Available online at www.sciencedirect.com

ScienceDirect

Procedia
Social and Behavioral Sciences

Procedia - Social and Behavioral Sciences 111 (2014) 440 – 449

EWGT2013 – 16th Meeting of the EURO Working Group on Transportation

Spatial analysis of transportation-related social exclusion in the Lisbon metropolitan area

John P. Pritchard[a,]*, Filipe Moura[a], João de Abreu e Silva[a], Luis M. Martinez[a]

[a]*CESUR/DECIVIL- Instituto Superior Técnico - Technical University of Lisbon - Av. Rovisco Pais - 1049-001 Lisbon, Portugal*

Abstract

Social exclusion (SE) is a multi-faceted issue that is often conflated with economic poverty, but the poor are not always excluded, and the rich can also be excluded. In addition to the more commonly acknowledged socio-demographic and socio-economic dimensions, SE has temporal and contextual components that are especially relevant to daily mobility patterns. The goal was to identify socially excluded individuals and any potential areas of the Lisbon metropolitan area where accessibility and mobility restrictions could potentially exacerbate the issue. A cluster analysis to identify population segments with common accessibility patterns was performed using information from the latest mobility survey. In addition to this, the complexity of average daily trip chains was characterized in order to better understand the relationship between the identified clusters and their social and economic activity (under the assumption that more complex trip chains are correlated with more intense social and economic activity). Finally, within-neighborhood variability of certain relevant mobility variables was explored by computing bivariate local indicators of spatial association (LISA) to identify areas with individuals at-risk for SE.

Selection and/or peer-review under responsibility of Scientific Committee

Keywords: Social Exclusion; Trip Chain; Daily Mobility; Cluster Analysis; Local Indicators of Spatial Association; Spatial Analysis.

1. Introduction

Individual daily mobility can be characterized as a series of trips, organized into chains (series of trips linking an origin to a destination) that can compose a tour (beginning and ending at the same location, e.g., home). They enable access to opportunities and participation in social and economic activities. These activities can be grouped into three general categories: foundational/anchoring, mandatory and non-mandatory. If an individual is not able to participate in activities of civil society that are considered normal and expected, he is considered to be socially excluded. This means that by examining accessibility and daily trip chains, it can be possible to identify individuals at-risk for social exclusion since inadequate daily mobility limits access to opportunities.

* Corresponding author. Tel.: +0-000-000-0000 ; fax: +0-000-000-0000.
E-mail address: john.pritchard@ist.utl.pt

1877-0428
Selection and/or peer-review under responsibility of Scientific Committee
doi:10.1016/j.sbspro.2014.01.077

The main research objective is the identification of accessibility and mobility-related social exclusion through cluster and spatial correlation analysis. The expected outcomes are the identification of population segments with common accessibility patterns and of areas where within-zonal variability of selected socio-economic, accessibility and mobility indicators highlights the potential for social exclusion. Section 2 of this paper contextualizes the research goal by reviewing the literature of the associated concepts and their interrelationships. Section 3 describes the methodology followed and the methods used. Finally, the results are presented in Section 4 and the corresponding discussion and conclusions are included in Section 5.

2. Research Context

2.1. Why we travel

Within transport planning, travelling is treated almost exclusively as a derived demand. With the exception of some specific leisure trips (e.g. road-trips, Sunday drives) generally speaking individuals travel, not for the sake of travelling but in order to perform activities and meet others. This generalization has been contested by many within the field, especially in the last 15 years, who do not see travel as a disutility that should be minimized. In fact, they propose that there is a positive utility to travel (e.g. Choo et al., 2005; Jain & Lyons, 2008). Whatever the motivation for travel, belonging to a community means that personal travel decisions are influenced by who and what is around you. As far back as 1979, Ben-Akiva and Lerman (1979) identified that many household and individual decisions impacted personal travel. Van Acker et al. (2010) presented travel decision-making as three-tiered process influenced and constrained by the individual, the social environment, and the spatial environment.

Given the decision-making process involved in trip-making we present the following framework of the main building blocks determining individual daily mobility:

1. <u>Motivation:</u>
    a. Perceived desires and needs of the individuals;
    b. Activities required to satisfy the wishes and needs;
2. <u>Available capacity of the transport system</u>:
    a. Infrastructure, equipment (including, but not limited to, vehicles) and services;
3. <u>Barriers and conditions:</u>
    a. Restrictions to mobility (e.g., impairment, age, etc.);
    b. Interpersonal relationships (e.g., children);
    c. Available time intervals (e.g., non-working hours) for daily mobility (daily travel time-budget - TTB); and
    d. Daily travel money-budget (TMB) allotted for transportation.

Trips vary by their purpose and by how they are organized. They have been defined by the type of activity they serve; grouped into three general categories: anchoring, mandatory, and non-mandatory. These categories have also been referred to as subsistence, maintenance, and discretionary (Bhat & Misra, 1999) and as mandatory, flexible, and optional (Primerano et al., 2007). The nomenclature is interchangeable and does not vary in definition. The first set includes activities around which the day is organized that tend to be the result of long-term decisions and are nearly immovable, such as work. The mandatory activities include essential, complementary activities that must be performed but are much more flexible, e.g. necessary shopping where the date, time and place can change. The non-mandatory activities are still an essential part of normalcy but they vary and tend to be even more flexible, e.g. leisure activities. We propose that the trips related with non-mandatory activities are the first and most obviously affected by social exclusion. These trips are more likely to be avoided by socially-disadvantaged groups and individuals.

Trips can also be defined as: single purpose- single destination (SPSD), single purpose- multiple destinations (SPMD), multiple purposes- single destination (MPSD), and multiple purposes- multiple destinations (MPMD) trips. As Ho and Mulley (2013) highlight, however, MPSD trip tours or chains are conspicuously absent even from trip-chain based analyses. In fact, multipurpose trips, in general, both MPSD and MPMD, tend to be underexplored because they complicate data collection since categorization can become arbitrary (Axhausen, 2008).

2.2. Trip chaining and modal choice

Trip chains, as opposed to single trips, are more indicative of the true decision-making process associated with travel. Their importance when analyzing travel behavior has been highlighted by many studies (e.g. Acker & Witlox, 2010). In addition to anecdotal evidence from our everyday lives that we organize our trips in chains, the notion of trip-chaining has had some empirical validation. For example, in Melbourne 47% of work trips and 36% of non-work trips have been found to have more than one stop (Currie & Delbosc, 2011).

A trip chain is generally accepted to be a sequence of trips starting and ending at home (e.g. Primerano et al., 2007). Trip chains have also been defined, as a sequence of trip segments between any pair of anchor activities (e.g. home, work, or school) bounded by stops of 30 minutes or less (Mcguckin et al., 2005). Under the first definition a daily activity chain of Home-Work-Errand-Home would be considered a single chain, under the second it would be divided into two chains With Home-Work being the first simple chain and Work-Errand-Home being the second chain. This difference impacts what data is used as well as the results of the studies, since incomplete chains are often ignored. Using only the home as an anchor so that all trip chains are Home-X-Home type tends to be justified because most tours originate and end at home. For example, Primerano et al. (2007) found that this was the case for close to 98% of the trips from the metropolitan Adelaide survey used in their study.

Just like travel time budgets, which have been found to be bounded at a close-to-constant limit across different societies (Schafer & Victor, 2000) there also seem to be limits on the number of daily trips performed that are close-to-constant. This has led Timmermans et al. (2003) to conclude that other factors, such as overarching psychological principles play a larger role than the transport system or the relative geographic location of an individual in shaping activity patterns, except when under enormous constraints. This, however, does not mean that the typology of the trip chains does not vary amongst different demographic groups. The main determinant of the nature and complexity of the trip chains, and thus, their activity-time allocation has been found to be household types (Lee et al., 2007).

Trip-chaining and modal-choice are closely related. Modal choice affects the nature of the trip chains and the potential trip chain influences the modal choice. For all types of trip chains (both work and non-work related) the pattern of these trips drives the modal choice (Ye et al., 2007). There have also been indications that as trip chains grow more complex, public transportation (PT) becomes less desirable (Hensher & Reyes, 2000). This finding has been disputed in studies such as the one presented by Currie and Delbosc (2011), which found a much more complex relationship between car chains and PT chains. There were variations in the complexity depending on where the trips ended (within/outside the CBD) and on the mode of PT used. The results showed that both tram and train chains were on average more complex than those made by cars. As Ho and Mulley (2013) emphasize, it is important to further analyze this issue since it has a potential to greatly affect policy. If PT and trip complexity have an inverse relationship, then PT ridership could decrease if trip chain complexity increases as a result of greater variability of personal daily agendas. Significantly, other researchers have found that PT is more closely connected to trips that are fixed in time and place than with flexible trips (e.g. Vilhelmson, 1999).

It should also be noted that the trips within a chain will always be conditioned by the modal choice. Once the chain is initiated, the individual will be inclined to complete the chain using the same mode regardless of the nature of the sub-trips. To highlight how important this is, results from a 2009 study in Norway found that 48% of short car trips (≤ 1 km) were part of trip-chains above 5 kilometers (Vågane, 2012). This could significantly bias studies focused on single trips instead of trip chains, where these trips could potentially be identified as unnecessary car trips which should be targeted for a modal shift. This interrelationship between mode and chain is further cemented because individuals tend to structurally commit to a specific modal choice (e.g. purchasing an automobile or PT pass). This commitment in many cases can be binding, with individuals being reluctant to shift modes (Simma & Axhausen, 2001). This structural decision will thus shape the nature of the personal daily travel for a significant amount of time by reducing the perceived mode alternatives. Even amongst low-income individuals, for which travel expenditure is a large percentage of their monthly budgets, those with cars have been found to be highly car dependent and make very few trips by public transport (Currie & Senbergs, 2007).

2.3. The concept of social exclusion and its relation to transportation

Social exclusion is a wide–encompassing term that has been defined differently by a number of authors. It is generally agreed that exclusion is a multidimensional problem by nature and that social exclusion refers to a dynamic process and not necessarily to an end-result (Lucas, 2012; Rajé, 2007; Sen, 2000). In other words, 'who' and 'when' someone is excluded can change over time.

As a policy issue social exclusion and poverty have at times been used interchangeably. This has been criticized by many authors (Atkinson & Da Voudi, 2000; Levitas, 2004; Sen, 2000). As Daly and Silver (2008) highlight, even though the two terms are often conflated, they offer two different perspectives. Their multidimensional, multidisciplinary aspects as well as some shared theoretical background and the multiple definitions offered for both terms makes them easy to confuse and/or conflate. Social exclusion, in contrast to economic poverty, is based on inclusion into civil society. Low income does not constitute a necessary requirement for experiencing social exclusion. Focusing on social exclusion, in and of itself, is an important endeavor since being excluded can be a form of deprivation with innate importance in addition to its causal relations with other issues. Exclusions of the social nature can in turn lead to other deprivations that can significantly decrease the quality of life (Sen, 2000). Analyzing social exclusion in addition to income poverty, beginning in the 1990s, has broadened the discussion of the definition of well-being by incorporating dimensions that were not previously considered (Atkinson & Da Voudi, 2000; Room, 1999). Chief among these dimensions are the access to social capital, the focus on multidimensional disadvantage, and relational dimensions of stratification. It also prompted a more dynamic analysis of the issue by focusing on the process as well as the outcomes.

Social exclusion is, then, a state where an individual is not able to participate in activities of civil society that are considered normal and expected within said society. Social inclusion on the other hand can be seen as the ability to participate adequately in society. This sense of normalcy can be seen through the spectrum of Maslow´s (1943) pyramid of human motivation, where in addition to physiological needs, there are also safety, belonging and self-esteem factors that must be considered. In the 1990s, literature suggests that social exclusion was understood to have 3 broad dimensions: economic, social and political (Bhalla & Lapeyre, 1997). This was later expanded to a definition where social exclusion occurred when one or more of the fundamental systems of society breaks down (Atkinson, 2000) and finally to the concept being defined by nine distinct dimensions, each with several exclusionary factors: (1) economic, (2) societal, (3) social networks, (4) organized political, (5) personal political, (6) personal (demographics), (7) living space, (8) temporal, and (9) mobility (Kenyon et al., 2002).

Transportation is a central component of human life. Even against the backdrop of severe economic and physical hardship faced by many poor individuals in the developing world, transport remains a chief concern (Lucas, 2011). Poor transport options and alternatives can be a result of social exclusion and can also reinforce social exclusion. Transport is a factor of social exclusion because deficiencies in the sector can prevent individuals from participating in work, educational activities and community events as well as exclude them from healthcare facilities. In order to be fully included in society it is necessary to possess social capital, but in order to maintain this network, transport and mobility are required because of the importance of co-presence (Urry, 2002). It has also been suggested that access to transport systems, given their connective function, is a critical dimension of well-being (Dodson et al., 2006).

Church et al. (2000) identified seven main categories of sources of social exclusion potentially related with poor accessibility and mobility: (1) physical barriers related to the nature of the transport system and built environment, (2) poor generalized accessibility, (3) exclusion from facilities, (4) economic and transport network barriers which limit access to opportunities (e.g. potential jobs), (5) time constraints, (6) perceived safety and fear for well-being, and (7) constraints resulting from contemporary security and space management strategies often discourage certain socially excluded individuals from using public and quasi-public transport spaces.

The Social Exclusion Unit in the U.K. (SEU, 2003) correctly emphasizes the fact that cost can be a restricting factor for many users and that in many cases poor transport exacerbates the issues faced by many excluded groups, but acknowledges that transportation difficulties do not necessarily result in social exclusion. Other authors, including Lucas (2012), agree that transport poverty does not necessarily result in social exclusion. The report also highlights the fact that in addition to this exclusionary factor, people in the more deprived communities also suffer the most from the externalities of the transport system (e.g. pollution, pedestrian accidents, etc.)

3. Methodology

Data for this study was provided mostly by an online mobility survey developed through the MIT Portugal SCUSSE project. Biases resulting from online surveys have been acknowledged by Abreu e Silva and Martinez (2011). This data was complemented with a domiciliary computer-assisted personal interview survey with 1,000 additional responses to un-bias the sample. For our analysis a total of 867 valid responses with complete trip chains (at least 2 trips) were used. This data was complemented with general demographic, land-use and accessibility information associated with the zones of the city.

The respondents were characterized by gender, age, income levels, and family types and the complexity of the trip chains was explored. Trip chain complexity was defined simply as the number trips per chain. A more complex measure could not be used given the data limitations. Similarly, whether trips were MPSD or SPSD could not be determined. Point estimates were calculated and Kruskal-Wallis H-tests were performed to determine the statistical significance of the differences across sub-groups. H-tests were chosen because the sample was heavily skewed and not normally distributed. Pair-wise comparison between subgroups was also performed. The difference between the two lowest income groups was found to be significantly different for the trip variables.

Given the sample size (N=867), a K-means Cluster Analysis (with a preliminary hierarchical cluster analysis to determine the number of clusters) was performed. Based on the results of the initial hierarchical clustering of the variables (using the elbow method) it was determined that 3 clusters should be used in the k-means analysis. The resulting clusters are characterized in Figure 1 and were geographically mapped using the Intergraph Geomedia software.

In order to explore within-zonal variability we relied on bivariate local indicators of spatial association (LISA) (see: Anselin, 1995). These were calculated and plotted using Geoda geo-data analysis software. LISA are commonly used to analyze contiguous areas, but can also be used to analyze point data. In this case, each data point corresponded to a member of the sample, geographically located at their home-location. Given the sample size and its spatial distribution the neighborhood was defined using a distance band of 2 km and spatially weighted. For the bivariate analysis, a weighted variable (income) was compared to several non-weighted mobility variables.

4. Results

4.1. Survey variables and descriptive results

After eliminating highly correlated variables and performing exploratory factor analysis to attempt to reduce the number of variables, the following variables were selected to perform the cluster analysis:

Table 1. Descriptive Statistics of Variables (N=867)

Variable	Description	Mean	St. Dev.
Mobility Indicators			
Trips_chain	Trips performed in one day as part of trip tour	2.37	0.980
Trip_time	Duration of daily travel (in hours)	1.17	0.736
Dist_Avg_trip	Distance of average single trip within chain	9.16	7.55
Only_Car	Trip tour where all included trips were made by private vehicle	0.51	0.500
Only_bus	Trip tour where all included trips were made by bus	0.13	0.342
Personal Attributes			
Gender	Binary variable, where 1 is male	-	-
Age	Continuous variable, the age of the respondent	45.35	14.212
Income	(1)<1000 , (2)1000-2000 , (3)2000-3500 , (4)3500-50 00 , (5)5000-10000 , (6)>10000	2.28	1.327
Family_type	(1)single male, (2)single female, (3)married father, (4)married mother, (5)single parent	-	-
Activity_type	(1) employed, (2)part-time, (3) unemployed, (4) retired, (5) student, (6) Inactive	-	-
License	Binary variable, where 1= having a valid driver´s license	-	-
T_pass	Binary variable, where 1= paying for a monthly PT pass	-	-
Neighborhood Attributes			
Dist_PT	Walking time from the nearest PT station or stop (in mins.)	7.60	13.177
Entropy	Entropy Index within 500 m (where 0= no land-use mix and 1=mixed land-use).	0.187	0.104

The entropy index, which is a variable that measures land use mix, was calculated following the methodology of (Cervero and Kockelman, 1997) and (Potoglou and Kanaroglou, 2008).

4.2. Trip chain complexity results

Within our sample we see that parents travel longer average distances than their counterparts without offspring. Furthermore single parents have the highest trip chain complexity as well as the longest average trip time, but married fathers travel the longest average distance (See Table 2). Even though the results seemed to confirm the findings from other studies (e.g. Vågane, 2012), in order to examine whether these differences were statistically significant, a Kruskal-Wallis H-test was performed. The results indicate that the differences across family types were significantly different from zero for travel times (H (4) =11.117, p-value = 0.025) but not for distance travelled or trip chain complexity.

When compared across age groups ([1] 18-25, [2] 25-35, [3] 35-65, [4] >65) trips/chain (H (3) =43.956, p-value = 0.000) and trip times (H (3) =36.367, p-value= 0.000) were found to be statistically different. The pair-wise comparison between groups showed that there was no statistical difference between groups 1 and 2, but it was significant between groups 2 and 3 and groups 3 and 4.

Table 2. Trip chain complexity characterization

Household Type	trips/chain	Dist. (*km*)	Trip duration (hr.)
Male (no children)	2.452	9.78	1.23
Female (no children)	2.338	8.20	1.10
Male (partner & children)	2.322	10.56	1.23
Female (partner & children)	2.234	9.26	1.07
Single Parent	2.458	9.76	1.49

Similarly, when compared across income groups, again, both the trips/chain (H (5) = 83.596, p-value= 0.000) and the trip duration (H (5) = 82.067, p-value= 0.000) were found to be statistically different. A pairwise comparison found significant differences for both trip/chain and trip duration between the two lowest income groups with 6% and 7% of the variance, respectively, being explained by the difference in income. No statistical difference was found between the 2nd and 3rd, 3rd and 4th, 4th and 5th or 5th and 6th income groups (see table 1 for information about the groups). The mean rank for the lowest income group was the lowest for both trip variables. This is a significant finding because it potentially represents the cutoff point where the risk of exclusion as a result of mobility/accessibility deficiencies becomes an issue. Finally, a Mann-Whitney U test was performed to compare between genders. From this data, it can be concluded that there is not a statistically significant difference between the male and female groups´ median trip duration and average distance travelled, but the trips/activity was tending towards significance with a p-value of 0.059.

4.3. Cluster analysis results

In an attempt to identify population segments with common accessibility patterns a cluster analysis was performed. The results can be found below. The clustering obtained (using socioeconomic and mobility / accessibility-related variables) did not result in an encompassing and clear segmentation of the population. Overall, the clusters obtained relate to segments of the population with similar income but with significant differences in their proximity to PT and slight differences in their residential built-environment. Clear evidence of social exclusion was not found. The three identified clusters can be characterized as follows:

Table 3. Final cluster centers

Variable	Cluster 1	Cluster 2	Cluster 3
Trips_chain	2	2	2
Trip_time (hr.)	1.617	0.985	1.495
Dist_Avg_trip (km)	28.63	4.77	14.80
Only_car	1	0	1
Only_bus	0	0	0
Gender	0	1	0
Age	47	46	44
Income	3	2	2
Dist_PT (mins)	15.28	6.80	7.53
Entropy	0.193	0.192	0.171

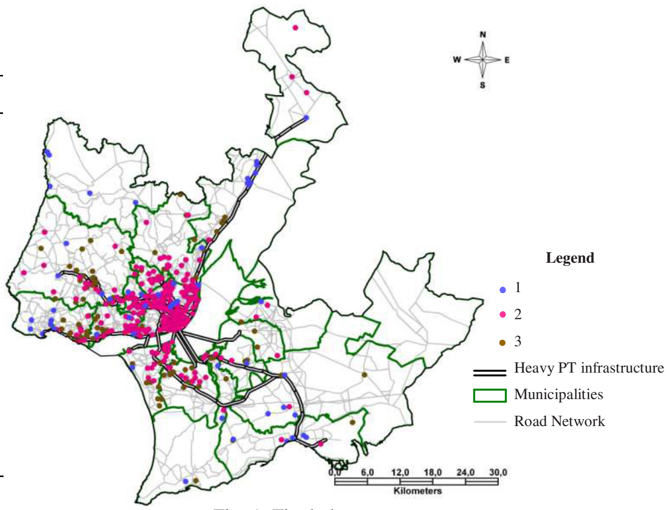

Fig. 1. Final cluster groups

The 1st cluster (with 62 cases) was composed of slightly older individuals. The amount of time spent travelling was higher and the trips significantly longer, on average, and these trips tended to be by car. The individuals belonging to this cluster tended to be male, have higher income and live further away from PT stops and stations.

The 2nd cluster (with 573 cases), on average and by far, had the lowest travel times and travel distances. The members were slightly younger than the members of cluster 1, tended to be female and live closest to PT stops and stations.

The 3rd cluster (with 232 cases) was the youngest cluster, on average. Its members tended to be males and travel by car despite being only slightly farther from PT stops and stations than the members of the 2nd cluster. Their travel times and distances tended to be higher than the 2nd cluster but lower than the 1st.

4.4. Neighborhood measurements results

To measure within-neighborhood variability bivariate local indicators of spatial association (LISA) were used. The spatial results can be found below. Areas with red dots indicate areas with individuals that presented high values of the weighted variable (income) as compared to their nearest neighbors (< 2 km) and high values of the un-weighted variable being measured (e.g. Trip chain complexity). Dark blue dots indicate individuals with low values for both the weighted and un-weighted variables. Finally, light blue dots represent individuals with low income but high values of the un-weighted variable and pink dots represent high income individuals with low values of the un-weighted variable.

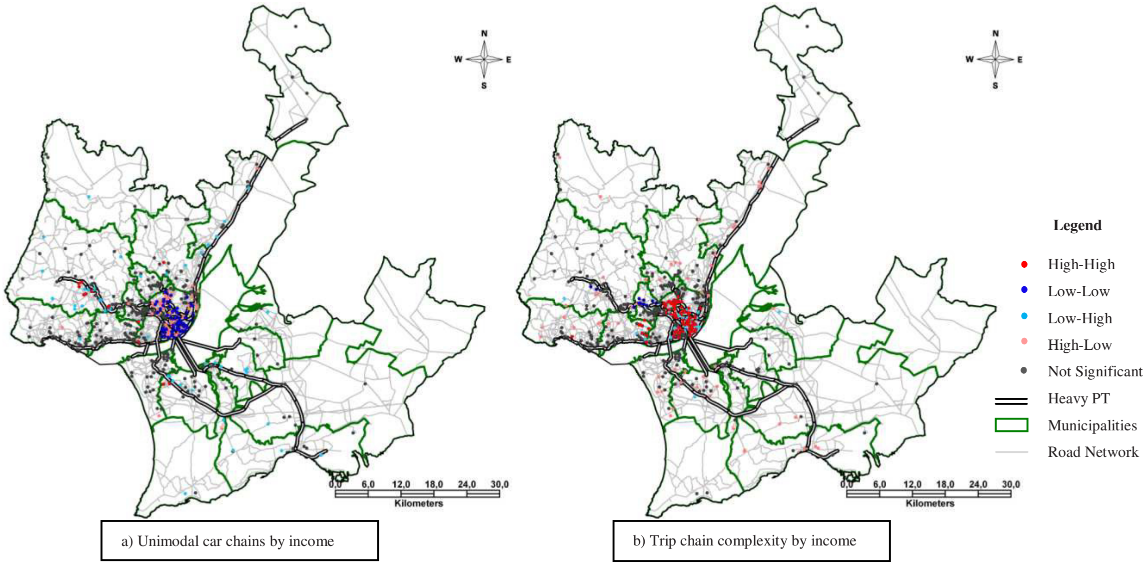

Fig. 2. Selected LISA results: a) Unimodal car chains by income; b) Trip chain complexity vs. Income

The results presented here are in accordance with the fact that within the Lisbon metropolitan area (LMA) the highest amount of activities are concentrated within the Lisbon municipality (where the CBD is located). The neighborhood analysis shows that it is only possible to have a comparatively high accessibility and mobility with simultaneous low income (low-high – light blue dots in Figure 2b) in the center of the city. Likewise, only in the center of the LMA could people present an elevated number of daily trips without having to rely on a car. Trip chains were also found to be more complex in the center regardless of the income (both high-high – red dots – and low-high – light blue dots, in Figure 2b).

High-income individuals with few daily trips were scattered mostly in the suburbs, while individuals with high income and high accessibility were clustered in the city center. This result could be indicative of self-selection with high-income individuals choosing to live in areas with low accessibility levels because of other perceived benefits that outweigh the negative impact of low accessibility and mobility. Thus, looking at self-selection effects is a potential direction in future works. Clustering of individuals with low accessibility, low mobility and low income were confirmed to exist in some of the more depressed areas of the city (dark blue dots in Figure 2b). This is an indication that individuals with low incomes on the periphery of the city do not have access to a great number of economic and leisure activities and a most probable indication of social exclusion.

5. Discussion and Conclusions

Using a mobility survey together with land use and socio-demographic data we studied social exclusion by looking at travel behavior indicators (under the assumption that more complex trip chains are correlated with more intense social and economic activity). The obtained results seem to point towards the existence of excluded groups as a result of accessibility/mobility deficiencies. However, the weight and explanatory significance of each of the variables needs to be explored further. Trips per chain and trip duration also varied significantly between the two lowest income groups, but not amongst the rest of the groups. This is significant because it points towards a cutoff point below which accessibility and mobility are impaired by low levels of income. This finding should be analyzed in more depth in future studies with new data because of the potential policy implications.

From the spatial analysis two main policy-relevant aspects emerge. The first one is related to the fact that people with low income that reside in the city of Lisbon tend to have higher mobility than the ones with similar income levels that live in the suburbs. This confirms the importance and relevance of public transport in allowing higher levels of mobility for people with lower income levels and therefore with lower car access and ownership levels. The second aspect is related to the spatial concentration of individuals with lower mobility and income levels in some of the historically underprivileged and underserved areas of the city. This is indicative of the existence of, at least, an association between social exclusion, mobility behavior and income, which should be explored in more depth.

This last finding reflects the observed reality in Lisbon, where the center is dense with a variety of PT alternatives (i.e. metro, buses, trams) while the periphery tends to be more car-oriented with low levels of mixing between land uses. The existence of areas with low mobility, low accessibility, low income levels, coupled with low land use mix and few modal choices is problematic. The access to opportunities of the residents of these areas is constrained. In regards to mobility, they could be especially prone to issues such as forced car ownership given the low mobility levels of non-drivers in these areas. This, in turn, would impact and condition other aspects of their lives. While low mobility does not necessarily result in social exclusion, this is a troubling finding that will be further explored in future research.

Finally, even though the use of cluster analysis to identify socially excluded groups did not provide strong results, it was successful in identifying groups of individuals with similar mobility and accessibility profiles. This methodology should be explored further using a different set of variables and other data sets.

References

Acker, V., &Witlox, F. (2010). Commuting trips within tours: how is commuting related to land use? *Transportation 38*, 465–486.
Anselin, L. (1995). Local Indicators of Spatial Association-LISA. *Geographical Analysis* 27, 93–115.
Atkinson, R. (2000). Combating Social Exclusion in Europe: The New Urban Policy Challenge. *Urban Studies 37*, 1037–1055.
Atkinson, R., Da Voudi, S. (2000). The Concept of Social Exclusion in the European Union: Context, Development and Possibilities. *Journal of Common Market Studies 38*, 427–448.
Axhausen, K. (2008). Social networks, mobility biographies, and travel: survey challenges. *Environment and Planning B: Planning and Design 35*, 981–996.

Ben-Akiva, M., & Lerman, S. (1979). Disaggregate Travel and Mobility Choice Models, in: Hensher, D.A., Stopher, P.R. (Eds.), *Behavioural Travel Modelling*. Croom Helm, Andover, pp. 654–679.
Bhalla, A., & Lapeyre, F. (1997). Social Exclusion: Towards an Analytical and Operational Framework. *Development and Change 28*, 413–433.
Bhat, C.R., & Misra, R. (1999). Discretionary activity time allocation of individuals between in-home and out-of-home and between weekdays and weekends. *Transportation 26*, 193–229.
Cervero, R., & Kockelman, K. (1997). Travel demand and the 3Ds: Density, diversity, and design. *Transportation Research Part D: Transport and Environment 2*, 199–219.
Choo, S., Collantes, G.O., & Mokhtarian, P.L. (2005). Wanting to travel, more or less: Exploring the determinants of the deficit and surfeit of personal travel. *Transportation 32*, 135–164.
Church, A., Frost, M., & Sullivan, K. (2000). Transport and social exclusion in London. *Transport Policy 7*, 195–205.
Currie, G., & Delbosc, A. (2011). Exploring the trip chaining behaviour of public transport users in Melbourne. *Transport Policy 18*, 204–210.
Currie, G., & Senbergs, Z. (2007). Exploring forced car ownership in metropolitan Melbourne, in: Australasian Transport Research Forum.
Daly, M., Silver, H., 2008. Social exclusion and social capital: A comparison and critique. *Theory and Society 37*, 537–566.
De Abreu e Silva, J., & Martinez, L.M. (2011). The application of internet based surveys in the Lisbon Metropolitan Area, in: *9th International Conference on Transport Survey Methods*. Termas de Puyehue, Chile.
Dodson, J., Buchanan, N., Gleeson, B., & Sipe, N. (2006). Investigating the Social Dimensions of Transport Disadvantage—I. Towards New Concepts and Methods. *Urban Policy and Research 24*, 433–453.
Hensher, D., & Reyes, A. (2000). Trip chaining as a barrier to the propensity to use public transport. *Transportation 27*, 341–361.
Ho, C.Q., & Mulley, C. (2013). Multiple purposes at single destination: A key to a better understanding of the relationship between tour complexity and mode choice. *Transportation Research Part A: Policy and Practice 49*, 206–219.
Jain, J., & Lyons, G. (2008). The gift of travel time. *Journal of Transport Geography 16*, 81–89.
Kenyon, S., Lyons, G., & Rafferty, J. (2002). Transport and social exclusion: investigating the possibility of promoting inclusion through virtual mobility. *Journal of Transport Geography 10*, 207–219.
Lee, Y., Hickman, M., & Washington, S. (2007). Household type and structure, time-use pattern, and trip-chaining behavior. *Transportation Research Part A: Policy and Practice 41*, 1004–1020.
Levitas, R. (2004). Let's hear it for Humpty: social exclusion, the third way and cultural capital. *Cultural Trends 13*, 41–56.
Lucas, K. (2011). Making the connections between transport disadvantage and the social exclusion of low income populations in the Tshwane Region of South Africa. *Journal of Transport Geography 19*, 1320–1334.
Lucas, K. (2012). Transport and social exclusion: Where are we now? *Transport Policy 20*, 105–113.
Maslow, A.H. (1943). A Theory of Human Motivation. *Psychological Review 50*, 370–396.
Mcguckin, N., Zmud, J., & Nakamoto, Y. (2005). Trip Chaining Trends in The United States: Understanding Travel Behavior for Policy Making. *Transportation Research Record: Journal of the Transportation Research Board 1917*, 199–204.
Potoglou, D., & Kanaroglou, P.S. (2008). Modelling car ownership in urban areas: a case study of Hamilton, Canada. *Journal of Transport Geography 16*, 42–54.
Primerano, F., Taylor, M. a. P., Pitaksringkarn, L., & Tisato, P. (2007). Defining and understanding trip chaining behaviour. *Transportation 35*, 55–72.
Rajé, F. (2007). *Negotiating the Transport System: User Contexts, Experiences and Needs*, 1st ed. Ashgate Publishing Limited, Aldershot, UK.
Room, G.J. (1999). Social exclusion, solidarity and the challenge of globalization. *International Journal of Social Welfare 8*, 166–174.
Schafer, A., Victor, D.G., 2000. The future mobility of the world population. *Transportation Research Part A: Policy and Practice 34*, 171–205.
Sen, A. (2000). Social Exclusion: Concept, application, and scrutinity. *Office of Environment and Social Development Asian Development Bank*, Manila, Philippines.
SEU (2003). Making the Connections : Transport and Social Exclusion Interim findings from the Social Exclusion Unit. London.
Simma, A., Axhausen, K., 2001. Structures of commitment in mode use: a comparison of Switzerland, Germany and Great Britain. *Transport Policy 8*, 279–288.
Timmermans, H., Van der Waerden, P., Alves, M., Polak, J., Ellis, S., Harvey, A.S., Kurose, S., & Zandee, R. (2003). Spatial context and the complexity of daily travel patterns: an international comparison. *Journal of Transport Geography 11*, 37–46.
Urry, J. (2002). Mobility and Proximity. *Sociology 36*, 255–274.
Vågane, L. (2012). The complexity of travel: Trip chaining in Norway, in: *European Transport Conference*. Glasgow, U.K.
Van Acker, V., Van Wee, B., & Witlox, F. (2010). When Transport Geography Meets Social Psychology: Toward a Conceptual Model of Travel Behaviour. *Transport Reviews 30*, 219–240.
Vilhelmson, B. (1999). Daily mobility and the use of time for different activities . The case of Sweden. *GeoJournal 48*, 177–185.
Ye, X., Pendyala, R.M., & Gottardi, G. (2007). An exploration of the relationship between mode choice and complexity of trip chaining patterns. *Transportation Research Part B: Methodological* 41, 96–113.