



# Resilient territories and mobility adaptation strategies in times of economic recession: Evidence from the metropolitan region of Barcelona, Spain 2004–2012

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## Abstract

The international financial crisis has affected people's everyday activities, changing multiple aspects of their daily behavior. In countries deeply affected by the economic recession, the crisis has produced a significant incentive to change transport and mobility habits towards cheaper and affordable modes of transport. The impacts of the crisis have been spatially heterogeneous and socially diverse, and consequently mobility adaptation strategies depend on both territorial and social resilience. The present paper analyzes the main changes of mobility habits that occurred between 2004–2012 in the Metropolitan Area of Barcelona, covering the end of the era of economic growth, and the advent and unfolding of the economic crisis. The research uses travel survey data to understand how different population groups have adapted their mobility to the crisis, and how core and outer metropolitan areas have shaped the adaptation strategies of their inhabitants. The results show a general trend towards a rationalized use of private modes in favor of an increased use of shorter trips and non-motorized modes, but also show how social factors and urban forms interact to generate significant differences in mobility adaptation strategies.

## Keywords

Adaptation strategies, economic crisis, mobility, mobility habits, territorial resilience

## Introduction

The international financial crisis has had a profound impact throughout Europe. The crisis emerged from the heart of the major world economies and quickly spread through global financial networks, affecting the overall European economy and putting each

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national economic system to the test. The crisis has had a more intense impact on the peripheral economies such as Spain, Greece or Ireland (Hadjimichalis, 2011), while Nordic and central economies such as Denmark, Germany or Sweden resisted much better (Kiss, 2012).

The process of financialization of everyday life that occurred in most European economies throughout the last 20 years (French et al., 2011) has enabled a quick transference of the impacts of the economic crisis from the financial level to the real economy and to people's everyday lives (Aalbers, 2009). Given that mobility is intimately related with our modern day-to-day activities, studying the state of mobility before and during the crisis can provide a useful source of data with which to study the effects of that crisis on people's everyday lives (Ulfarsson et al., 2015). The impacts of the crisis, however, have been highly unequal both in territorial and social terms, which, as stated by Martin (2011), calls for an analysis of the geographies of the crisis, considering both territorial resilience and social vulnerabilities.

### **Mobility, transport and crisis**

Travel patterns reflect people's activity spaces and thus provide valuable insight on the impact of the crisis on daily life. Changing economic conditions generate in families and individuals a need for reducing the costs associated with transport and, at the same time, change the nature of mobility needs. As the crisis effects have transitioned from the financial to the everyday economy, people's mobility patterns have been changed due to transformed mobility necessities and the need to reduce transportation costs. The aim of most of these adjustments has been that of maintaining accessibility levels (Reggiani et al., 2015) while adapting minor aspects of mobility. However, the nature of these changes is complex, with some path-dependent reactions combining with entirely new and unpredictable outcomes (Bertolini, 2007). The resulting changes include modal choices, destination relocations and changes in temporal budgets, among many others. Some changes are expected to be circumstantial, but some others, particularly those that affect people's mobility habits

and preferences towards transport, might not be reversed in time (Garcia-Sierra et al., 2015). The crisis thus constitutes a transitional moment for mobility that creates spontaneous and qualitatively radical changes, but also offers an opportunity for maximizing the effectiveness of public policies. In such terms, it has been considered that the crisis offers an opportunity for sustainability transitions (Geels, 2013), although it also poses a threat to people's quality of life.

In Spain, one of the countries where the crisis hit harder in terms of loss of employment and household income, the period 1990–2007 was characterized by a steady increase in passenger car use (Pérez-Martínez, 2011), fuelled by a housing bubble that was fed on car-dependent urban environments. As described by Burriel (2011, 2015) the urbanization impetus produced massive residential dispersal and the formation of unplanned urban continuums in the outskirts of the country's largest metropolitan areas. The first stages of the crisis, however, also coincided in time with a significant rise in petrol prices, increasing the relative costs of transportation (Sobrino and Monzon, 2014). The fall of family spending capacity combined with the increase in petrol prices created a powerful incentive to change travel patterns in the search for reduced travel costs. Car use, which is usually hard to abandon (Garcia-Sierra et al., 2015), was heavily affected by the outcome of the crisis, and especially by the loss of employment (Dargay and Hanly, 2007) and, as a result, the pre-crisis expansive trend in automobile mobility was almost completely cut (Sobrino and Monzon, 2014).

Overall, the current literature considers the combination of reduced purchasing power and the rise of unemployment rates as the main causes of crisis-related changes in travel behavior (Ulfarsson et al., 2015). The magnitude of these changes, however, has been spatial and socially uneven, which explains why one of the main research questions regarding the crisis today involves investigating why some territories are coping with the effects of the crisis better than others (Hassink, 2010), along with analyzing the spatial distribution of the social vulnerabilities with respect to the crisis (Jabareen, 2013).

### *Territorial resilience and urban forms*

The concept of resilience is becoming commonplace in spatial analysis regarding the crisis (Pendall et al., 2010). Originating in the environmental and biological disciplines, the first definitions of resilience referred to the ability of a system to absorb disturbances and pressures and still persist with its main functions (Jabareen, 2013). Today, the concept of resilience, when applied to human complex systems, implies an evolutionary thinking that does not consider an ideal state of the system that has to be maintained (Bertolini, 2007). Instead, it prioritizes the idea of a positive and dynamic adaptation to external pressures that enables a system to maintain its core functionality (Resnick et al., 2014).

In strict spatial terms, a resilient territory is defined as providing the necessary resources to facilitate the development of adaptation strategies towards both coping with the effects of the disturbance and overcoming the crisis itself (Kärrholm et al., 2014). In terms of everyday mobility and transportation, this means providing the necessary conditions to allow individuals a wide range of mobility coping strategies in response to not only structural and physical disturbances on the transport system, but also socio-economic changes (Bertolini, 2007). Much like economies, the amount of shock that mobility systems can absorb depends on their diversification (Pike et al., 2010). Under that view, monocentric urban areas that are highly dependent on a single mode of transportation are bound to constrain adaptation strategies (Li et al., 2015). On the other hand, compact urban development with good provision of public transport offers a wide range of possibilities for moving to a desired destination, so that if transport by car eventually becomes unavailable, then that same trip can be fulfilled via public or non-motorized transport. The spatial morphological settings, such as diversity, population density and land use mix, along with the flexibility and connectivity of the transport network, are key components of the territorial resilience (Eraydin and Tasan-Kok, 2013) as they allow the development of mobile coping strategies and lower the risk of producing social transport disadvantages. As demonstrated by Beatley (2011), well-designed built forms and urban infrastructures contribute to building social

resilience and enhance the ability of communities to cope with natural and human-made hazards. On the contrary, planning and infrastructure deficits can compound higher systemic and social vulnerability risks in some urban areas (Jenelius and Mattsson, 2015).

### *Adaptation strategies*

Together with resilience, the concepts of exposure and vulnerability (Adger, 2006; Jenelius et al., 2006) are also useful for understanding the unequal impacts that the crisis has had on everyday life. On the one hand, vulnerabilities – best described as the susceptibility to harm – appear when the system is put under external pressure or change (Adger, 2006). This pressure can be either sudden, such as a natural catastrophe, or a ‘slow burn’ of change, such as with an economic crisis (Pike et al., 2010). The concept of vulnerability includes two factors: probability and consequence. A vulnerable population group is one that has either a high risk of experiencing the crisis or one that bears high costs and consequences when a crisis occurs. Following that rationale, it could also be explored whether the vulnerability of a population group to the economic crisis is enhanced, either by its location in a non-resilient territory that favors the appearance of recurrent crises, or by the group’s social disqualification, which magnifies the consequences of a crisis (even when some of the group members inhabit a resilient territory).

In times when austerity measures and cuts to public services are threatening mobility, adaptation strategies and socially inclusive transport systems become paramount in order to prevent social exclusion. With the crisis causing a disruption to many family budgets, users have to re-examine their traveling behaviors and habits, which often leads to changes and the establishment of new routines (Reggiani et al., 2015). As noted by Nielsen (2015) and Ulfarsson et al. (2015) for the cases of Denmark and Iceland, respectively, the impacts of the crisis have been highly heterogenic in socioeconomic terms, with travel behavior changes and adaptation strategies being strongly dependent on people’s socioeconomic status.

Among the most frequent adaptation strategies, there has been a rescaling of activity spaces, leading to a decline in the frequency of use of motorized modes of transport, and also of the distance traveled (Nielsen, 2015). Whenever possible, people have relocated some of their daily activities in their proximate neighborhood scale, trying to improve their traveling efficiency by reducing travel times and investing in non-motorized modes of transport. As Vale (2013) and Milakis et al. (2015) conclude, modal and distance changes are often a result of wanting to keep travel times within acceptable margins.

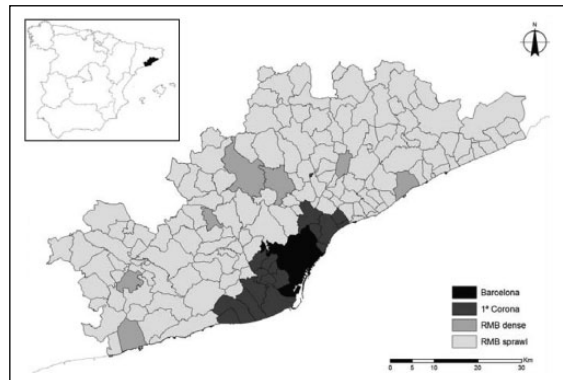
Overall, the crisis has exacerbated the transport disadvantages generated by an already unequal access to the transport system (Delbosc and Currie, 2011; Schwanen et al., 2015). Thus, this article is not concerned with how to return to an original pre-crisis state of affairs, but seeks to identify those coping and adaptation strategies that help people improve accessibility levels, in order to inform the design of effective and inclusive transport policies of the future.

## Methods

### Settings

The metropolitan region of Barcelona had a concentration in 2010 consisting of 67% of the Catalan population and 11% of the total population of Spain. It is a territory of 164 municipalities in seven counties, gathering a total population of 5,023,635 inhabitants, whose functional dynamics are structured under a metropolitan logic (Muniz et al., 2008). The region occupies a total of 3000 km<sup>2</sup> within a radius of 30–45 km, and its structure is of two concentric rings that expand from the central city of Barcelona. The core of the metropolitan region is occupied by the municipality of Barcelona, with 1,602,386 inhabitants, which has silted up its urbanization with uniformly high density levels (15,802.6 inhabitants/km<sup>2</sup>) and a good territorial distribution of services and amenities (Marquet and Miralles-Guasch, 2016) together with a high public transport provision.

The first metropolitan ring (AMB) forms an urban continuum with the core city, and is shaped by municipalities characterized by uneven density and urban development. For its part, the second



**Figure 1.** Metropolitan region of Barcelona.

metropolitan ring (RMB) is located on the periphery and adds up to 2.1 million inhabitants. The inner characteristics of this second metropolitan region are, however, wildly unequal in terms of urbanization and development (Bayona i Carrasco and Pujadas, 2014). The territory is structured by seven medium-sized historical cities with a common compact-city morphology, which is similar to the morphology of the central municipality of Barcelona (Miralles-Guasch and Tulla Pujol, 2012). These seven cities share a form of development consisting of high densities and land-use mix, which makes their morphological patterns completely unrelated to the characteristics of the rest of the second metropolitan ring, which consists of small municipalities with sprawled developments (with densities below 1000 inhabitants/km<sup>2</sup>) (Miralles-Guasch and Tulla Pujol, 2012). Because of these differences, an analysis of mobility behaviors has to consider these two metropolitan sub-ambits separately, distinguishing the second metropolitan ring cities from the rest of the second metropolitan ring. For the sake of clarity, we have labeled these different areas of the second metropolitan ring as ‘RMB dense’ and ‘RMB sprawl’ (Figure 1).

### Data

Mobility data was gathered from the 2004, 2007, 2010 and 2012 editions of the survey on weekday mobility *Enquesta de Mobilitat En dia Feiner* (EMEF). The period 2004–2012 displays the evolution of

**Table 1.** Time series of surveys and sample weights.

	EMEF 2004	EMEF 2007	EMEF 2010	EMEF 2012
People interviewed	4,642	4,754	5,793	6,462
Reported trips	15,612	16,869	22,276	24,491

**Table 2.** Evolution of gross household income per inhabitant, motorization rate (vehicles/1000 inhabitants) and unemployment rate in the RMB, 2004–2012.

	Barcelona (mean)	AMB (mean)	RMB (sprawl) (mean)	RMB (urban) (mean)
Income per inhabitant				
2004	15,230	11,931	13,192	11,977
2007	18,760	16,288	16,886	15,177
2010	19,390	14,726	16,608	12,944
2012	20,000	16,108	16,241	16,032
2007–2012	6.6%	–1.1%	–3.8%	5.6%
Motorization rate (vehicles/1000 inhabitants)				
2004	566.3	632.2	752.4	771.9
2007	571.1	723.3	824.2	808.6
2010	578.4	700.0	886.3	742.2
2012	573.6	747.0	857.1	843.4
2007–2012	0.4%	3.3%	4.0%	4.3%
Unemployment rate				
2004	3.9%	3.6%	3.6%	4.5%
2007	3.3%	4.3%	4.1%	2.9%
2010	6.5%	8.8%	9.1%	8.8%
2012	7.0%	10.4%	9.2%	13.0%
2007–2012	3.6%	6.1%	5.1%	10.1%

Source: Diputació de Barcelona (DIBA), programa HERMES 2015 (<http://www.diba.cat/hg2>).

mobility patterns before and during the economic crisis. The EMEF is taken periodically as an initiative of the Metropolitan Transport Authority of Barcelona. The aim of the operation is to describe the mobility of the resident population in the metropolitan region of Barcelona. The EMEF is taken every year, employing a computer-assisted telephone interviewing (CATI) technique to interview a representative sample of the population. As seen in Table 1, the selected surveys interviewed an average of 5412 people, reporting a total average of 19,812 trips. Details were collected for every trip made by the interviewees on the day prior to the interview.

While the period 2004–2007 is aligned with the end of the expansive economic period experienced

by Spain, the period 2007–2012 covers both the first and the advanced stages of the economic crisis. The main analysis is focused on the changes that occurred between 2007 and 2012; the period 2004–2007 allows us to understand how the crisis broke with the existing dynamics and trends in terms of transport. Table 2 adds some data on the evolution of income, motorization rates and unemployment rates in the municipalities that shape the four study areas.

### Analysis

Cross-tabulations and averages were used to compare the evolution at the macro level of several mobility indicators before and after the crisis. The chosen

indicators were: average number of trips taken per day; average time invested in traveling per day; average distance covered per day; and modal split. Modal split was described as the share of total mobility assumed by non-motorized (walking and biking), public (bus, train, tram) or private (car, scooter, motorcycle) transport. We specifically aimed at the 'big picture' of the changes registered in Spain using descriptive methods, purposefully avoiding the establishment of causal relationships. We acknowledge the inherent problems of trying to infer causality between such forces at work such as the economic recession and the social dynamics expressed by transport and travel behaviors (Handy et al., 2005; Næss, 2015). Our aim is to build an interpretative understanding of the links between travel behavior and macroeconomic changes.

## Results

The overall evolution of mobility indicators in the RMB is a clear mirror of the changing economic conditions, from the economic boom years (2004–2007) to the crisis era (2007–2012). As shown in Table 3, in the economic boom era mobility was clearly expanding, at a rate above 5%, including the number of trips, time spent on traveling and distance traveled. In a time of good economic circumstances and even better economic forecasts, there was no constraint to mobility growth. In terms of modal choice, there was a slight increase in private transport use, as both public and non-motorized modes of transport were decreasing.

With the arrival of the crisis, this expansive trend came to an abrupt end. For the whole metropolitan region, during the period 2007–2012, there was an 11.7% decrease in distance traveled, while the average time spent on traveling was reduced during the period 2010–2012 down to 2007 levels. The only still-expanding indicator was the daily number of trips, with a 5.8% increase that even out-grew the rates from the economic boom era. In terms of modal choice, there is a complete upheaval in the period 2007–2012, with an important increase in the use of non-motorized modes of transport (+8.8%) that came predominantly from the decline of motorized private mobility (−7.8%).

## *Mobility changes and adaptation strategies per territory*

The crisis, however, does not affect all indicators of mobility in the same way, nor all territorial ambits equally. Changes in modal split and people's modal choice have a direct impact on other attributes of mobility, such as distance traveled, time invested in traveling and the overall number of trips. In fact, the relationship between modal choice and structural elements of our mobility, such as trip times, distance and frequency, appears to be congruent and multidirectional, with changes in either dimension also affecting the other factors. Changing from driving to walking, for instance, entails either opting for a closer destination or spending more time traveling but, due to the fact that time is a finite resource, investing more time in a single trip might force a reduction in the time available for other trips, making us reduce the overall number of everyday journeys.

Due to unequal territorial resilience and the uneven distribution of the most vulnerable social groups, the final form of the changes to mobility patterns has been highly heterogenic. People living in different areas of the metropolitan region have been exposed to different degrees of impact and they have also had different capacities for responding and adapting to the changes imposed by the crisis.

For the period 2007–2012, people living in the Barcelona municipality have been able to keep increasing their number of daily trips (+11.1%) while also increasing their share of non-motorized transport (+8.2%). This has been possible thanks to a combination of more time spent on traveling (+4.2%) and a reduction of distance traveled (−10.9%). Barcelona's morphological settings, especially its land-use mix and distribution of services, have made it possible to rely on proximate destinations and to cut down on transport expenses while keeping the increase in the overall number of daily trips. This particular set of adaptation strategies can also be found among those who live in the RMB dense, for whom the available built environment also offers the possibility of concentrating activity spaces and relocating some of their mobility on the proximity scale.

**Table 3.** Travel behavior by territorial areas.

		Number of trips (n) <sup>*</sup>	Time <sup>†</sup>	Distance <sup>‡</sup>	Modal choice		
					Non-motorized <sup>§</sup>	Public transport <sup>  </sup>	Private transport <sup>**</sup>
Barcelona							
	2004	3.28	75.1	6.07	43.7%	33.6%	22.7%
	2007	3.43	79.4	6.16	44.5%	32.2%	23.3%
	2010	3.71	82.6	6.08	50.1%	30.4%	19.6%
	2012	3.81	82.7	5.49	52.6%	29.8%	17.6%
	2004–2007	+4.7%	+5.7%	+1.4%	+0.8%	−1.40%	+0.6%
	2007–2012	+11.1%	+4.2%	−10.9%	+8.2%	−2.4%	−5.7%
AMB							
	2004	3.28	70.5	5.70	45.1%	20.7%	34.3%
	2007	3.50	79.1	6.05	45.3%	20.8%	33.9%
	2010	3.81	79.3	5.16	50.5%	20.0%	29.5%
	2012	3.70	79	5.35	52.9%	19.8%	27.3%
	2004–2007	+6.8%	+12.2%	+6.2%	+0.2%	+0.1%	−0.4%
	2007–2012	+5.7%	−0.1%	−11.7%	+7.6%	−1.0%	−6.6%
RMB sprawl							
	2004	3.45	68.5	5.48	35.2%	8.9%	55.9%
	2007	3.65	71.3	5.66	33.1%	8.9%	58.0%
	2010	3.93	79.4	5.10	38.7%	8.8%	52.5%
	2012	3.70	70.4	5.27	41.7%	8.6%	49.7%
	2004–2007	+5.7%	+4.1%	+3.1%	−2.1%	0.0%	+2.1%
	2007–2012	+1.4%	−1.3%	−6.9%	+8.6%	−0.3%	−8.3%
RMB (urban)							
	2004	3.58	68.9	4.51	45.8%	9.3%	44.9%
	2007	3.73	75.4	5.03	46.5%	9.4%	44.2%
	2010	4.05	77.1	4.35	55.0%	10.3%	34.8%
	2012	4.07	80	4.39	57.9%	9.7%	32.4%
	2004–2007	+4.3%	+9.4%	+11.5%	+0.7%	+0.1%	−0.7%
	2007–2012	+9.1%	+6.1%	−12.7%	+11.4%	+0.3%	−11.8%
Total							
	2004	3.36	71.4	5.59	42.2%	20.2%	37.6%
	2007	3.55	76.6	5.91	41.8%	19.5%	38.7%
	2010	3.80	79.3	5.31	47.7%	18.7%	33.5%
	2012	3.75	77.1	5.22	50.6%	18.6%	30.9%
	2004–2007	+5.5%	+7.3%	+5.8%	−0.4%	−0.7%	+1.1%
	2007–2012	+5.8%	+0.7%	−11.7%	+8.8%	−0.9%	−7.8%

\*Average number of trips per day; †average daily minutes invested in transportation per person; ‡average traveled distance (in km) per trip; §share of non-motorized trips over total trips; ||Share of trips in public transport over total trips; \*\*share of trips in private transport over total trips.

However, not all metropolitan regions have the conditions to allow these kinds of adaptation strategies. People living in municipalities with low population densities and who are located in the second

metropolitan ring (RMB sprawl) have also cut their use of the private vehicle, which represented 58% of all their mobility in 2007, to 49.7% in 2012. This reduction has been almost completely absorbed by

an increase of 8.6% in the use of non-motorized modes of transport (from 33.1% in 2007 to 41.7% in 2012). That modal change, however, cannot come from a reduction of their traveled distance (−6.9%), and their modal change is thus compensated, not by a focus on proximity, but by a cut in the total number of trips they make per day. While in other areas the number of trips kept growing for the period 2007–2012, and even at a higher rate than in the pre-crisis period (+11.1% in Barcelona), in the RMB sprawl this growth is cut to only +1.4%.

### *Impacts of the crisis and the built environment: Compactness vs. sprawl*

To test the importance of the built environment at determining not only the impacts of the crisis but also the adaptation strategies available to those who live in it, we focused on the evolution of the main mobility indicators in the city of Barcelona and the most disperse municipalities in the second metropolitan region (RMB sprawl) for the period 2007–2012. Figure 2 shows the evolution of modal choice in both territories while also taking into account some key socioeconomic attributes.

Barcelona's modal split is characteristic of most European metropolitan capitals, with a high usage of non-motorized modes, a medium use of public transport and a minor use of private transport. The modal split of the RMB sprawl, however, is characterized by a duality between walking and the use of the car, due to a weak public transport supply.

As can also be seen in Figure 2, both territories show similar trends in the period 2007–2012, consisting of an increase in the use of walking and cycling, to the detriment of the use of the motorized modes. This evolution is also shared among the majority of the selected socioeconomic groups. While for the case of Barcelona this increase comes from a decrease in public and private transport, in the RMB sprawl the increase in non-motorized mobility comes almost exclusively from the attenuation of the use of the private vehicle. Finally, Figure 2 also shows how each socioeconomic group's modal split is different.

Figure 3 shows the evolution of some structural components of mobility such as the number of trips,

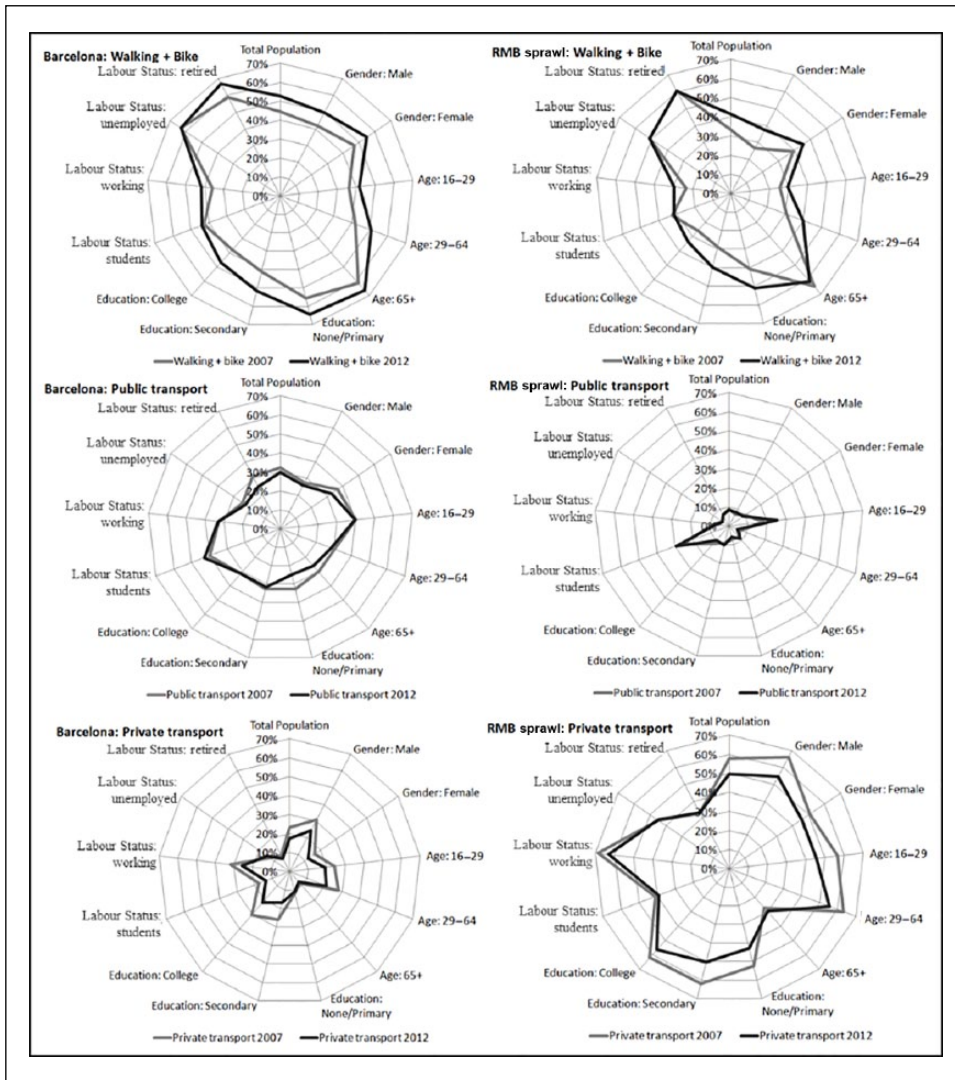
the amount of time spent on traveling and the distance traveled in both Barcelona and the RMB sprawl for the period 2007–2012, while also taking into account the same key socioeconomic attributes. Changes in such structural aspects of mobility are less significant than the changes observed in modal choice. The distribution of the number of trips and travel time among all population groups is more homogeneous in Barcelona than in the RMB sprawl, where each population group develops its own set of distances, time investments and daily trips. Distance is the one indicator that appears to be most unequal and heterogeneous among social groups both in Barcelona and the RMB sprawl, with some groups clearly investing in proximity (the retired, seniors and the unemployed) and others relying greatly on longer distances (males, the employed, 16–29 years age group).

### *Adaptation strategies per population groups*

Even when the focus is narrowed from the whole metropolitan area to a single metropolitan sub-area, there are significant differences among the impacts inflicted by the crisis on the different population groups. To analyze how the socioeconomic conditions are also determining the amount of mobility changes triggered by the crisis and have also shaped each group's adaptation strategies, Table 4 and Figures 2 and 3 compare the changes that occurred in Barcelona and in the RMB sprawl for the period 2007–2012.

In terms of gender, the results show how men in Barcelona are cutting their use of private transport at a higher rate (−6.3%) than women (−4.2%). However, women are increasing their number of trips (+15.1%), their travel time (+7.2%) and their distance traveled (+3.3%) at a higher rate than their male counterparts. By contrast, in the RMB sprawl the evolution of travel indicators for men and women are almost diametrically opposed. While men are coping with the 11.6% decrease in private transport by incrementing their travel time and reducing their distance traveled, women are responding to modal changes by greatly reducing distance (−14.1%) and time (−9.4%), and at the same time they have also reduced their number of daily trips (−3.6%).

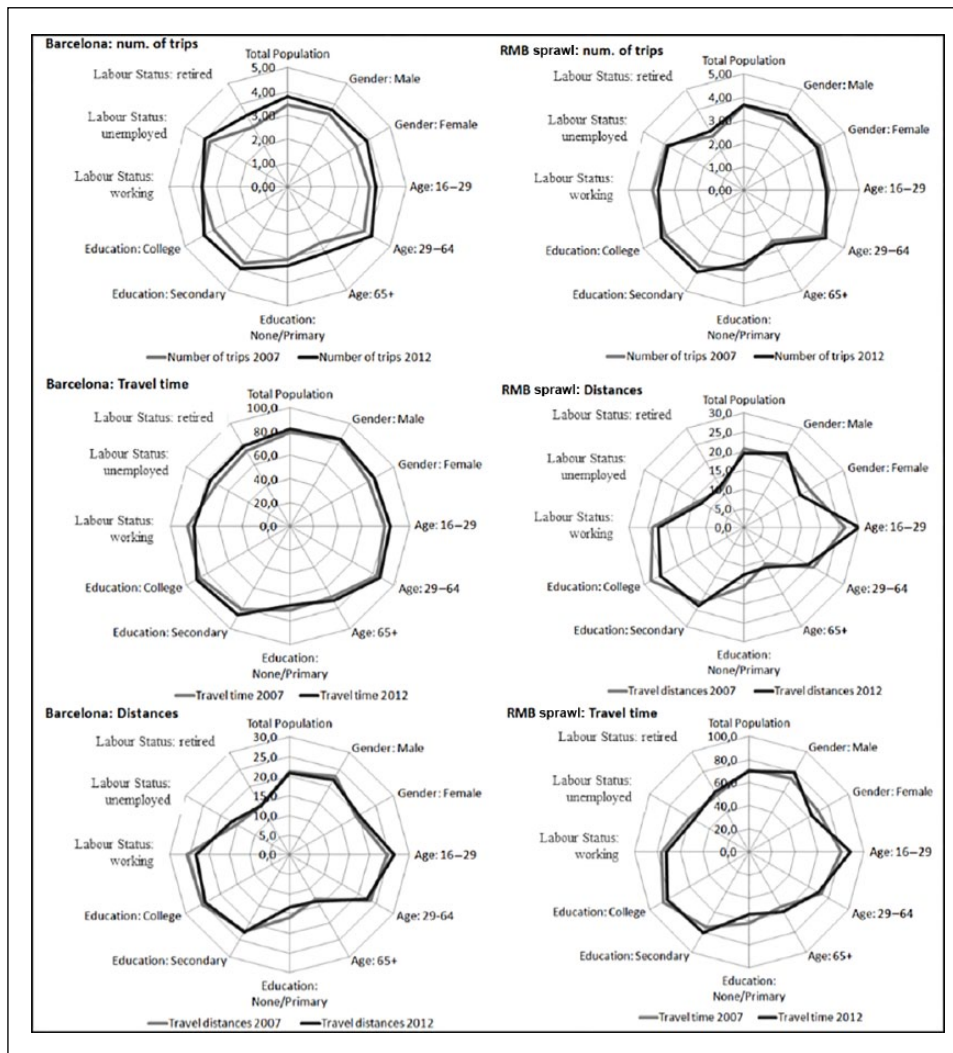




**Figure 2.** Modal choice evolution in Barcelona and the RMB sprawl for the period 2007–2012.

In terms of age, the biggest modal choice adjustment is found in the RMB sprawl, with people in the 16–29 years age range reducing their use of private transport by 11.1% and transferring to public transport, which grows by 6.9%. In fact, all of the analyzed age groups are reducing their use of private transport, although that reduction is stronger among those living in the RMB sprawl. In addition, while in Barcelona the usual response is to increase non-motorized trips, in the RMB sprawl there are also

those who prefer to increase their public transport use. All of these modal changes are causing different adaptation strategies. In the case of the younger population (16–29 years of age) these modal changes are making those who live in the RMB sprawl radically cut their number of daily trips (–2.2%), while those who live in Barcelona can cope with the effects of the crisis and keep a 7.5% increase in the number of trips. In an opposite trend, we find that the senior population over 64 years of age to be the group with



**Figure 3.** Mobility indicators evolution in Barcelona and the RMB sprawl for the period 2007–2012.

the least number of changes in their modal choice. For this particular group, the crisis has meant an important increase in the number of trips taken per day, although in the RMB sprawl this has come at the price of an important jump in the total travel time spent on transport (+8.4%).

Finally, it is remarkable how the decrease in the use of private transport has been highly similar between people in the 29–65 year age range living in Barcelona and also living in the RMB sprawl (–7% and –7.8%, respectively). Despite using the

car only for 27.6% of their trips (Figure 2), middle-aged people in Barcelona have been able to cut their use of the car by almost the same rate as those living in the RMB sprawl, who were using the car in 2007 for up to 63.2% of their daily trips. In Barcelona, this has come at the expense of an increase in travel times (+3.1%), due to a higher usage of slow modes of transport, and a commitment to proximity and shorter travel distance (–4.3%). In contrast, for those living in the RMB sprawl, the decrease in the use of the car has meant

**Table 4.** Relative changes in the period 2007–2012 per socioeconomic group.

		Barcelona						RMB sprawl					
		Trip characteristics			Modal choice			Trip characteristics			Modal choice		
		Trips (%)	Time (%)	Distance (%)	Walk/ bike (%)	Public (%)	Private (%)	Trips (%)	Time (%)	Distance (%)	Walk/ bike (%)	Public (%)	Private (%)
Gender	Male	6.2	1.0	-4.9	7.9	-1.7	-6.3	7.2	8.3	4.6	10.7	0.9	-11.6
	Female	15.1	7.2	3.3	7.9	-3.7	-4.2	-3.6	-9.4	-14.1	6.5	-1.5	-5.0
Age	16–29	7.5	6.1	7.2	5.7	-0.4	-5.3	-2.2	9.7	14.3	4.2	6.9	-11.1
	29–64	9.8	3.1	-4.3	8.9	-1.9	-7.0	4.8	-3.7	-7.8	9.3	-1.4	-7.8
	64+	17.7	5.1	5.4	5.2	-4.2	-1.0	6.9	8.4	8.8	-3.4	1.2	2.2
Education	None/primary	8.8	-6.3	-16.3	8.8	-7.8	-1.0	-7.1	-12	-20.9	10.2	-0.9	-9.3
	Secondary	6.9	7.1	0.6	10.5	-1.2	-9.2	6.7	7.7	4.3	10.8	0.8	-11.6
	College	12.5	3.2	-3.1	8.9	-0.2	-8.7	5.3	-4.8	-9.5	7.7	-2.2	-5.5
Labor status	Working	-1.1	-6.5	-9.2	5.9	0.3	-6.1	-6.0	-5.2	-6.4	6.1	-0.5	-5.5
	Unemployed	6.2	8.4	9.8	0.0	-1.4	1.4	-2.0	-6.5	-6.2	0.0	-0.3	0.3
	Retired	18.8	6.4	-0.1	8.2	-6.2	-2.0	9.1	5.3	7.6	-0.4	0.0	0.3
	Total	11.1	4.2	-10.9	8.2	-2.4	-5.7	1.4	-1.3	-6.9	8.6	-0.3	-8.3

both reducing their number of trips and greatly reducing distance traveled (-7.8%).

As seen in Table 4, all education statuses show transference from motorized transport towards non-motorized modes. While in 2007 those with a lower education status had 10.8% use of the car, the more educated classes had 30.6% use of the car (see Figure 2). In 2012, this latter figure was greatly reduced, up to a rationalized 21.9%. In the RMB sprawl, those with a college degree have been forced to undertake small changes in their modal choice, with a mild reduction of 5.5% in their use of the car. In contrast, those with secondary and primary studies have cut their use of the car by almost 10%. What is consistent in both geographic areas is that those with a lower level of studies are committing to reducing their travel distance (-16.3% in Barcelona, -20.9% in the RMB sprawl). More worrisome is the fact that, while for people with low education levels who live in Barcelona these changes imply an increase in the number of trips that is slightly under the average, for those living in the RMB sprawl the crisis imposes a 7% cut in the number of daily trips.

Finally, labor force status is the variable that brings the least differences among territories. In both Barcelona and the RMB sprawl, the trend among the employed is to try to reduce their car use by investing in non-motorized means of transport, shorter distance traveled and fewer trips made per day. Although the direction of the changes is the same, the amount of change is clearly greater in the RMB sprawl.

## Discussion

In this paper we have explored how the economic crisis has affected travel behavior in the Barcelona metropolitan region. We aimed to gain some understanding about how adaptation strategies vary between territories and socioeconomic groups. The crisis has changed mobility needs and has created a strong incentive to cut some of the spending invested in the most expensive modes of transport. Despite the presence of other confounding factors, the trend in the Barcelona area seems to indicate a general

optimization in the use of motorized modes of transport, mainly the car, in favor of non-motorized modes of transport, such as walking and biking. The direction of this trend can be spotted across all socioeconomic groups and territories studied, although the exact magnitude of the actual changes varies wildly. The fluctuations of modal choice have triggered a set of changes upon other aspects of mobility, such as travel times, distance covered and the number of trips per day, which are part of the core structure of people's everyday mobility.

Out of those structural issues, the most prominent aspect of the new mobility model that arose in times of economic crisis has been a return to mobility of proximity, with traveled distances decreasing in all of the analyzed territories. The steepness of that decrease, however, varies on the one hand with the possibilities of the built environment, and on the other with the socioeconomic condition of individuals, as each socioeconomic group chooses its own balance between number of trips, distance and time invested in traveling. These findings confirm previous work on the role of socioeconomic factors in determining travel behavior in compact Mediterranean cities (Marquet and Miralles-Guasch, 2014, 2015b) and extend them not only in the ambit of the central Barcelona city but to the whole of the Barcelona metropolitan area.

Another common and relevant aspect is the reluctance in cutting the number of trips made per day. In fact, the number of daily trips increases in times of crisis (2007–2012), at a higher rate than in the economic boom years (2004–2007). This trend demonstrates the importance of activity engagement for modern societies, as data suggest that, even in times of economic crisis, activity engagement is the last thing that people are willing to cut. Another enticing hypothesis is that the increase in non-motorized modes together with the reduction of distance traveled could lead to an increase in the number of trips, as one could substitute a longer trip for a number of short ones. This causal relationship, however, will need to be further explored in the future.

In any case, this growth in the number of daily trips seems to contradict some studies that in recent years have observed a stall in travel demand. This whole hypothesis of peak travel (Millard-Ball and Schipper, 2011) or what Metz has called a “saturation

of demand for daily travel” (Metz, 2010, p. 668) seems, in light of our results, more of a contextual fact driven by the persistence of the crisis, than a structural peak in the demand for travel. In fact, our results are not denying the overall saturation of demand for mobility, but rather proving the existence of a close relationship at the individual level between the time invested in traveling, the location of the activities and the number of daily trips that can be sustained. From a time–geography perspective, and taking into account the finitude of time (Neutens et al., 2011) and limited time budgets (Mokhtarian and Chen, 2004; Van Wee et al., 2006), a switch from fast to slow modes of transport has to be compensated for, either by a shorter distance traveled, or by a lower number of daily trips. Thus, our results partially confirm the hypothesis stated by Wegener (2013), in which a rise in transportation prices would lead to shorter and more local trips. In the case of Barcelona, the relative increase in transportation costs due to the crisis has indeed generated shorter and more local journeys, although more rather than fewer trips. This ever-growing mobility is a positive indicator amid the economic crisis, as the rising number of activities is an important driver of people's wellbeing and quality of life (Stanley et al., 2011).

The territorial settings for the metropolitan sub-areas analyzed along with their territorial resilience also shape adaptation strategies. In that sense, the main adaptation strategy in Barcelona, and in the denser parts of the RMB, seems to consist on relying on proximity environments. Relocating some of the everyday destinations at the neighborhood scale eases modal change without having to invest more time in transportation. However, this is only possible thanks to a suitable built environment (Marquet and Miralles-Guasch, 2015b) that offers an equal possibility of proximity traveling to all population groups (Marquet and Miralles-Guasch, 2014). The availability of proximity environments not only allows the development of further trips but also promotes them, as demonstrated by Nielsen (2015).

The development of adaptation strategies in less resilient territories, such as those found in the RMB sprawl, involves having to decide on some major structural changes in mobility patterns. Our results show how the final terms of these decisions are

highly dependent on the social and economic conditions of certain population groups. Women's adjustments in non-resilient territories, for example, appear to be harsher, with a reduction of -3.6% of daily trips, which might be related to the lower access to private transport that has been observed in the research of Scheiner and Holz-Rau (2012) and Polk (2004), among others. These difficulties to accessing private transport can be compensated for in resilient areas such as the centre of Barcelona, but in the RMB sprawl the lack of access to a car represents a burden on everyday mobility. This same lack of access to a car, which is also usually associated with young people, is also causing people between 16–29 years of age and living in non-resilient territories to sacrifice some of their daily mobility, as their daily trips have no easy transition to the non-motorized modes of transport. Finally, those with a lower level of education have been the ones most affected by the crisis, and thus have also been in need of making major adjustments. These adjustments seem to come from greatly reducing travel distances and optimizing private transport use. The cost of doing so has been almost negligible for those living in Barcelona, in contrast with the high cost for those who live in the RMB sprawl, who have had to cut their daily traveling by 7.1%.

It is also noteworthy how the retired and the senior population are the groups who are increasing their mobility the most. This might mean that either the senior population is naturally becoming more active, or that they are becoming more involved in assisting with family dynamics, by assuming some family tasks in times of need. The rise in senior activity engagement, however, is not immune to territorial settings, as seniors living in Barcelona are increasing their mobility at almost twice the rate as seniors living in sprawled territories. This is also consistent with studies that find the older population to be highly dependent on their nearest built environment (Marquet and Miralles-Guasch, 2015a; Steels, 2015).

Overall, the present paper has provided an overview of the changes in mobility patterns that occurred during the crisis period in the Barcelona metropolitan region. We have done so by including both territorial and socioeconomic factors that help us to understand the final shapes of adaptation strategies. While this

study has provided some initial exploratory conclusions on the relationship between the economic recession and travel behavior changes, it does suffer from a number of limitations. The descriptive nature of our study prevents us from establishing complete causal inferences. The recession has been a macroeconomic phenomenon unequally affecting urban populations and territories for a long period of time. This poses challenges to researchers and to studies like this trying to understand the direct effects of the crisis on specific aspects of everyday life. Some of the changes in mobility indicators observed by this study may have been caused in part by changes of mobility preferences, increased environmental awareness or even by changes in the transport network and infrastructure; although the large inertia of these factors make it unlikely. Future research will have to focus on the complex interrelationships between socioeconomic and territorial factors, and how they interact to shape unique changes in mobility patterns.

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