a highly unequal society like Medellín (Medina, Morales, & Núñez, 2008), together with the willingness of the inhabitants to walk or take short trips on a daily basis can help to understand the demand for mobility beyond the territorial or infrastructure perspective. In similar studies conducted in the European context, it has been demonstrated how the local scale of the city provides a safe haven for the most deprived social groups (Marquet & Miralles-Guasch, 2014). For those with difficult access to the transportation systems, being able to locate a part of their everyday mobility inside the near neighborhood and within walking distance can help alleviate their everyday temporal and spatial constraints (Boussauw, van Meeteren, & Witlox, 2014). Marquet & Miralles-Guasch (2015b), and Boussauw (2011) report that distance traveled is often a function of the specialization of the trip end. Short walking trips, which cover small distances are typically used for personal purposes, creating a duality on which the large traveled distances invested in occupational or highly specialized purposes are compensated by shorter journeys for purposes such as everyday shopping or other personal business (Marquet & Miralles-Guasch, 2014). Scheiner (2010) also reported gender and economic gaps in traveled distances with women and lower economic groups traveling shorter distances. Finally, other factors that are strongly present in the European and the US reality, such as the strong friction of distance that affects walking trips (Millward, Spinney, & Scott, 2013) and that makes walking acceptable for only short distances, might be challenged in more unequal societies with less access to the private car.

What most of these studies demonstrate is that local travel has specific components that are highly dependent on the studied population/social group. It is therefore necessary to understand how people in Latin America are using this mobility of proximity at the same time that we analyze other related aspects like their willingness to walk over short distances.

3. Accessibility and transport investment in Medellín, Colombia

Improving accessibility levels, reducing car dependency, and producing walkable environments are thus policy priorities for most developing countries and Latin-American cities. In the specific case of Medellín, the Metrocable system has proven to be a useful tool for the integration of neighborhoods with difficult access, and its construction has been complemented by interventions on public space, housing, and employment in specific deprived neighborhoods (Brand & Dávila, 2012). According to Leibler & Musset (2010), the Metrocable project has been a useful tool for social justice and to reduce inequalities between territories. Medellín has made an effort to become a livable city by putting the improvement of everyday mobility and accessibility as the prime target of public policies. The transition from a highly unsafe city to an innovative and attractive metropolis has drawn a lot of attention into the Medellín case, making it an example of a successfully transformed city (Drummond, Dizgun, & Keeling, 2012).

However, despite these efforts on social urbanism, Medellín is still a highly unequal city, both in morphological (Medina et al., 2008) and social terms (Velásquez-Castañeda, 2013). As demonstrated by Drummond et al. (2012), the investment in public transport has made more at the symbolic level than at the practical level, and the city still faces huge challenges in mobility and accessibility.

4. Methodology

4.1 *Measuring local accessibility*

To measure local accessibility through the prism of everyday mobility (Neutens, Schwanen, & Witlox, 2011) we analyze proximity trips from a large travel survey in Medellín. These proximity trips are defined by a combination of time and modal choice. A complete explanation on the concept and definitions of a proximity trip can be found in Marquet & Miralles-Guasch (2015b). Those travels made in a non-motorized mode of transport and those that took 10 min or less from origin to destination are selected and labeled as proximity trips. These kinds of trips cover a small distance made in a universally accessible and clean mode of transport. In addition, they also take a range of travel time, an essential part of accessibility measurements (Curl, Nelson, & Anable, 2011), that has been commonly considered as short and easily available (Ryley, 2008). With this definition, a proximity trip represents a traveled distance that is consistent with the general idea of the neighborhood (Sugiyama, Francis, Middleton, Owen, & Giles-Corti, 2010) and is also a clear indicator of local activity. Observing the distribution of proximity trips among the social groups and strata allows us to understand how each social group relates to their most immediate neighborhood. A proximity trip is composed by a modal choice and a temporal attribute, and therefore, when analyzing the willingness of different social groups to take proximity trip, we must consider both combined factors. A social group in particular might be using less proximity trips because of their low willingness to walk or because of the lack of nearby services to which they can travel within a short period of time.

4.2 *Medellín and main data source*

The study is focused on the municipality of Medellín, capital of the Antioquia Department, located in the northwest of Colombia. Medellín is situated in the Valle de Aburrá natural region, in the central Andes. Medellín is also the most important municipality of the Valle de Aburrá metropolitan area that encloses 9 other municipalities and has up to 2.46 million inhabitants. The city of Medellín is administratively divided into 16 *comunas* and 5 rural *corregimientos*. Due to the urban dimension of the present research, the rural *corregimientos* have been excluded from the final analysis.

The main data source has been the Encuesta Origen Destino (EOD 2012), which is a large travel survey that has been carried out by the Metropolitan Area of the Valle de Aburrá in collaboration with the National University of Colombia and the Planning Department of the City of Medellín. The survey was conducted with the purpose of analyzing the everyday mobility of the inhabitants of the Valle de Aburrá together with the freight mobility (AMVA & Univesidad Nacional, 2012). The mobility data provided by the EOD 2012 survey make it possible to know the travel patterns of the region and to characterize the people's main mobility habits.

The survey sample included a total of 65,865 people living in the Valle de Aburrá of which 41,000 were living in Medellín. The sampling provided a confidence level for the study of proximity of 95% with a ± 0.37 relative error. The survey was conducted in person, asking for the mobility data corresponding with a working day for people of all ages and occupations. The EOD 2012 also includes socioeconomic indicators, and in addition, it incorporates the economic stratification scale, a classification used by local authorities to tax public services according to people's economic status (DANE, 2012). The use of the economic strata adds some valuable information to a context of great economic disparities.

4.3 *Variables and analysis*

The analysis used a wide range of trip-related variables together with predictor demographic, socioeconomic, and built environment variables. Demographic and socioeconomic variables were provided by the EOD 2012 matrix and included *Gender* (male, female), *Age* (<21; 21–55; >55 years), *Educational level* (none/elementary; secondary studies; college studies), *Economic strata* (low: strata 1 and 2; medium: strata 3 and 4; high: strata 5 and 6), *Employment status* (employed; retired; unemployed), and *Vehicle availability* (car; motorcycle/scooter; none available).

Selected built environment characteristics like *population density* and *land use mix* were also added as standardized variables to the analysis. These variables were computed at the *comuna* level by the Planning Department of the City of Medellín (Departamento de Planeacion. Alcaldia de Medellin, 2014). Finally, *insecurity levels* computed at the *comuna* level were also added as an important built environment attribute that is capable of modifying travel behaviors. *Comunas* in Medellin were classified upon three insecurity levels based on the reporting of thefts and other major crimes extracted from municipality statistical data (Alcaldía de Medellín, 2010). From

all the trip-related data available in the EOD 2012, the study used the variables *modal choice, length of the trip* (in minutes), *purpose of the trip* (occupational; personal; return home), and *time of the trip* (morning, midday, and afternoon).

The study uses a sequence of quantitative analysis to shed light on the use of proximity trips. Right after a preliminary bivariate explorative analysis, a CHAID (Chi-square Automatic Interaction Detector) decision tree is implemented to profile the most and least frequent users of proximity-based trips. The CHAID method has now an established tradition in transport studies (Pitombo et al., 2011; Zhang, Yu, & Chikaraishi, 2014) and is especially useful when trying to understand the behavior of a set of interrelated nominal variables when faced with a single decision. In this specific case, age, gender, and socioeconomic strata were used as predictors of taking or not a proximity-based trip. Decision trees split the data to form homogeneous subsets, but they differ from other regression analyses by making the decision of which predictor comes into play at a more localized level (Sullivan & van Zyl, 2008). At each node, the decision upon which an independent variable is most related with the dependent variable is calculated, but only within the subpopulation in that node and the relation is measured via chi-square testing (Horner, Fireman, & Wang, 2010).

In order to analyze how demographic, socioeconomic, and built environment variables affected the decision to take a proximity trip, a series of logistic regression was implemented. The binary logistic nature of the regression fitted our nominal predictors and our binary dependent variable. Three logistic regressions were run; the first one was to estimate the probability that a person would choose to use a proximity trip over any other kind of trip. Two more regressions were run to estimate the probability to engage in a walking trip and the probability of taking a short trip (<10 min). With each logistic regression producing each group's odds ratio (OR) of engaging in a specific travel behavior, it was possible to understand not only the willingness of taking a proximity trip but also the OR of taking either of the two components of proximity: a walking trip and a short trip. With this method, it was possible to assess particular situations like the possibility that some group's proximity usage might be dragged by an unwillingness to walk or by the lack of destinations in the range of a short trip. Statistical comparisons were made using SPSS version 19.0.

5. Results

5.1 *Explaining local traveling as a travel choice*

The sample characteristics and the breakdown of the introduced variables are shown in Table 1. Overall, the EOD 2012 reports 51,411 trips that took place inside the city of Medellín in a working day. Of those, 14.4% met the conditions to be considered proximity trips, and thus local trips, as they were undertaken by walking and took less than 10 min. The average number of proximity trips however is not representative of the importance that local scale mobility seems to have in the everyday mobility of certain population groups. In fact, the results in Table 1 clearly show a distinctive use of the trips throughout social groups. Among those for whom short walking trips constitute more than 20% of their overall mobility, we find people younger than 21 years of age (24.5%) in the population with either elementary studies or no studies (29.5%), the unemployed population (55.6%), or those who live in urban environments with high population density (23.6%). On the other

Table 1. Bivariate relation between main variables and the use of proximity.

Independent variables	Proximity trips Row %	Non proximity trips Row %	Total Col %	Association measures *p*-value	Cramer's V	Eta
Demographics						
Gender				<0.001	0.049	
Male	12.6*	87.4**	49.3			
Female	16.1**	83.9*	50.7			
Age				<0.001		0.195
Age <21	24.5**	75.5*	30.3			
Age 21–55	9.1*	90.9**	56.7			
Age 55+	13.6	86.4	13.0			
Socioeconomics						
Educational level				<0.001		0.194
None/ elementary studies	29.5**	70.5*	12.6			
Secondary studies	14.7**	85.3*	62.2			
University studies	6.1*	93.9**	25.3			
Economic strata				<0.001		0.110
Low	17.8**	82.2*	45.0			
Medium	13.3*	86.7**	40.6			
High	6.5*	93.5**	14.4			
Employment status				<0.001	0.213	
Employed	7.2*	92.8**	50.4			
Retired	12.6*	87.4**	5.1			
Unemployed	55.6**	44.4*	44.6			
Vehicle availability				<0.001	0.121	
Car	7.2*	92.8**	23.8			
Motorcycle/ scooter	13.4*	86.6**	15.8			
None	17.4**	82.6*	60.4			
Built environment						
Population density				<0.001		0.208
Low	5.3*	94.7**	33.4			
Average	15.1**	84.9*	36.9			
High	23.6**	76.4*	29.7			
Land use mix				<0.001		0.168
Low	21.4**	78.6*	34.1			
Average	13.4**	86.6*	42.7			
High	5.7*	94.3**	23.3			
Insecurity				<0.001		0.203
Low	21.9*	78.1**	37.9			
Average	14.6	85.4	32.7			
High	4.4**	95.6*	29.4			
Trip characteristics						
Purpose				<0.001	0.041	
Occupational	14.2	85.8	36.8			
Personal	17.5**	82.5*	16.6			
Returning home	13.4*	86.6**	46.6			
Time				<0.001		0.068
Morning	13.5*	86.5**	39.0			
Midday	18**	82*	29.0			
Afternoon	12*	88**	32.0			
Total	14.4	85.6	100.0			

*Significantly higher values.
**Significantly lower values.

end, there are some social groups that seem to avoid almost completely the use of this near scale mobility. That is the case of those with university studies (6.1%), the higher economic class (6.5%), or those who live in neighborhoods with low population density (5.3%) or high insecurity levels (4.4%).

5.2 Profiling the proximity users in Medellín

Using a CHAID decision tree method to visualize the gender, age, and socioeconomic strata variables (Figure 1) creates an easy-to-read map of users and non-users of proximity. Age proves to be the most important factor in predicting proximity. Children and teenagers (node 2) have the largest proportion of proximity trips, as 24.5% of all their journeys are made by walking and in a maximum time period of 10 min. The older people (node 3) are using proximity for 13% of their trips, and finally, adult people (node 1) are using proximity for only 9.1% of their trips. These lower values of the adult group reflect time constraints and time budgets of the adult population (mostly working population) in addition to their economic ability to move by using a motorized means of transport. For both adults and older adults, the following explanatory factor is gender; it is noteworthy how in both cases women take proximity trips in greater proportion than men. Finally, economic strata is also found to be affecting proximity trips, as those people with higher economic status clearly are using less proximity trips than the lower economic classes. Of the entire sample, the group that has a higher proportion of proximity use contains the elderly women of high and medium (17.9%) economic class. In contrast, adult men of high economic class are the ones that most seldom use these kinds of trips (3.5%).

5.3 Local traveling multivariate analysis

Although it seems clear that the most frequent consumers of proximity in Medellín are the young, the females, and the low class population, age, gender, and economic status are not the only factors at play. Taking a short walking trip is a complex mobile behavior comprised by the willingness/potential to walk plus the willingness/possibility of taking a short trip. This means that for some population groups, proximity traveling can be impossible because of their reluctance to walk or because of the physical impossibility of finding a suitable destination within a range of a 10-min trip. Understanding how the relationship of the different social groups toward proximity is also a result of their relationship toward walking and toward taking short trips will help us understand the nuances of local scale and inner-neighborhood traveling.

Table 2 depicts the role of the demographic, socioeconomic, built environment, and trip-related variables in determining the willingness to: (1) walk, (2) take a short trip, or (3) take a proximity trip. Results of the logistic regression can reveal some important trends on each analyzed travel behavior. The model does a better job at predicting the willingness of the different social groups to walk (Nagelkerke = 0.318), than their willingness to take short trips (Nagelkerke = 0.098). As a result, the R^2 value of the logit model suggests a reasonable performance of the selected variables in trying to explain the variability on proximity use (16.1%).

On the right-hand part of Table 2, we can see the OR for the possibility of engaging a proximity trip. In terms of the demographic variables, the logistic regression confirms that women

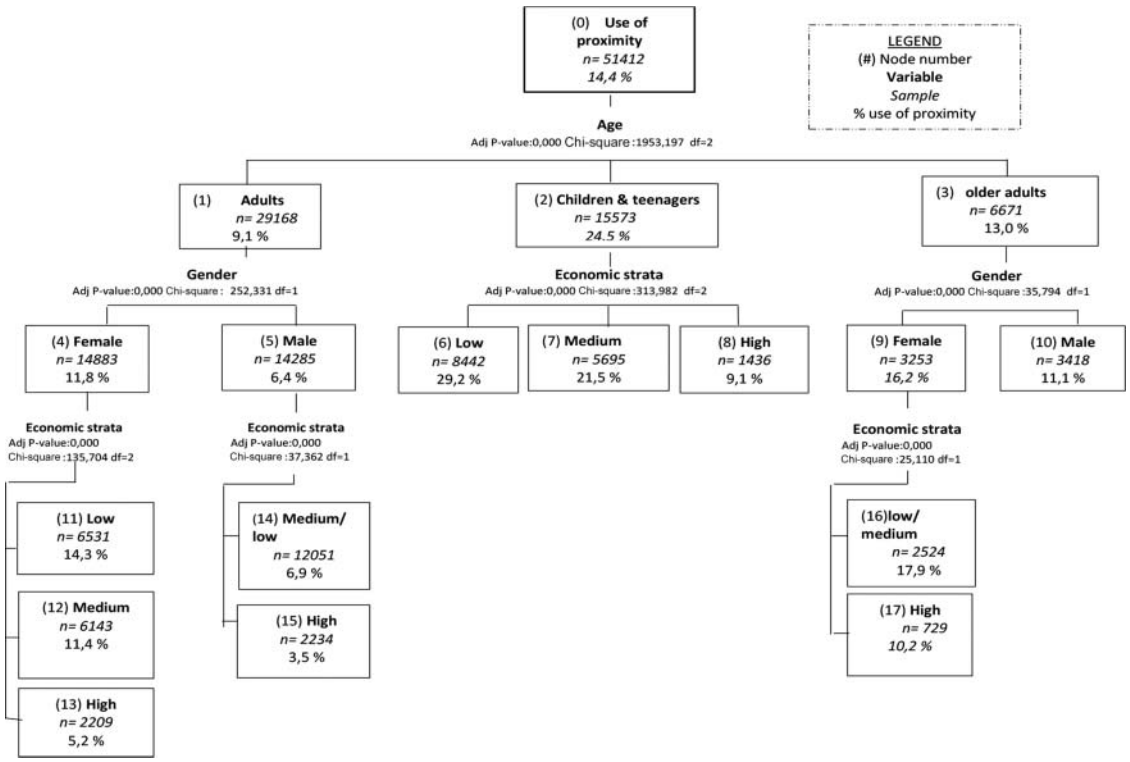

Figure 1. CHAID decision tree: users of proximity.

Table 2. Relationship between variables and walking, taking a short trip or a proximity trip.

	Probability of taking a walking trip			Probability of taking a short trip			Probability of taking a proximity trip		
	Dependent variable: 'Is it a walking trip (1 = yes, 0 = no)			Dependent variable: 'Is it a <10' trip (1 = yes, 0 = no)			Dependent variable: 'Is it a proximity trip (1 = yes, 0 = no)		
Independent variables	Sig.	Exp(B)	95% CI	Sig.	Exp(B)	95% CI	Sig.	Exp(B)	95% CI
Gender									
Male (=ref)		1			1			1	
Female	0.657	1.01	[0.96;1.05]	0.003	1.07	[1.02;1.12]	0.000	1.16	[1.10;1.22]
Age									
Age <21 (=ref)	0.000	1		0.000	1		0.000	1	
Age 21–55	0.000	0.54	[0.51;0.57]	0.000	0.72	[0.67;0.76]	0.000	0.68	[0.63;0.73]
Age 55+	0.000	0.71	[0.65;0.77]	0.000	0.84	[0.77;0.92]	0.000	0.78	[0.70;0.87]
Educational level									
None/elementary (=ref)	0.000	1		0.000	1		0.000	1	
Secondary studies	0.000	0.57	[0.53;0.60]	0.000	0.61	[0.57;0.65]	0.000	0.65	[0.60;0.69]
University studies	0.000	0.43	[0.39;0.47]	0.000	0.61	[0.55;0.66]	0.000	0.49	[0.43;0.54]
Economic strata									
Low (=ref)	0.000	1		0.000	1		0.000	1	
Medium	0.000	1.22	[1.16;1.28]	0.000	1.23	[1.16;1.29]	0.000	1.13	[1.06;1.19]
High	0.000	0.79	[0.71;0.87]	0.000	1.75	[1.59;1.92]	0.483	1.05	[0.92;1.18]
Employment status									
Employed (=ref)	0.000	1		0.000	1		0.000	1	
Retired	0.000	1.92	[1.71;2.15]	0.001	1.23	[1.08;1.39]	0.000	1.65	[1.41;1.92]
Unemployed	0.000	2.68	[2.52;2.83]	0.000	1.53	[1.43;1.63]	0.000	1.98	[1.82;2.13]
Vehicle availability									
Car (=ref)	0.000	1		0.012	1		0.000	1	
Motorcycle/Scooter	0.000	1.47	[1.35;1.59]	0.048	1.09	[1.00;1.17]	0.000	1.36	[1.22;1.50]
None	0.000	2.41	[2.25;2.57]	0.676	0.99	[0.92;1.05]	0.000	1.68	[1.53;1.82]
Population density									
Low (=ref)	0.000	1		0.000	1		0.000	1	
Average	0.318	1.09	[0.92;1.27]	0.000	0.65	[0.55;0.76]	0.039	0.79	[0.62;0.98]
High	0.000	1.55	[1.31;1.83]	0.137	0.88	[0.73;1.04]	0.169	1.18	[0.93;1.48]
Land use mix									
Low (=ref)	0.000	1		0.000	1		0.000	1	
Average	0.001	0.89	[0.83;0.95]	0.045	1.07	[1.00;1.15]	0.001	1.14	[1.05;1.23]
High	0.935	0.99	[0.86;1.13]	0.000	0.63	[0.55;0.72]	0.299	0.90	[0.74;1.09]
Insecurity									
Low (=ref)	0.000	1		0.000	1		0.000	1	
Average	0.000	0.79	[0.73;0.84]	0.000	0.82	[0.76;0.87]	0.000	0.74	[0.68;0.80]
High	0.000	0.34	[0.29;0.38]	0.000	0.36	[0.30;0.42]	0.000	0.24	[0.19;0.28]
Purpose									
Occupational (=ref)	0.000	1		0.000	1		0.000	1	
Personal	0.000	1.31	[1.21;1.40]	0.000	1.40	[1.29;1.50]	0.000	1.28	[1.17;1.39]
Returning home	0.000	1.29	[1.21;1.38]	0.634	1.02	[0.94;1.08]	0.038	1.09	[1.00;1.17]
Time									
Morning (=ref)	0.000	1		0.000	1		0.000	1	
Midday	0.000	1.41	[1.32;1.49]	0.000	1.17	[1.10;1.24]	0.000	1.17	[1.09;1.25]
Afternoon	0.000	1.30	[1.21;1.39]	0.001	1.13	[1.05;1.21]	0.000	1.20	[1.10;1.31]
Constant	0.000	0.30		0.000	0.45		0.000	0.15	

are 1.16 times more likely than men to take a proximity trip, whereas young people below 21 years of age have a larger OR of opting for this kind of mobile behavior. People aged between 21 and 55 years were taken as a reference and appeared to be in fact the group that was least susceptible to taking a short walking trip. There is a stark decrease in the frequency of utilization of proximity trips when we turn from the young (reference category) to the adult age range (Exp(B) = 0.68). The most radical change of behavior is found in men, for whom proximity trips represent 25% of their overall mobility when they are young (<21 years of age) but only 6.4% when they grow into the adult category (22–55 years of age). The possibility that an adult male chooses a proximity trip is thus a quarter of what it used to be when he was under 21 years of age. This same trend is also found in women although in a mildly manner, as they cut their proximity use by half as their age.

In terms of educational level, those with secondary or university studies are much less likely to engage in a proximity trip than their counterparts. This same link is clearly reported also in terms of social class and professional activity. These three categories seem to be highly correlated as higher educational levels entail more possibilities to be employed and thus higher possibilities to break into the higher economic strata. The employment variable is in fact the most important single variable in determining the use of proximity trips. As we could see in Table 2, employed people use short walking trips for only 7.3% of their trips, when for unemployed people, proximity trips represent 55% of their overall mobility. Because of that, the logistic model finds the unemployed people to be 1.98 times more susceptible to taking a proximity trip than the employed population. There is obviously some collinearity here, as employed people also tend to be people between 21 and 55 years of age with higher educational levels and also using a higher share of occupational trips, areas all negatively correlated with proximity traveling. In terms of economic status, the low-income

population is also the one with a higher OR of using a proximity trip, although the differences between low and high social classes are smaller than the differences found in the case of the employment status. Finally, the last socioeconomic variable to be tested was the availability of a motorized vehicle. Quite obviously, having access to a car was found to be an indicator of lower chances of using a proximity trip, while those who had access to a motorcycle were found to be 1.3 times more probable to use a proximity trip compared with car users.

With respect to the built environment variables, population density and land use mix showed contradictory results. Whereas, bivariate analysis in Table 2 showed how high populated areas and low mixed areas concentrated on a higher degree of proximity trips, the logistic regression results are inconclusive, in part due to the lack of statistical significance in the high-density and high mixture categories. Results however clearly show that the most important built environment indicator is insecurity. In average or highly insecure areas, the odds of taking a proximity trip are much lower (Exp(B) = 0.74 and 0.24) than those in the most safe areas.

Finally, the analysis of the trip-related variables in the form of trip purpose and the time when the trip was taken also shows interesting results. Proximity trips are more frequent when they serve a personal and non-occupational purpose (Exp(B) = 1.28), while the return home is slightly more balanced (Exp(B) = 1.09). In terms of time of the day, proximity trips are more often taken at midday and in the afternoon sections of the day, with the coefficient estimates of the trips that are made in the morning being much lower.

5.4 *The components of proximity use and local traveling*

As a complex mobile behavior, proximity traveling is not a mobile choice on its own, but a composition of the attitudes toward walking and taking short trips. Thus, to understand the complexities of proximity traveling, it is also necessary to understand how each social group relates to both walking and short trips. Table 3 has also the logistic regression for the probability of taking a walking trip and the probability of taking a short trip. Understanding the reluctance/eagerness of each social group to take a walking or short trip (Figure 2) helps us understand their final attitude toward proximity traveling.

On the graphic representation of the OR for walking, short and proximity trips, obtained through the logistic regressions, it is clear that the probability of taking a proximity trip is the result of different combinations toward time use and modal choice. In most of the cases, the probability of taking a proximity trip appears as a middle ground between a high willingness to walk and a low possibility of taking short trips. That is the case for retired and unemployed people, together with motorcycle users and those who do not have access to a motorized

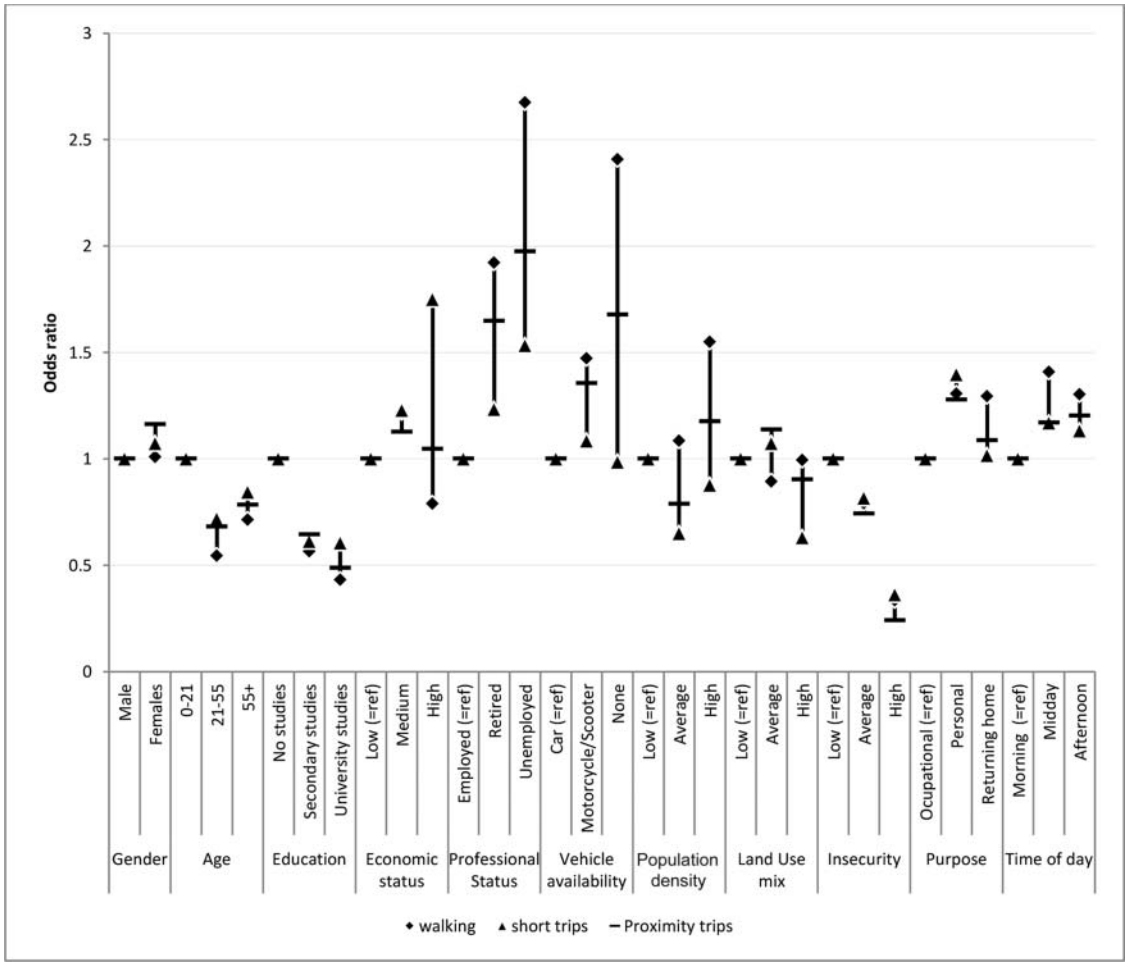

Figure 2. Graphical representation of the odds ratio of engaging in a walking/short/proximate trip.

vehicle. In addition, that is the same situation found in average and high population density areas, where walking is highly frequent but short walking trips are scarcer. On the reverse side, there are some groups that show a high preference toward short trips but also a very low propensity to walk. That is the case of those within the range of 21–55 years of age, those with college-level studies, and above all, those with a high economic status. Overall, the variables with higher internal differences between walking propensity and utilization of short walking trips are the professional and economic status.

Only in a handful of cases, we find that proximity use is either higher or lower than both walking and short trip propensity. Within these cases, we find women, those with secondary studies and those who live in areas with average land use mix. On the other hand, trips that are made in average and highly insecure areas tend to show a lower propensity of being proximity trips than either walking or short journeys.

6. Discussion

The study of the factors determining local accessibility and the mobility of proximity in Medellín has shown significant differences from similar studies conducted elsewhere. The specific conditions of the Latin-American city develop its own particular determinants of travel behavior, expressed in the present article, not only on the use of proximity trips but also on the willingness to walk and the availability of short trips for everyday mobility. Only 14% of the overall mobility of Medellín is conducted through proximity trips, a low number when compared to the 24% of proximity trips of other cities like Barcelona (Marquet & Miralles-Guasch, 2015b). The role of proximity traveling is however much more important for some specific social groups such as the people under 21 years of age, the unemployed, the low educated, and those without access to private motorized modes of transport. The study confirms that for those social groups, the neighborhood scale constitutes a territorial capital through which they can alleviate part of their transport disadvantage (Jouffe, 2011).

Due to their role in determining mobility needs, both demographic and socioeconomic indicators are found to be highly associated with proximity use. Among this set of predictors, the case study of Medellín highlights the role of employment status, educational level, and age. These results reproduce an established trend that recognizes the role of socioeconomic factors in determining mobility patterns (Buehler, Pucher, Merom, & Bauman, 2011). In contrast, gender differences are not found to be as relevant as in other studies (Law, 1999; Scheiner, 2010). The combination of education and professional status creates severe travel differences between what we could call a higher class composed of highly educated and employed people who usually have easier access to the car, and a lower class composed of the poorly educated and often unemployed population. For the higher class, the use of proximity is hindered by an extremely low propensity to walk for transport (see Figure 2).

This aversion toward walking can be explained by a combination of factors. First, as first demonstrated by Steg (2005) and by others afterward (Barr & Prillwitz, 2014), the use of the private vehicle is seen as a sign of social status and personal success and contains a number of lifestyle-related significances (Freudendal-Pedersen, 2009). In highly unequal societies, like the one that characterizes Medellín, some forms of mobility are synonymous with social status (Jouffe & Lazo, 2010). Notwithstanding, the strong relationship between highly educated/economic classes and the avoidance of walking can be attributed to the insecurity factor, which is still prevalent in most Latin-American metropolises (Gomez et al., 2015) and particularly in Medellín (Naranjo Sanín, 2010).

Insecurity is found to be one of the main mobility changers in our study, as it affects travel behavior in different ways. On the one hand, general insecurity levels are the origin of the creation of gated communities and segregated residential areas for the medium- and high-income groups (Jaramillo et al., 2012). Segregated communities are often characterized by low land use mix (Yang, 2008), which also entails a high car dependence. On the other hand, high criminality levels also force people toward some modes of transport that are perceived as more secure, with walking being perceived as the more exposed mode of transport. According to Schwanen et al. (2015), the overall effects of perceived insecurity can cause a fear-based exclusion toward certain modes of transport. Taking into account city-wide insecurity levels and localized insecure areas or neighborhoods can improve our understanding of the willingness to walk of specific groups of people or in particular urban areas.

Among the built environment variables, this study has failed to find a clear relationship between built environment factors that are traditionally associated with walkability, like population density and land use mix. While population density is positively associated with proximity and walking, land use mix is not. These counterintuitive results are due to the negative linear relationship between population density and land use mixture in Medellin, where the densest areas are also found to be the ones with less land use mixture. Together with that, we find a clustering of the poorer population in the denser–less mixed urban areas. At the end, the densest urban areas are the ones that are generating more proximity trips, despite the fact that they also tend to be the less diverse in terms of land mix and the ones with a more difficult topography (Cordoba et al., 2014). In our opinion, this only reinforces our findings on the importance of the socioeconomic factors above the built environment ones in determining travel behavior in Medellin. Finally, in what refers to travel variables, our study finds a weak relationship between the travel purpose and the use of proximity. While Marquet & Miralles-Guasch (2014) found a very strong association between personal travel purposes and the use of proximity trips, and Boussauw (2011) reported a high correlation between traveled distances and travel purpose, in Medellín, this relationship is clearly weaker as other variables such as socioeconomic status and insecurity levels clearly are affecting the possibility of taking a proximity trip to a greater degree than the specialization of the trip end.

Overall, the analysis highlights the specificities of the Latin-American cities as results challenge some previously assumed determinants of travel behavior that were tested in developed countries and that are not reproduced in cities with different morphological, topographic, and social realities such as Medellín. Results in this article also contribute to some of the key research questions on accessibility stated by Van Wee (2016), analyzing the role of short distances and slow modes in accessibility analysis. While Van Wee's prediction that short

distance and slow mode trips would be highly dependent on the activity or trip purpose was confirmed in the European context by Marquet & Miralles-Guasch (2015b) and Limtanakool et al. (2006), the current analysis demonstrates that proximity use in Medellin is far less associated with trip purpose and much more related with the characteristics of the people who travel.

In terms of policy implications, our findings suggest that public policies oriented to encourage modal change promoting active modes of transport might find additional difficulties in Latin America due to the fact that the willingness to walk is driven by a slightly different set of variables. As Jakovcevic & Steg (2013) have proven, these differences are not located in the belief system, as both Latin-American and European/Northern American citizens share similar values toward the different modes of transport. It is thus more a matter of additional factors influencing travel behavior. Our results suggest that among these differential variables, one might find a stronger relationship between social status and the willingness to walk, as well as a powerful role of the perceived insecurity factor, that has even stronger effects on the higher classes.

Finally, our results show how some socioeconomic groups develop a stronger dependence toward their neighborhood and their immediate urban environment. Consistently with the theories expressed by Jouffe (2011) and Lazo (2012), our results confirm that the local scale is used predominantly by the low educated, the unemployed, and the lower economic class. The importance of the neighborhood in everyday life is not evenly distributed among all social classes, but rather concentrated in the classes that are commonly associated with the transport disadvantage. This is important when addressing not only *how* we can improve general accessibility levels but also when taking into account *who* is benefiting or not benefiting from it (Curl et al., 2011). In terms of policy, this reinforces the idea expressed by Manaugh & El-Geneidy (2012) that increases in accessibility levels should not be prosecuted only through infrastructure investments but rather through investments in local distribution of services and the design of proper environments that promote and facilitate mobility through active modes of transport.

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