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TRAVEL BEHAVIOUR IN A POST-SOCIALIST CITY

Abstract. Automobile traffic has been recently on the rise in many post-socialist cities despite EU policies fostering public transportation and active modes of travel. Against this background, the contribution of this paper is to look deeper into the travel behaviours of residents using a survey of 887 questionnaires as well as GPS travel recordings (almost 3 billion logs) conducted in the city of Poznań (539,000 inhabitants). Based on our analysis we found that proximity to public transport and cycling infrastructure seem to be among the most important factors influencing travel behaviours of inhabitants. What is more, their accessibility affected also residential locational preferences. However, we also observed that even in neighbourhoods with good accessibility, commuting by car plays a major role.

Key words: travel behaviour, post-socialist city, transport policy, residential self-selection, Poznań.

1. INTRODUCTION

Urban travel behaviour has recently received considerable attention from scholars across the globe (Schwanen *et al.*, 2001; Næss, 2006; Schönfelder and Axhausen, 2016). Yet, within the growing range of studies, relatively little attention has been paid to post-socialist cities of Central and Eastern Europe (CEE). This is surprising given the scope of change in urban transportation, or, in other words, of the “transport revolution” that occurred in these countries (Pucher and Buehler, 2005). The drivers of this change were diverse, but strongly linked to two major factors. The first of them is urban sprawl, which resulted from private sector led housing development under limited planning control (Hirt, 2007; Kok and Kovacs, 1999; Leetmaa and Tammaru, 2007). The second major cause of change in urban transport has been increasing automobile ownership driven by a preference for

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more individualised mode of travel (Komornicki, 2003). Then, some efforts have recently been made to promote the use of public transport and of active modes of travel. These could be seen as part of a broader trend of adopting Western policy solutions and practices, which are considered an expression of modernity.

Set against this background, this paper seeks to explore neighbourhood-level travel behaviour in the post-socialist context using the Polish city of Poznań as a case study. Evidence is drawn from a questionnaire survey of households and from mobile phone GPS recordings. Providing more evidence in this field is urgently needed because the way travel behaviours evolve is very likely to affect the future functioning of urban systems in Central and Eastern Europe. While the sustainability paradigm in general and EU transport policies in particular encourage the use of public transportation and active modes of travel, what has actually been observed in post-socialist contexts is increasing reliance on the private automobile.

2. POST-SOCIALIST PERSPECTIVE ON TRAVEL BEHAVIOUR

For a number of reasons, post-socialist countries offer a unique context for the study of travel behaviour. The transition from central planning to a market-oriented and democratic system has brought manifold consequences, which have translated into various changes in urban space (Borén and Gentile, 2007). Drawing on the seminal model of urban cycles (Berg *et al.*, 1982), it could be hypothesised that until the end of the 1980s, socialist cities found themselves in a prolonged phase of urbanisation. The systemic change has brought about a rapid shift towards suburbanisation, which became the predominant trend of post-socialist urban development (Niedzielski and Śleszyński, 2008; Stanilov and Sýkora, 2014). Accelerating growth of the hinterlands accompanied by a decline of core city areas has been documented in a number of Central and Eastern European cities (Kotus, 2006; Leetmaa and Tammaru, 2007; Ott, 2001). This phenomenon could be interpreted as a way of fulfilling societal aspirations of the nascent middle class (Ouredníček, 2007). While the process as such is not unique to the post-socialist context, what makes it peculiar is the fact that far-reaching changes occurred within a relatively short period.

Changes in the spatial structure of cities in conjunction with evolving consumption patterns were closely linked to changing travel behaviours. While the scope of residential suburbanisation greatly exceeds workplace suburbanisation, relocations to the suburbs are linked to a substantial increase in commuting (Krisjane *et al.*, 2012). Coupled with rising motorisation rates (Table 1), this resulted in a rapid rise in automobile usage. In many cities, individual motorised commuting has become the dominant mode of travel (Novák and Sýkora, 2007). Previous re-

search posited that car ownership in post-socialist countries was driven mainly by economic factors, such as income and costs (Komornicki, 2003). However, more recent contributions pointed out to the importance of the car as a status symbol, suggesting that cars might be owned and used even if they are not necessary from a strictly economic point of view (Pojani *et al.*, 2018).

Table 1. Passenger cars per 1,000 inhabitants in CEE countries in early and late transition period

Country	1994	2014
Bulgaria	188	417
Croatia	150	348
Czech Republic	266	449
Estonia	231	497
Hungary	202	315
Latvia	100	330
Lithuania	196	414
Poland	186	526
Romania	89	247
Slovak Republic	186	360
Slovenia	336	522

Source: OECD (2017).

In socialist times, mobility in urban areas used to be highly dependent on public transportation. During the post-socialist period the usage of public transportation has been generally on decline. However, public transportation infrastructure, and particularly high capacity corridors such as urban light rail, continue to be perceived as important elements of the transportation system (Gadziński and Radzimski, 2016). While suburbanites are likely to rely more on the automobile, lack of alternatives has also been reported as a reason behind the decision to drive (Hirt, 2008; Kährlik *et al.*, 2012; Špačková *et al.*, 2016).

Active modes of travel have received very little attention in the post-socialist urban literature so far. Walking remains an important mode of travel in post-socialist cities due to the relative compactness of their built-up structures. Cycling is much less widespread in CEE cities than in Western Europe. This fact seems to be, *inter alia*, linked to concerns about road safety (Evgenikos *et al.*, 2016). It is generally agreed that walking and cycling have not been treated as distinct policy priorities in post-socialist countries. This situation is beginning to change, with increasingly more attention being paid to addressing the needs of pedestrians and cyclists. Compared to the early 1990s, a certain progress is visible, but still the cycling infrastructure often fails to meet modern quality standards (Barnfield and Plyushteva, 2015).

3. METHODOLOGY

To fulfil the adopted research objectives we decided to conduct a case study in the city of Poznań. To present the context, first we focused on the main trends affecting travel behaviours of inhabitants within the city. Secondly, we conducted in-depth comparative studies for selected districts of Poznań. Such an approach allowed a closer look at the local specifics of particular areas, including their unique neighbourhood characteristics and transport system conditions. We focused on three districts located in the northern and eastern parts of Poznań – Naramowice, Piątkowo, and Rataje (Fig. 1). The selected areas are characterised by significantly different levels of accessibility of transport modes. All of them are located outside the city centre and are characterised by the dominance of multi-family buildings, but other conditions (especially transport opportunities) seem to be significantly different. Their more detailed characteristic could be found in the fourth section of the paper.

The paper employs a multi-method approach and combines data from different sources. The main groups of data used in the study and the way they were utilised are presented below.

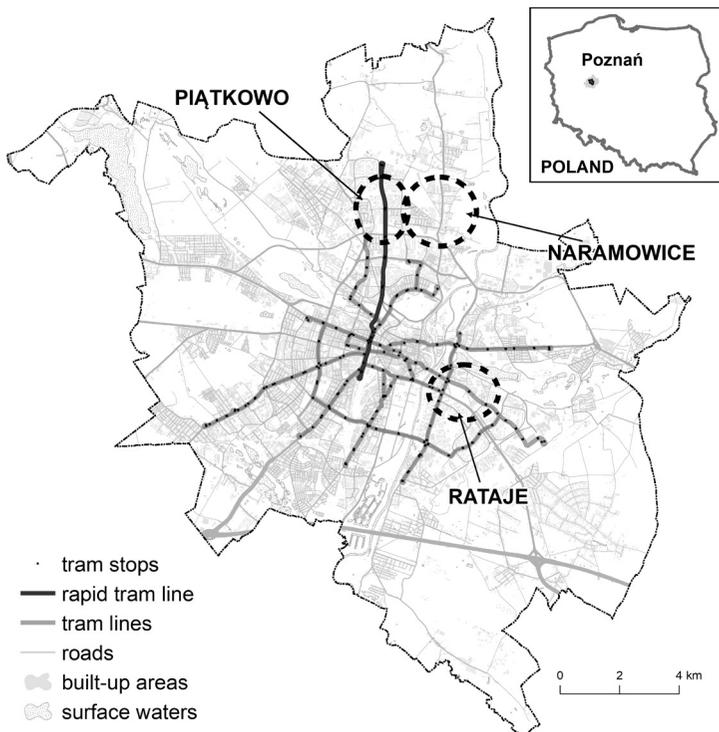


Fig. 1. Study area and selected districts

Source: own work.

The first group of data was collected with the use of face-to-face interviews, which were conducted with the inhabitants of Naramowice, Piątkowo, and Rataje from June 2016 to October 2016. The main objective of this survey was to collect information on the typical travel behaviours of inhabitants, their motivations on housing decisions, and subjective opinions on the level of satisfaction with the place of residence. To cover a broad variety of housing types and neighbourhood conditions, we decided to explore the opinions of people living in different parts of selected districts. Therefore, we divided them into smaller parts (housing estate level) and selected respondents proportionally from all designated areas. In total, the opinions of 887 inhabitants were gathered. The detailed socio-demographic characteristics of respondents are presented in Table 2.

Table 2. Socio-demographic characteristics of respondents from selected districts

Category/characteristic	Piątkowo	Naramowice	Rataje
No. of respondents	374	301	212
Gender [%]			
male	42.6	48.2	49.1
female	57.4	51.8	50.9
Age [%]			
< 25	34.0	14.6	19.8
25 – 39	31.0	42.5	40.6
40 – 59	19.1	29.2	30.2
> 60	15.9	13.6	9.4
Education [%]			
elementary	5.7	1.0	2.9
vocational	20.3	4.0	17.7
secondary	43.8	37.9	42.1
higher	30.3	57.1	37.3
Occupational status [%]			
in education	32.7	13.0	23.4
employed	41.2	67.8	59.7
unemployed	2.9	1.00	2.8
pensioner	15.4	10.3	10.6
housewife	7,7	8.0	3.7
Economic situation [%]			
very good	8.9	7.3	7.2
rather good	41.8	41.2	35.9
average	38.1	44.5	48.7

Table 2: cont.

Category/characteristic	Piątkowo	Naramowice	Rataje
rather poor	5.4	4.7	8.2
very poor	1.6	0.0	0.0
no answer	14.3	2.3	0.0
Household size	2.93	2.98	2.67
No. of children per household	0.53	0.83	0.42
Household status – ownership [%]	54.7	74.4	64.2
Household status – rented [%]	45.3	20.9	35.8

Source: own work based on interview results.

In our analyses we also utilised location data obtained in a survey based on a mobile app¹. The data was treated as supplementary information and used to verify the hypothesis on relationships between housing location and travel behaviour. The survey was conducted only on a group of students and young adults, so it should be treated rather as a pilot study. However, with the use of the obtained data, it was possible (for this particular social group) to identify popular travel destinations and relate them to the type of residential area and the accessibility level. It was particularly important in the case of Piątkowo district where students seem to be a significant group of inhabitants (they amounted to one third of all respondents who participated in the interviews).

In total, we collected almost 3 billion records with latitude-longitude coordinates, precise time and speed information, as well as several socio-demographic characteristics of study participants (104 persons). The collected data was cleaned, arranged in a database, and visualised with the use of GIS software (ArcGIS 10.3.1). To improve the perception, the data is presented in a hexagonal grid.

4. TRAVEL BEHAVIOURS IN POZNAŃ

4.1. Urban context and transport policy

The case study used in this article is the Polish city of Poznań, with a population of 539,000 in 2017. Together with Wrocław, Poznań is considered to be one of two major urban cores in the western part of Poland. Higher education constitutes

¹ Detailed information about the construction of the research tool and the survey methodology was presented in: Gadziński (2018).

an essential function of the city, with about 100,000 students enrolled at local universities. The important academic function of the city combined with its favourable economic development in the post-transition period triggered substantial migration from rural areas. Despite that trend, the population of Poznań declined by 48,000 persons between 1990 and 2015. That was because population growth took place in the hinterland zone while the core city declined. Residential suburbanisation led to an increase of 147,000 persons in the hinterland zone (Fig. 2). Workplace suburbanisation has had a more limited extent (Miasto Poznań, 2014).

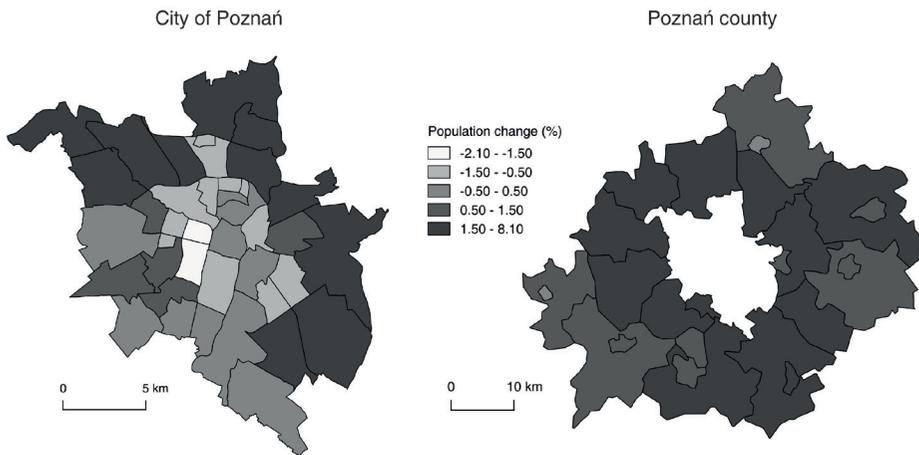


Fig. 2. Population change in Poznań and the hinterland zone (2001–2015)

Source: own elaboration based on GUS (2017) and Miasto Poznań data.

Spatial decentralisation of the resident population within the urban region and longer commuting distances pose increased pressure on the local transport infrastructure. In the course of post-socialist reforms, the responsibilities for urban transportation had been shifted to the local level, but only limited access to external funding was provided. That changed with the accession of Poland to the European Union in 2004, which gave a boost to local transport investment. However, while the principal objective of EU transportation policy is to foster sustainable mobility, in the case of Poznań an increase first occurred in road investments, followed by higher spending on public transportation (Fig. 3).

Prioritisation of road infrastructure as a leading solution to challenges arising from spatial decentralisation was the prevailing, yet contested vision of local transport policy for much of the post-socialist period. A radial model comprising three concentric ring roads guiding automobile traffic away from the city centre dominated local transport planning in the early 2000s. Particularly the third, exter-

nal ring road raised much controversy, since its construction would imply a spending of a least 6.7 billion PLN, i.e. about 1.5 billion euro (Miasto Poznań, 2008). In comparison, the total investment in road infrastructure in Poznań between 2001 and 2016 equalled less than half of that amount. Recently, the ring roads do not appear to be on the local transportation policy priorities list, but road investments continue to constitute an essential part of municipal spending.

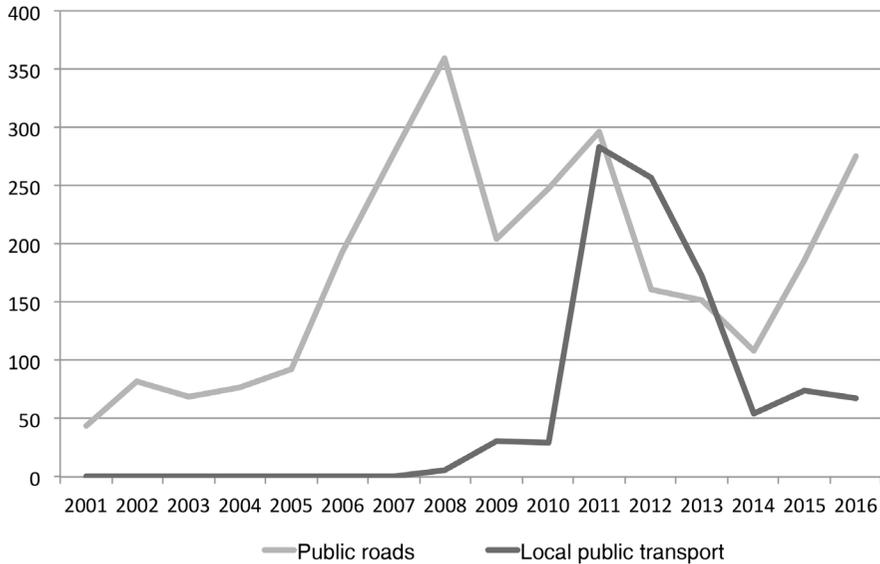


Fig. 3. Investment in transport infrastructure in Poznań (millions PLN)

Source: own work based on Miasto Poznań financial reports.

With regard to public transportation, the largest investment in the 1990s was the Poznań Fast Tram, a project initiated already in the socialist times and accomplished after the transition (Gadziński and Radzinski, 2016). In the period following the EU accession, several other yet smaller-scale projects have been brought into being, including a link of the Poznań Fast Tram to the central railway station, and an extension of the tram network to the suburban retail area of Franowo. Also, EU funds helped the city to substantially modernise its fleet of buses and trams. As of 2017, the public transportation network of Poznań comprised 21 tramlines, including one nightline, and 72 bus lines, including 21 nightlines (Miasto Poznań, 2017).

The cycling infrastructure in Poznań is often considered less developed than in other major Polish cities (Grochowski and Szymczak, 2015). For several years, extensions of the bicycle network were closely linked to investments in road infrastructure, without being explicitly recognised as a distinct policy objective.

The total length of the cycling infrastructure, including cycle tracks, cycle lanes and shared-use paths, amounts to 140 km (Miasto Poznań, 2017). Other source quoted 184 km as the overall length of bikeways and other facilities for cyclists (Grochowski and Szymczak, 2015, see Fig. 4). A bike-sharing scheme has been in operation since 2012, including 88 stations and 923 bikes as of 2017. In 2018, the number of bike-sharing stations increased to 113 providing better coverage particularly in the outer neighbourhoods. Low perception of traffic safety and an incoherent cycling infrastructure network are seen as the major hindrances to bicycle usage (Miasto Poznań, 2017).

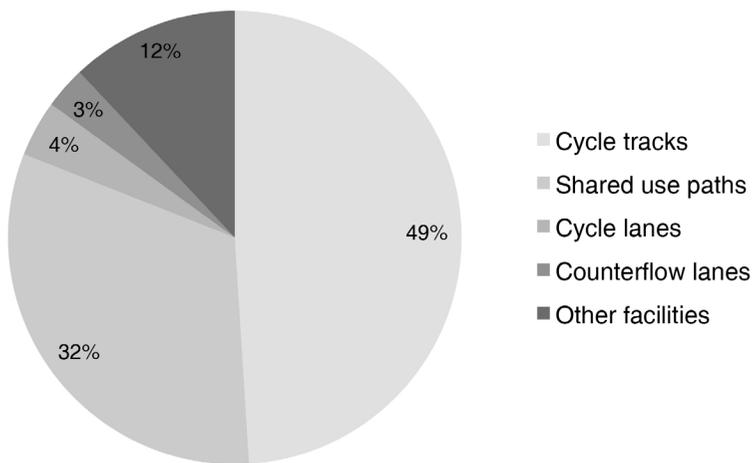


Fig. 4. Cycling infrastructure in Poznań by type

Source: Grochowski and Szymczak (2015).

Until recently, pedestrian traffic in Poznań has not received much attention in the local transport policy. A number of obstacles to pedestrian traffic have been identified, such as the practice of expanding cycling infrastructure at the expense of pedestrian space (Grochowski and Szymczak, 2015). A notable point is that pedestrian traffic is not recognised as a formal part of the local transport policy agenda, which only includes public transportation, cycling, parking, and road traffic as distinct policy fields. While several Polish cities recently appointed a pedestrian officer responsible for consulting planning and policy papers, Poznań has not decided to take this step so far.

To conclude, the local transport policy of Poznań in the post-transition period could be characterised as an assemblage of projects, initiatives, and strategies that were to a large extent driven by external opportunities such as EU funds. These various initiatives only to a limited extent were able to communicate the vision of a comprehensive transport strategy. For several years, the prioritisation of au-

tomobile traffic as the preferred solution in the light of the on-going suburbanisation process constituted a major obstacle for the implementation of a sustainable transport policy agenda.

General information on travel behaviours in Poland is delivered by complex traffic surveys. However, they were organised in Poznań irregularly and with a low frequency (mainly due to their high costs). What is more, the methodology has changed over the years, so in some cases it is difficult to compare the results. Nevertheless, these surveys remain a fundamental source of data that allows some important trends to be indicated (Table 3). The share of car travel has increased significantly since the late-1980s. Only between the years 2000 and 2013 car traffic increased by 57% within the city, and by 83% in the suburbs (Badania i opracowanie..., 2013). This was related to a decrease in public transport usage. However, we should notice that the role of mass transit in urban travel is still considerable, and around 40% of inhabitants use this mode on a regular basis. Together with the decline in public transport usage, we could observe also decreasing popularity of active travel. However, there is also evidence that the number of cyclists has increased significantly in recent years (Badania i opracowanie..., 2013).

Table 3. Modal split and mobility level in Poznań over the years

Year	Modal split			Number of travels per day (without walking)
	car [%]	public transport [%]	active travel (w – walking, c – cycling) [%]	
1988	16	51	31	1.83 (1.28)
1997	48	37	15	-
2000	53	37	10 (w: 8, c: 2)	2.44 (1.99)
2013	39	43	17 (w: 13; c: 4)	1.70 (1.48)

Source: Badania i opracowanie..., 2013; Studium uwarunkowań..., 2014.

The above-mentioned trends seem to be a consequence of the greater prevalence of cars in households, and of the transformation of spatial structures in the city. The suburbanisation process has resulted not only in a decline in population density in the city centre, but it also caused a decrease in the efficiency of public transport. In most cases new residential estates were built in areas without connection to tram or train infrastructure (Gadziński, 2014; Radzinski, 2009). According to legal regulations, there are no requirements to be met with regard to public transportation accessibility when applying for a construction permit. Therefore, in many cases new residents of suburbs became largely dependent on cars in their daily travels.

4.2. Evidence from three neighbourhoods

The analysis of travel behaviour in Poznań is based on a questionnaire-based survey conducted in 2016 in three neighbourhoods. These neighbourhoods differ in terms of their built-up structures as well as with regard to the accessibility of public transport and the active modes of travel². Rataje is a prefabricated housing neighbourhood constructed during the socialist period. It is characterised by typical modernistic design, including the separation of different modes of travel. The construction of Piątkowo started already in the 1980s, but it was completed after the systemic change, whereas the neighbourhood of Naramowice is an example of new developments, as it was built mainly from the 2000s onwards.

In comparing travel times to the city centre with trams and buses (Fig. 5), we found a high level of public transport accessibility in Rataje and Piątkowo, which is provided especially by an extensive tram network and supporting bus connections. Piątkowo has got direct access to the Poznań Fast Tram, which provides a convenient connection to the city centre, while Rataje is served by a regular tram line. Among the three neighbourhoods, Naramowice is the only one not directly connected with the tram network (Fig. 5). Consequently, public transport is only based on bus connections (7 daily lines) and almost all bus routes run through the main axial street, which received attention from the national media in 2014 as the slowest transit corridor in Poland. What is more, Rataje and Piątkowo are connected to the city centre also via a dedicated cycling infrastructure. In the case of Naramowice, separated tracks for cyclists still have not been provided.

Differences between Naramowice, Piątkowo and Rataje in terms of public transport accessibility and cycling infrastructure seem to be among the most important factors influencing travel behaviours of inhabitants. This hypothesis could be proved by the results of our investigations. Table 4 compares the results of the survey based on face-to-face interviews. The results clearly confirm that public transportation is the most popular transport mode in Piątkowo. More than half of the respondents use trams and buses at least several times a week. Public transport was also very popular in Rataje. However, respondents from this district use both cars and public transport comparably often. Thus, the respondents in Naramowice prefer cars in their daily travels (50% of them use cars every day). What is more, they own generally more cars and fewer seasonal tickets than the inhabitants of Piątkowo and Rataje. Regular cycling is rather unpopular in Naramowice, while

² For research purposes (to underline the differences between districts) we proposed two measures of public transport accessibility. They are presented in Fig. 5. In the first case, we analysed walking time to the nearest tram stop. Average speed of pedestrian was adopted as 5 km/h. In the second case, travel times to the city centre with the use of trams and buses (including walking time to public transport stops) were estimated. Calculations were based on official timetables. Both accessibility measures were network-based – we assumed that people use existing roads and pavements (OpenStreetMap data was used).

as much as 7% of the respondents from Piątkowo and almost 9% from Rataje declared that they used bicycles every day. These results are strongly linked with the perception of various transport modes. The respondents from Piątkowo and Rataje recognised trams as the most accessible mode of transport, even though they pointed out that the time needed to get to the parking place was much shorter than the walking time to the closest tram stop, while in Naramowice, cars were indicated as the most accessible mode of transport. This opinion was shared by 66% of respondents from this district.

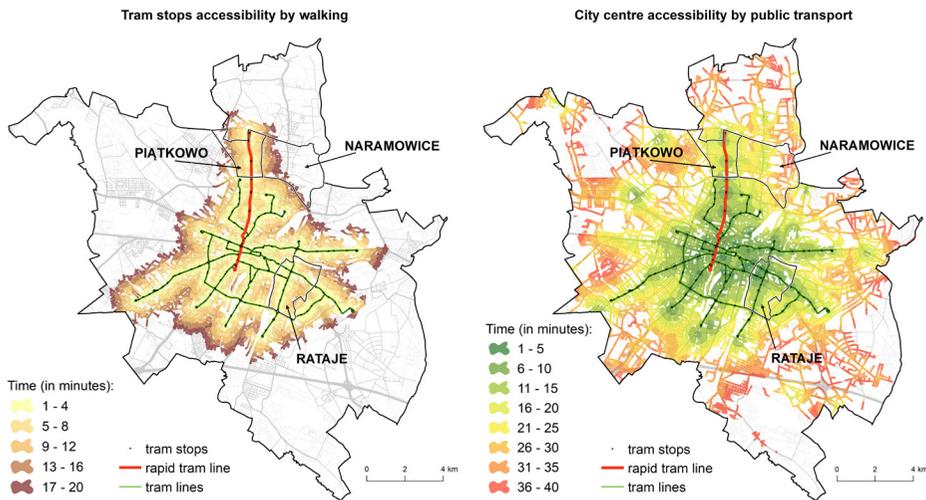


Fig. 5. Public transport accessibility in Poznań

Source: own work based on public transport timetables.

Table 4. Travel preferences declared by the respondents from Piątkowo, Rataje and Naramowice districts

Category/characteristic/declared preference	Piątkowo	Naramowice	Rataje
Travel options in households			
Number of cars per household	0.97	1.20	0.95
Households without a car [%]	31.64	17.28	29.72
Number of season tickets per household	1.60	0.94	1.42
Households without seasonal tickets [%]	21.18	43.19	26.89
Travel modes: use frequency [%]			
Using cars everyday	27.22	49.83	41.83
Using cars at least several times per week	45.01	68.44	58.17
Using buses everyday	28.84	20.93	30.48

Category/characteristic/declared preference	Piątkowo	Naramowice	Rataje
Using buses at least several times per week	51.75	43.19	62.38
Using trams everyday	32.35	5.69	33.33
Using trams at least several times per week	56.33	21.74	62.86
Using bicycles everyday	7.01	2.33	8.65
Using bicycles at least several times per week	25.34	17.33	30.77
Accessibility perception:			
'Car is the most accessible mode of transport' [%]	31.23	65.89	27.35
'Bus is the most accessible mode of transport' [%]	18.90	28.15	34.08
'Tram is the most accessible mode of transport' [%]	46.46	1.99	35.87
Time needed to get parking place (in minutes)	2.59	1.71	3.93
Time needed to get bus stop (in minutes)	6.12	6.52	7.67
Time needed to get tram stop (in minutes)	6.87	24.29	10.01

Source: own work based on interviews results.

4.3. Role of residential self-selection

The concept of residential self-selection might be instrumental in explaining the observed differences among the three neighbourhoods. According to this concept, individual travel preferences and habits might condition the choice of the place of residence (Handy, 1996; Krizek, 2003). People tend to choose residential locations taking into account the accessibility of the preferred transport mode or travel connections to the most popular activities. In other words, they try to maximise their satisfaction with the housing location by choosing the preferred type of neighbourhood (Cao and Ettema, 2014). Previous studies (Kim *et al.*, 2005; De Vos, 2015; De Vos and Witlox, 2016) indicated that: a) areas with a high level of public transport accessibility attract mainly people who prefer mass transit, b) areas in city centre or in mixed land use are attractive for individuals who do not like to travel for longer distances, and c) car-oriented suburbs are selected more frequently by people who like to travel and prefer cars in their daily travels.

When comparing the social and demographic structures of Naramowice, Piątkowo and Rataje with the declared travel behaviours, we found some evidence that the choice of residential locations might have been linked to, or preconditioned by, the preferred travel mode. For example, there is some evidence that a high level of public transport accessibility in Piątkowo attracted a significant number of students. It is reflected by the social structure of the inhabitants interviewed in our survey, but also confirmed by the results of previous studies (Gaczek *et al.*, 2006; Gadziński and Radzinski, 2016). Piątkowo is considered a very attractive

location for students due to its proximity to the Poznań Fast Tram, which provides good access to the largest university campus in the northern outskirts of the city, to the city centre, as well as to the main train station.

This finding is also confirmed by GPS data (Fig. 6), which shows the most popular areas of students' activities. We distinguished two types of such areas. The first category includes locations that are popular during the whole day or night. They could be identified as the places of respondents' residence. The concentration of such areas is visible especially along the Poznań Fast Tram line (e.g. in the Piątkowo district). The second category includes locations that are often visited during the day. They represent such activities as studying, working, shopping, etc. The most popular travel destinations in our survey were the university campus and the city centre area where the cultural and entertainment activities are located. These results show that potentially the most attractive locations for students are areas with good accessibility of public transport and cycling infrastructure.

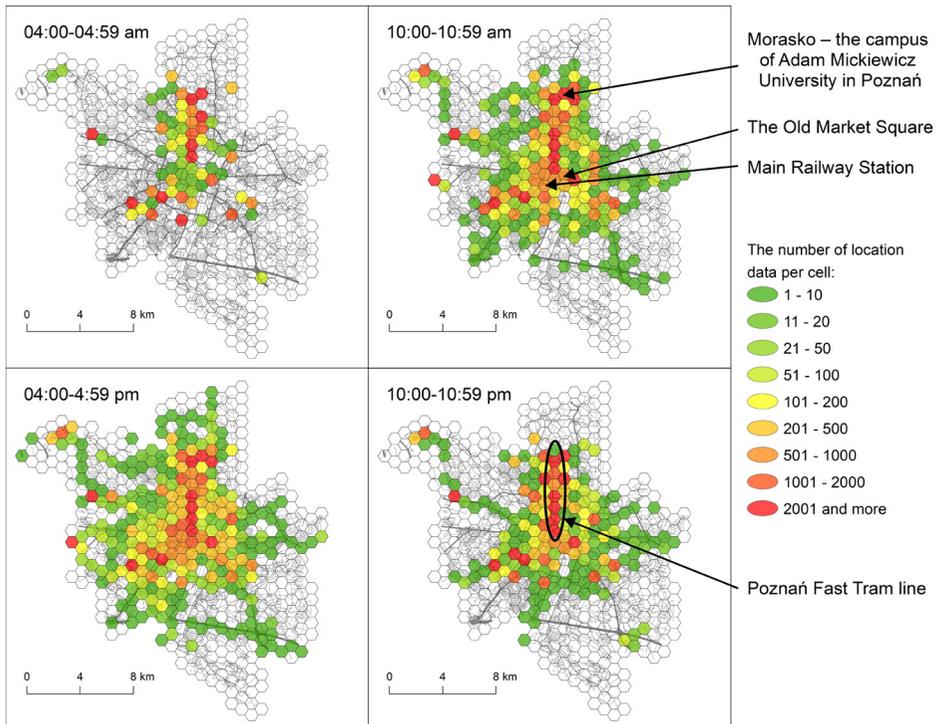


Fig. 6. Spatial distribution of students' activities in selected parts of a day

Source: own work based on GPS data.

Therefore, we could observe an intensive development of the rental market for apartments in close proximity to tram stops (Gadziński and Radzimski, 2016). It should be noted that renters could be more flexible in housing selection (due to a wide offer of apartments on the market and usually short-term contracts) and adjust the place of residence to their current needs. Consequently, it could be easier for them to achieve higher satisfaction with their place of residence. According to our survey, more than 45% of respondents in Piątkowo lived in rented flats, while in the case of Naramowice this share amounted to only 21%. When looking at the renters' characteristics, we noticed that a typical person renting a flat was in education (52% of respondents), was less than 25 years old (54%), and had lived in the current apartment for three years. Most renters, especially from Piątkowo, preferred public transport in their daily travels. 40% of interviewed persons declared to be using trams or buses every day. At the same time, only 17% declared that they were using cars with the same frequency.

5. CONCLUSIONS

In this paper we looked at the travel behaviours in the city of Poznań, which has undergone substantial changes in its spatial structure and transport policy during the post-socialist period. The dominant trend of travel behaviour in Poznań in the last years has been an increase in car travel, which has not been curbed by considerable investments in public transportation. In the paper we extended the analytical framework to focus on the neighbourhood level, which led us to some interesting observations. The results showed that travel behaviour is closely linked to the characteristics of the neighbourhood. Public transport usage and cycling are more common in neighbourhoods with better access to the relevant infrastructure, while residents of neighbourhoods with limited accessibility to sustainable transport infrastructure tend to buy fewer public transport season tickets, to own more cars, and to use them more frequently. These findings could be interpreted in two ways. The first interpretation is that access to good quality public transport and cycling infrastructure encourages sustainable travel behaviour (see Boarnet and Sarmiento, 1998; Jäppinen *et al.*, 2013; Van Acker, 2007). Thus, investments in trams, buses and cycle paths could be expected to reduce car travel and promote the usage of sustainable modes of travel. An alternative explanation is based on the concept of residential self-selection, which assumes that people choose their place of residence in conjunction with travel preferences. If that were the case, providing alternatives to the car would not significantly reduce driving among households whose residential choice was conditioned by

that mode of travel (see Aditjandra *et al.*, 2012; Bohte *et al.*, 2009; Pinjari *et al.*, 2008). The actual character of the causal relationship should be thus subject to further investigation.

Acknowledgements. This research was supported by the National Science Centre, Poland (grant number: UMO-2015/17/D/HS4/00270)

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