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Periurban Urbanization and Travel Choice Behaviour: Problem or Solution?

M A Hermida*, D Astudillo and F León

Universidad de Cuenca, Departamento de Espacio y Población, LactaLAB-Ciudades Sustentables, Facultad de Arquitectura y Urbanismo, Cuenca, Ecuador

augusta.hermida@ucuenca.edu.ec

Abstract. In 21st century cities, an adequate urban design represents a great opportunity to reduce the number of trips and distances travelled. It is also known that improving city design and transportation networks could reduce carbon emissions more than replacing all fossil fuels with renewable energies. With this background, it seems fundamental to focus on the systemic relationship between urban forms and travel choices behaviours. In the case of the city of Cuenca (Ecuador,) in the last 5 years, more than 70 mono-functional urbanization and condos, many of them being gated-communities, have been built outside the urban limits. These form of urbanization is supported both by public and private promoters. Due to this situation, this research project seeks to determine the relationship between the location of these urbanizations and condos, with the travel choice behaviour of users. Geographic information systems, Q methodology, travel diaries and qualitative methods were used for data collection and spatial representation. Three discourses were found, people who preferred the proximity to nature and open spaces, other who gave more importance to efficient mobility and the last ones for whom security was the most important aspect. This work opens possibilities for further research on the importance of urban form for sustainable planning and mobility.

1. Introduction

Since the 50s in the United States middle and upper classes started to move away from the urban centres, leaving cities with low densities [1]. Since then, the idea of peri-urbanization or urban sprawl started to propagate to other countries through the 70s, and was principally established in Latin America countries [2]. The peri-urbanization concept is understood as the constant prolongation of the urbanized city into the rural area; mainly, with a residential character and distinct ways of appropriation and use of space [1], situation that has given place to a hasty and unmeasured urbanization growth [3]. One of the principles that define peri-urbanization is mobility because there is a considerable increase in the distances people need to cover every day [1]. This has originated an unmeasured exploitation of fossil fuels due to the excessive use of private vehicle as the principal mean of transportation [4]. The mobility conflict, added to the lack of investigations in the local context, ratifies the importance of performing studies that allow debate about the impacts that gated communities and condos in the periurban may generate in relation to travel choice behaviour and the city's energy consumption [5]. With this background, the purpose of this research was to analyse people's preferences regarding housing typology according to their location and travel choice behaviour, and also to compare the displacements regarding transportation means depending on gender and location. The research was held in Cuenca, city located in the Andean region of Ecuador, with



505.585 thousand inhabitants and a mild weather that ranges between the 15°C. The study area was the urban and the extension area, with a total of 18.678,06ha [6]. In the last 60 years, Cuenca's population density has decreased by 30% [7] and has shown an unnecessary tendency to sprawl [8].

2. Theoretical framework

Periurban or peri-urbanization is understood as the constant extension of urban areas of the city that gradually occupy the rural space, forming indefinite limits where the land use and the ways of rural and city life get mixed [1]. Due to land speculation, to an idealistic idea of a countryside life, and in a much smaller proportion, due to population growth, inhabitants have been forced to spread on surface. That is why they are occupying areas with agriculture value and also others with low productive value, but anyhow, they are transforming the environment and generating a land dispute between urbanization and agricultural [9]. In the case of Ecuador, residential complexes called condos can be developed in a horizontal or vertical way. Horizontal condos consist of single-family houses, cheap or expensive, depending on the socio-economic level of its occupants. The building types can be detached or continuous with or without front retreats and private access streets. While vertical condos or also called apartment buildings [10] are configured under the condominium ownership because they own a particular area and besides they share common spaces of such as: circulation paths, meeting rooms and service zones. In the other hand, gated communities are made up of detached houses of variable surface, with low-densities. They are mostly located in the periphery of the cities; contiguous to extensive green areas with good environmental conditions and high landscape quality. Gated communities have physical barriers or doors, which privatise the public space [11]. An important aspect in the analysis is gender, which implies important differences in the ways in which mobility is lived, perceived and developed. For these reasons it would be wrong to continue conceiving pedestrians, passengers and drivers as universal subjects. Indeed, mobility research suggests that women have different mobility patterns than men, but in spite of that, public policies often do not respond to their needs, and insecurity and violence are present in their daily displacements [12].

3. Methods

Q-methodology was chosen because it allows the study of people's subjectivity. The British psychologist William Stephenson developed it in 1935, as a tool that could analyse the subjective perspectives of a heterogeneous group of people on a specific topic [13], in which qualitative and quantitative methods are combined [14]. Most of studies performed with this methodology have been applied in topics related to psychology, politics, health, education, environmental researches [15] and also mobility. As in the case of Rajé [16], who used this method to investigate the transport people perceptions. While Morinière & Hamza [17] employed it to relate how the environment influences mobility, thus also, Jones et al [15] investigated the associated subjectivities with walking and biking through the city. As well, Hickman et al [18] examined individual attitudes and speeches of metro trips; likewise, Hickman & Vecia [19] applied the Q-methodology to explore daily perceptions. Furthermore, Van Exel et al [20] explored traveller's preferences and travel average distances, Cools et al [21] used it to segment people and determine which approaches and determinants are important for medium distance travel. Finally, after the literature review, no studies were found that applied Q-methodology in relation to the choice of housing typologies, but with neighbourhoods. Borth & Summers [22] employed it to identify homebuyer's opinions and ideas about choosing home locations. The first step for the application of Q-methodology is the concourse formulation [23]. First of all, the subject to be studied is determined, then the possible perspectives of the topic are described. For this study, variables containing the different housing typologies and the mobility associated to them, according to the area in which they were located, were related. The second step is the definition of the *Q-sample*, a collection of statements that is presented to the respondents for rank ordering in a Q-sort [21] (p. 443). This study started with 36 statements, which were reduced to 9, and gather all the housing typologies existing in the city: gated communities, condos and detached houses. All of them located in the urban and periurban area, excepting vertical condos located in the historical centre

and the travel modes associated. It's important to note that narrative cards were elaborated in the first place, but at the end graphic cards were used because they were more didactic and comprehensible. The third step is the selection of the participants. Q-methodology does not require a large number of participants, because it measures the diversity of opinions. Therefore, it's important to highlight that the participant's selection is not random [24]. For this study, 36 people were selected representing a total of 18 families (table 1). Participants were previously selected, as they had to live in each of the housing typologies included in the statements. The fourth step is the *Q-sorting*; which was administered from May 22 to June 14, 2018. The conditions of the sort were: "Imagine for a moment that you have to move from your present home, but you only have a budget between \$80000 and \$100000. The budget was limited, as it could happen that people imagine living in places where their socio-economic status wouldn't allow them. First of all, the participant received information about the 9 graphics with the statements, and then they were asked to divide them into three groups: most agreed statements, neutral ones and least agreed. Immediately, each participant proceeded to place the cards on the board classifying them in five categories: a) where they would never live; b) where they would prefer not live; c) where they are indifferent to live; d) where they would live; and finally, e) where they would like to live. These categories are awarded a value that varies from -2 to +2. After the ordering process of cards, an interview was applied, asking them the reasons why they prioritized one card or another. In this way it was possible to capture people's perceptions. The statistical processing was performed using open-source software R.

Table 1. Participants' Profile of Q-methodology

Demographic		No. Participants	% Participants
Gender	Male	18	50%
	Female	18	50%
Age	27–46	17	47%
	47–67	19	53%
Monthly household Income	>\$800	2	6%
	\$800–2400	18	50%
	<2400	16	44%
Housing typologies and location	Horizontal condos in the urban area	4	11,11%
	Horizontal condos in the periurban area	4	11,11%
	Vertical condos in the urban area	4	11,11%
	Vertical condos in the periurban area	4	11,11%
	Gated communities in the urban area	4	11,11%
	Gated communities in the periurban area	4	11,11%
	Detached house in the urban area	4	11,11%
	Detached house in the periurban area	4	11,11%
	Vertical condos in the historic city centre	4	11,11%

Travel Dairy was used for the second part of this study; which was oriented to compare people's displacements according to the transportation mode used, differentiating them according to gender and house location. Therefore, travel diaries were applied, since they allow having a complete description about peoples commuting. The travel diary consists of all trips made in a day by a person, chronologically ordered. Its main objective it is to compile some travel characteristics, among them: origin, destiny, motive, hour, transportation mode and time employed. Travel diaries have become an essential tool when comparing displacements in relation to transportation modes used. Cheng et al [25] applied travel diaries to forecast travel demands through the random forest method. Similarly, Shay & Asad [26] employed them to examine travel relationships and transportation modes with the residential location. Moreover, Cervero [27] used them to study a normative model linked to the built

space, cost and socio-demographic factors of the travellers. While, Lucas et al [28] used daily travel diaries to analyse whether travel choice behaviour is linked to their personal limitations and environmental conditions of housing location. Home surveys with socio-demographic information were implemented before travel diaries, since it was necessary to have a participant's profile, as Shay & Asad [26] added, household and personal factors can interact with its environment. For the sample selection, eighteen families were selected from the urban and periurban area of the city, distributed in horizontal and vertical condos, gated communities and detached houses. In addition, as Cheng et al [25] (p. 3) claimed "taking a whole household as a unit, face-to-face, structured interviews were adopted to record all activities", that's why all household members, older than three years old, were surveyed. For the application of the Travel Diary, first the data on the socio-demographic record was filled, and then the travel diary was applied, detailing the journeys made during 24 hours of the previous day. The registered data came from a labour weekday and a Saturday, because the dynamics of these two are different. It was emphasized not to omit any displacement even if it was very short. In the end, 497 trips made by 55 individuals from 18 households were collected for analysis. The interview was conducted personally by prior appointment. The socio-demographic survey was based on some available questions in the Ecuadorian census [7] and in the U.S. National Household Travel Survey [29]. To label the routes of their displacements, the respondents received a Cuenca's map where they registered their trips. This information was processed using ArcGIS software (v. 10.2).

4. Results

For the Q-methodology analysis, in Table 2 the factorised ranking for each statement in each discourse is presented. It shows the three discourses with which the participants identified themselves. The scores range was between -2 to +2 assigned by the participants to each of the nine statements. The 0 represents a neutral position. The places where people wouldn't like to be are represented with -2, while their household ideals are aligned by +2. From the 36 participants, 10 were identified with the first discourse, 12 with the second and 3 with the last. Besides, 11 of them were not statistically significant for any of the discourses. The first discourse (A) was oriented to the proximity with nature and open spaces. The majority of respondents aligned with this discourse, prioritized living in a gated community located in the periurban area, where the use of private vehicle for their daily commuting prevailed. In addition, they agreed to live in a horizontal condo or in a detached house as long as they were located in the periurban area and used private cars. These participants do not tolerate the idea of living in vertical condos of any type. This group was categorized by men who had a higher monthly household income equal to six unified basic salaries (basic salary in Ecuador = 386 US dollars) and by owning two or more cars per family. The second discourse (B) was oriented to efficient mobility. Participants of this group preferred to locate themselves within the urban area, either in vertical condos, gated communities or detached houses, where they can use different travel modes. They rejected the possibility of living in horizontal and vertical condos in the periurban area. The respondents were characterized by inhabiting in detached houses and having a monthly household income level between two and six unified basic salaries. The third discourse (C) was oriented to security. Members on this group preferred to live in horizontal condos and gated communities, located in the urban or periurban area, because of security issues.

For the Travel Diaries analysis, after having the database in the ArcGIS software, the information was segmented, quantified and analysed according to gender, transportation mode and location. Subsequently, other attributes were derived for evaluation. The main transportation mode used by both women and men turned out to be the private car (figure 1): women as passengers and men as drivers. By contrast, it was found that in the two genders, most of the pedestrians' movements were from people inhabiting within the urban area, even though their principal motive was exercising, they felt comfortable with the nature that surrounded them. In addition, bicycle and motorcycle proved to be the transportation modes that were never used by women, due to the insecurity in the streets perceived by them. In men from the urban area, taxis and busses showed as the least used transportation modes, although the ones who resided in the periurban area had never used public transport. In general, men

and women located in the urban area show greater diversity in the transportation mode choice than those of the periurban. Regarding to the kilometres travelled, those men and women who lived in the periurban area travelled more kilometres in general than those in the urban area as their displacements implied long distances. In short, women in the urban area made 118 trips, while men 137 with a total of 615km and 679km respectively. In the periurban case, women made 92 trips and men 95 in 665km and 717km each. These data allowed to observe a clear scenario which indicated that in general men travelled more than women, no matter the area where they were located and the implications of living in the periurban; And, although less number of trips were performed by people living in the periurban, they travelled more kilometres than those of the urban area. Women travelled by car as passengers, and their main travel reason was to go back to their homes. When they mobilized by car as drivers, their reason was for going to work or to leave/pick up a member of the household. Women who resided within the urban area took walks in order to reach their places of study, while those of the periurban walk for sports practice. On the other hand, the main reason in men when commuting by car as drivers was to get to their workplaces, whereas, if they walked was for exercise. Nevertheless, those who used bus were the ones residing in the urban area who travelled to their lunch place. A greater number of trips were performed on weekdays compared to Saturdays, in men and in women, due to the extensive daily activities developed in working days. The number of men and woman average travel on a weekday in the urban area is six, while in the periurban is five. On the other hand, on Saturdays the average was two trips regardless of the area where the person lived. By analysing the travel time employed, there was a coincidence between men and women in the urban and periurban zone. Those who resided in the urban area employed 10-14min in their daily commutes, while those of the periurban 20-24min, this reaffirmed that the long displacements had a noticeable impact on the wasted time on the journeys of those who live far from the city.

5. Discussion

The majority of interviewed people would rather be located on the city outskirts and close to nature – *Discourse A*-, and showed high interest to houses with a wider surface, and open spaces free from the congested city. Accordingly, their trips were related to the use of private car, which facilitated their daily activities and considered it superior to other transportation modes, the same as evidenced by Van Exel et al [20] and the discourse of *car-dependent travellers* by Cools et al [21]. In spite of having preferred the periphery, they needed to feel safe, that's why they were mainly inclined to reside in gated communities or condos, without excluding the possibility of living in a detached house. This reaffirms the *new suburban* discourse proposed by Borth & Summers [22], in which, people chose to be located in the periurban of the city, where there are few connections and low demographic diversity. Instead, *Discourse B* is oriented towards an efficient mobility and was determined by people who employed different transportation modes, which affirmed the *location aware* discourse of Borth & Summers [22]. Furthermore, it was notable that mobility was important for women, thus they had different mobility patterns compared to men: they use more public transport and they walk. Therefore, they need to be located within the consolidated city. The *multi-mode advocate* discourse by Rajé [16] made a comparison between the transportation modes utilized by a 38 old year man and woman that ratified the presence of women employing varied transportation modes. People from *Discourse C* are safety-related; they naturally prioritized safety as the main element when choosing a home. Its location was a secondary factor, as they could be located within the urban as well as periurban area as long as they did it within a condo or gated community. For these people, feeling protected was transcendental, so they preferred to live in complexes where their houses were closer to their neighbours. On the other hand, after analysing the trips carried out in a weekday from the *Travel Diaries*, it was found that in general there's a repetitive pattern in people's trips which was corroborated by the finding of Shay & Asad [26], who detected that the home-work travel represented a routine behaviour, with repeated trips between the same origins and destinations, and at about the same time of day. As a result of this daily routine, congestion used to occur on rush hours. To solve this, policies and programmes should be implemented to aim changing of drivers' behaviour, including the sharing use of vehicles and the increase of non-motorized trips.

Table 2. Statements and scores ranking by discourse.

No.	Statement	Score by discourse		
		A	B	C
1	A similar house within a horizontal condo, located in the consolidated area and from which it's possible to move from one place to another in the transportation mode of your preference.	0	-1	2
2	A house within a horizontal condo where all of them are the same, located on the outskirts of the city and from which you are obliged to use private vehicle, or, in certain cases, bus, knowing that the nearest bus stop is far from your home.	1	-2	-1
3	A house within a gated community where the lot size and its home design are different, located in the urban area of the city and from which it's possible to move from one place to another in the transportation mode of your preference.	0	1	1
4	A house within a gated community where the lot size and its design are different, located in the urban area of the city and from which you are obliged to use private vehicle, or, in certain cases bus, taking account that the nearest bus stop is at a considerable distance from your home.	2	0	1
5	A detached house within the city and from which it's possible to move from one place to another walking, biking or in private vehicle. Also it is near bus stops.	0	1	-1
6	A detached house located at the edge of the city and from which you must use private vehicle, or, in certain cases bus, knowing that the bus stop is far. Also, the displacements are longer.	1	0	-2
7	An apartment located in the consolidated area, and from which it's possible to travel in the transportation mode of your preference.	-1	2	0
8	An apartment located on the outskirts of the city, and from which your daily travel is obliged to use car or bus, knowing that the bus stop is far. Also, the displacements are longer.	-1	-1	0
9	An apartment located in the historical centre, and from which it's possible to move walking, biking, or in bus. There's no garage.	-2	0	0

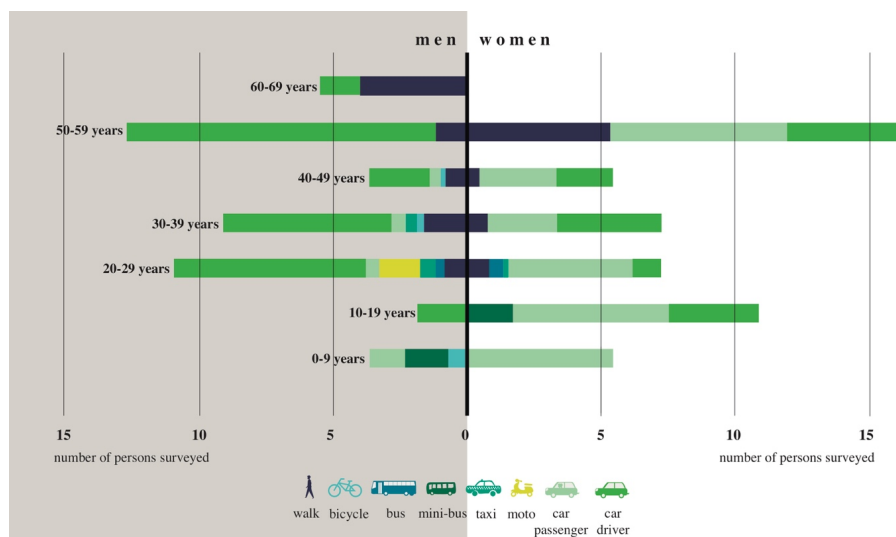


Figure 1. Number of trips regarding gender, age and transportation modes.

Contrarily, Helling [30] reported a stronger link to the usage of cars, more for home-work travels in men than in women, similar to the results we obtained that identified a notoriously superior usage of the private vehicle in male gender. Also, Matthies et al [31] found that women were more willing to reduce the usage of cars than men, mainly because of their environmental awareness and habits. Moreover, the obtained results evidence that age, among other variables, play an important role when choosing a certain transportation mode. Most men and women trips on foot started at their fifties due to prevailing health-related issues. Similarly, Kim & Ulfarsson [32] added that the choice of

transportation modes in elderly and retired people is sensitive to the environment. Shay & Asad [26] showed findings which ensure that personal and household (except the size of the household) characteristics were not statistically associated with the transportation mode choice, while others showed clear relevance, such as the conditions of travel and other relevant variables for the trip: the travel time, environmental factors and cars access. This data was consistent with our results. The level of household income determined certain preferences when choosing a form of urban development and was also associated with the transportation mode choice. The recovered data [26] suggested that people with less access to private vehicles reside in places where the built environment has high ratings on variables such as: density, connectivity, transit and other features of accessible and pedestrian facilities. The same occurred in Cuenca, respondents who showed greater diversity in their transportation mode choice lived within the consolidated area and had all the features mentioned above, while those who lived in the periurban only used private vehicle for their daily trips.

6. Conclusion

In our city, one of the main causes of rural-land occupancy is given by land prices. Rural-land price is notoriously lower in relation to land in the urban area. The perimeter of the city expands continuously and the main stakeholders involved in this phenomenon are private builders, who seek for cheap places, close to large roads that connect the periphery with the centralities. Likewise, it is necessary to get people to examine their location preferences, to be able to rethink their decisions and preferences by analysing the mobility, the transportation modes and the travel time that living in the periurban implies. Today, many cities focus on achieving a sustainable mobility avoiding large distances and long travel times. Policies should promote a compact city model, guaranteeing public transport and ensuring the presence of women to avoid discrimination and gender abuse. Although the results obtained were significant and satisfactory, it is important to mention that the methodologies employed are exploratory. Consequently, if a more comprehensive study were intended the size of the sample should be bigger so as to be more accurate in the results achieved.

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