

mobility behaviour; shopping behaviour; supermarkets; Austria

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**RELATIONSHIP BETWEEN MODE CHOICE AND THE LOCATION OF SUPERMARKETS – EMPIRICAL ANALYSIS IN AUSTRIA**

**Summary.** Main goal of the study work is to gain data about shopping and mobility behaviour at small local supermarkets with sales floor space less than 1.000 m<sup>2</sup>. Four location types have been defined and discussed; rural – peripheral location, rural – central location, urban – central location and urban – peripheral location. 200 shoppers each location were interviewed at the exit of the supermarket, which means a total of 800 interviews were carried out during all day times and working days of the supermarket. As expected, the mode choice is strongly dependent on the location of the supermarket. In car oriented settlements, which can be found at rural peripheral locations, nearly all shoppers accessed the supermarket with their cars. If weighting the expenditure per visit with the frequency of visits, the average expenditure per month and mode can be derived. The average purchase per month between the modes is more or less balanced. A difference in behaviour lies in the fact that cyclists and pedestrians go shopping more frequently but are spending less per visit.

Additionally, the results of this study are indicating the existence of a potential mode shift, especially if there is better land use planning for supermarket locations. Furthermore, considering the given situation and a given threshold of less than 5 kilograms of weight of the goods purchased, more than fifty percent of all shoppers could use non motorised modes with insignificant loss of travel quality. Combined with short travel distances to the next shop (the average distance is 4.9 km), a change to alternative means of transport would be relatively easy for a significant number of shoppers.

**ZALEŻNOŚĆ POMIĘDZY WYBOREM TRYBU ORAZ LOKALIZACJĄ SUPERMARKETÓW – ANALIZA EMPIRYCZNA W AUSTRII**

**Streszczenie.** Głównym celem badania w tym artykule jest uzyskanie danych o zakupach oraz zachowaniach mobilnych w małych lokalnych supermarketach o powierzchni sprzedaży mniejszej niż 1000 m<sup>2</sup>. Zostały zdefiniowane i omówione cztery typy lokalizacji: wiejskie – peryferyjne położenie, wiejskie – w centrum miasta, miejskie – centralne położenie i miejskie – peryferyjne położenie. W ciągu całego dnia przeprowadzono wywiady z 200 kupującymi wychodzącymi z supermarketów w każdej z lokalizacji, co oznacza 800 wywiadów w ciągu całego dnia roboczego supermarketu. Tak jak oczekiwano, tryb wyboru silnie zależy od lokalizacji w supermarkecie. W osiedlach zorientowanych na samochody, które mogą się znajdować w lokalizacjach peryferyjnych wiejskich, prawie wszyscy kupujący odwiedzili sklep, przyjeżdżając samochodami. Przy rozpatrywaniu wydatków na wizytę z częstotliwością wizyt mogą

zostać wydzielone średni wydatek na miesiąc oraz tryb. Przeciętna sprzedaż na jeden miesiąc pomiędzy trybami jest mniej lub bardziej zrównoważona. Różnica w zachowaniu polega na tym, że rowerzyści i piesi robią zakupy częściej, ale wydają mniej na wizytę.

Dodatkowo wyniki tego badania wskazują na istnienie potencjalnej zmiany trybu, zwłaszcza jeśli użytkowanie gruntów dla lokalizacji supermarketów jest lepiej zaplanowane. Co więcej, przy uwzględnieniu przedstawionej sytuacji oraz przedstawionego progno poniżej 5 kg wagi zakupionych dóbr ponad pięćdziesiąt procent wszystkich kupujących mogło użyć trybów niezmotoryzowanych przy nieznacznej utracie jakości podróży. W połączeniu z krótkimi dystansami podróży do następnego sklepu (średnia odległość – 4,9 km) zmiana alternatywnych środków transportu będzie stosunkowo łatwa dla znacznej liczby kupujących.

## 1. INTRODUCTION

Approximately a quarter of all trips in Austria are made with the purpose of shopping. Two third of these trips are made because of buying food and other comparable goods such as cleaning or sanitary products [3]. As surveys show, the mode choice for such trips differs because of the size of the city as well as because of the size and location of the supermarket. Literature show that the share of private car trips ranges from 24% up to more or less 100% [1]. Arguments for car use raised by the shoppers are mainly based on the weight and volume of the goods purchased. But in times of increasing fuel prices and the climate change observed, this topic need to be analysed on a more detailed level. There are several options and strategies to influence the mode choice such as restrictive land use planning, obligatory parking pricing, introduction of a trip generation tax, limiting the capacity of parking spaces or the definition of a trip contingent per entrance to the public road network [4]. All these measures are clearly restrictive and therefore discussed emotionally in the public. Additionally the real situation is unknown in many cases (e.g. the number of shoppers using the car and their potential flexibility), which could cool down the discussion a little bit. Furthermore shop keepers do not know much on changes of behaviour of their clients because of the implementation of such measures. In this unclear situation they more likely support the idea to keep everything unchanged even if practice examples in other areas prove the success of such measures without loss of revenues for the shop keepers. Another aspect is the widespread opinion, that clients approaching by car are the better clients as they fill their cargo space of their car by 100%. But in the case of daily goods this does not seems fully reasonable, only if clients using their car buying more expensive goods and/or buy more goods per capita. Main goal of the research work is to improve the data situation in this area. In detail the question will be discussed, if there is a link between mode choice and shopping behaviour and how does this interact with the location of the supermarket [6]. For reasons of better comparison and to exclude other influences in this research work only supermarkets of the same supermarket chain (Spar) offering ca. 1000 m<sup>2</sup> sales floor were included in the investigation. Four location types were selected in this work to explore the influence of the location. These are (1) rural area – peripheral location (2) rural area – central location (3) urban area – peripheral location and (4) urban area – central location.

## 2. RESULTS OF COMPARABLE STUDIES

There exists an analysis of shopping behaviour in the city of Salzburg [2]. Decisions of destination choice were investigated here. Additionally the share of shoppers was analysed, they could do the shopping trips with other modes without significant loss of trip quality. A survey took place at 18 exits of different food shops within the city of Salzburg. Main results were: (1) Shopping trips are usually very short: 34% of all shoppers interviewed, who approached the supermarket by car, travel less than 1 kilometre, 84% travel less than 5 kilometres. (2) Approximately half of the shoppers argued, they would not be able to use a bicycle because of the weight of their purchased goods. (3) The expenses of the purchased products is independent from mode used, especially private car and bicycle. (4) The

frequency of visits per capita is highest for those arriving at the shop by walking and smallest by those arriving by car. Comparing cyclists and car drivers, there is no big difference in terms of frequency of shop visits.

In another paper [1] the questions “who brings the money into the shops?” and “are there any options to influence this?” are discussed. The data used derives from a household survey and a survey in the shops. Among others, mode choice, volume, value and weight of purchased goods, frequency of shop visits, duration of trip and trip length to the shop were asked in settlements between 5000 and 50000 inhabitants. Main findings are: (1) the volume of purchased goods directly relates with the trip length of the shopper, (2) if one observes the expenses per shopper over a longer time period, the expenses of those shoppers arriving on foot is nearly the same as those arriving by car.

In all these research work carried out already, the main aspect laid not in the comparison of equal shop types (of the same supermarket chain) and the type of location as it was done in the current work. This fact leads to the inclusion of different other variables influencing the shopping behaviour. However, some findings led to similar conclusions compared with the research work discussed in this paper.

### 3. LOCATIONS ANALYSED

According to the four location types defined, a specific location of a supermarket of the supermarket chain “Spar” was selected. In all four sites a shoppers’ survey was carried out at the exit of the supermarket. The infrastructure supply for the shoppers, segregated by mode can be seen on table 1. For the location type “urban area – peripheral location” a supermarket in Vienna, 14<sup>th</sup> district (Penzing) was selected (full address: 1140 Wien - Penzing, Albert-Schweizer-Gasse 2a). The Viennese district named Penzing hosts approx. 83000 inhabitants. The supermarket is settled in a low-density commercial zone surrounded by other shops and manufacturers (e.g. Jacobs-Suchard). There is a big shopping centre in the vicinity of the supermarket (called as Auhof centre). Housing areas are not very close to the supermarket. There are 68 free parking spaces available and two bus lines accessing the site about 46 times per day. Pedestrians can access the supermarket via the urban pavement network, but have to cross the car park without infrastructure for pedestrians. Cyclists can use one of 10 covered bicycle stands, but there is no cycle path available directly to the site.

Table 1

Location type	Parking spaces car	Parking spaces bicycles	Public transport supply	Access for pedestrians
urban area – peripheral location	68	10 (covered)	Headway 20 minutes	Until car park
rural area – peripheral location	65	10	No supply	No paved access
urban area – central location	0	0	Headway ca. 3 minutes	Until shop entrance
rural area – central location	53	0	Headway 60 minutes	Until shop entrance

For the location type “rural area – peripheral location” a supermarket in the village of Timelkam, province Upper Austria was selected (full address: 4850 Timelkam, Atterseestraße 48). The municipality of Timelkam hosts approx. 6000 inhabitants. The supermarket is settled at a bypass road of Timelkam, which was constructed in the year 2003. The location is a good example of a car oriented site developed in a green field area. The supermarket is embedded in a commercial zone with several other shops nearby such as a food discount shop, a chemist shop, a shoe shop and a petrol station. Neither there is a public transport supply within walking neither distance, nor pavements for pedestrians. There exist 65 free parking spaces and 10 bicycle racks (not covered).

For the location type “urban area – central location” a supermarket in Vienna, 7<sup>th</sup> district (Neubau) was selected (full address: 1070 Wien - Neubau, Schottenfeldgasse 66). The Viennese district named Neubau hosts approx. 30000 inhabitants. Neubau is one of the most densely populated areas in Vienna. The area is mainly occupied by multi storey buildings for housing, service industry and offices respectively for transport infrastructure. The entire district is under a short term parking and pricing regimentation. As usual for such locations, the supermarket is integrated in the ground floor of a multi storey building. Neither a car park nor a bicycle rack is available for the clients of the supermarket. There are several public transport lines accessing the site (both bus and tram lines) with high frequent supply. Pedestrians can access the entrance of the supermarket directly via the urban pavement network.

For the location type “rural area – central location” a supermarket in the village of Neukirchen an der Vöckla, province Upper Austria was selected (full address: 4872 Neukirchen an der Vöckla, Neukirchen 43). The municipality of Neukirchen an der Vöckla hosts approx. 2500 inhabitants and belongs of the district of Vöcklabruck, in a distance of 12 km to the regional centre city of Vöcklabruck. The Supermarket is located on the main square of the village and is the only one food store in the village centre. There is an off street car park available with 53 spaces but no infrastructure for cyclists. During working days, there is a bus line available through the village, which runs every hour.

#### 4. INTERVIEW DESIGN

To exclude other effects such as holiday season or extreme weather situation, the survey took place in October. At all locations a day between Monday and Friday and additionally a Saturday was chosen for personal interviews with shoppers (on Sunday, all the shops at the selected locations are closed). During the full opening time beginning in the morning until evening the interviews were carried out. At all days the weather was dry without any rain. The interviews took place at the exit of the supermarket and included persons, who purchased goods at the supermarket. At every location 200 interviews were carried out, which means a total of 800 interviews. The interviewer was the same person for all the 800 interviews. When coding the answers some rules needed to be defined as they are: (1) if a person chose more than one mode for the trip from and to the supermarket, always the main mode was chosen (in terms of length). (2) If people stated they are temporarily residing in the area (tourists, workers temporarily living next to their working site) in this case this place was selected and not the place of living (in case of analysing the catchment area of the supermarket).

#### 5. RESULTS OF SHOPPING BEHAVIOUR

The purchased goods were aggregated in three different types of products: (1) Food products, (2) stationery products (e.g. office material, journals, newspaper or books) and (3) other non food products (e. g. cleaning material, packing materials or sanitary products). Multiple answers were possible. Table 2 shows very similar distribution of product types across the different location types. At the location type urban central the share of stationary products is over average, as this area is more likely surrounded by offices than the other location types. Contrary to this, at the rural peripheral location the share of non food products is over average as the alternatives to buy such goods in specialised shops are limited in this area.

Because of time restriction no weighing procedure was carried out during the interviews. The weight of the goods purchased was estimated. As preparation for this exercise the interviewer weighed specific items in advance (e.g. a crate of bottles, a glass bottle of wine, a package of beverage cans). In most cases the weight of the product is displayed on the package and the packaging material could be excluded as not very relevant for the total weight. The individual weights were classified in 4 categories. Practice proved, the detailed weighing was not necessary. The biggest share of total weights of the purchased goods is covered by the class 1 kg to 5 kg. Overall in more than 60% of all

purchases the weight of the products is less than 5 kg (see table 3). There are no big differences between the location types (figure 1). Even if comparing the location types rural peripheral and urban central (with their total different mode choice situation, see chapter 6), there is no significant difference of the situation. The highest share of the heaviest weight class of above 10 kg shows the urban peripheral location type with 26.0%, which is clearly above the others.

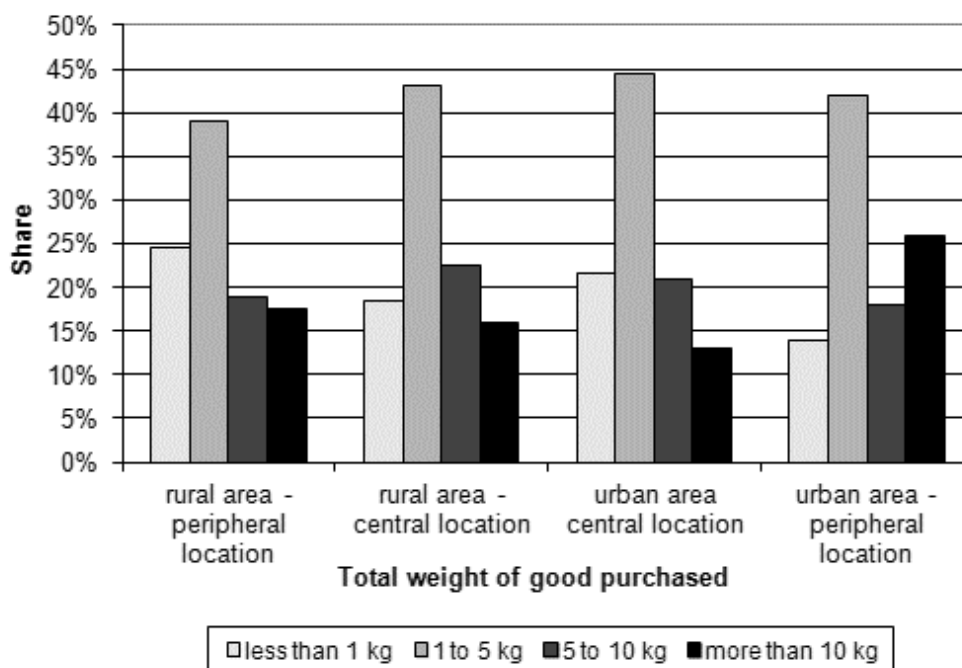


Fig. 1. The distribution of weight of purchased goods of the shoppers interviewed and the location type of the Supermarket

Rys. 1. Rozkład wagi zakupionych dóbr dla zapytanych kupujących oraz typ lokalizacji supermarketu

Table 2

The distribution of types of purchased goods of the shoppers interviewed and the location type of the supermarket

	rural area – peripheral location	rural area – central location	urban area – central location	urban area – peripheral location	all types
Food products	76.8%	79.7%	75.5%	79.4%	77.8%
Stationery products	6.2%	7.2%	10.2%	6.3%	7.5%
Other non food products	17.0%	13.1%	14.3%	14.3%	14.7%

Table 3

The distribution of weight of purchased goods of the shoppers interviewed and the location type of the supermarket

	rural area – peripheral location	rural area – central location	urban area – central location	urban area – peripheral location	all types
Less than 1 kg	24.5%	18.5%	21.5%	14.0%	19.9%
1 to 5 kg	39.0%	43.0%	44.5%	42.0%	42.0%
5 to 10 kg	19.0%	22.5%	21.0%	18.0%	20.1%
More than 10 kg	17.5%	16.0%	13.0%	26.0%	18.1%

If asking the interviewees for the amount of their expenses, in no case they argued with privacy concerns. In most cases they showed the bill, they received at the cash desk. Analysing the expenditures per mode type, shoppers selected to arrive at the supermarket, there is a clear ranking. Users of private cars show the highest expenditure rate with 23.60 € per visit, followed by cyclists, pedestrians and public transport users (table 4). This phenomenon concerns all location types.

Table 4

The distribution of the expenses for the purchased goods of the shoppers interviewed,  
the mode choice and the location type of the supermarket

	rural area – peripheral location	rural area – central location	urban area – central location	urban area – peripheral location	all types
Private car	20.90 €	22.10 €	25.90 €	27.70 €	23.60 €
Bicycle	To less values	To less values	To less values	To less values	14.80 €
On Foot	No values	11.90 €	17.20 €	17.10 €	16.50 €
Public Transport	No values	No values	To less values	No values	13.60 €

In further question, the frequency of visits to this supermarket was asked for (table 5). This question allows calculating the average expenses per month and shopper further on. The frequency of visits changes the ranking of the modes, as cyclists and pedestrians show the highest values with 9-10 visits per month on average. The calculated expenses per month of the shoppers interviewed are shown in table 6, distinguished after the mode choice and the location type of the supermarket. The distinctions of mode and location type was only possible for car users as other groups would have been too small and therefore deliver no accurate values. There is a clear trend, people shopping in central areas spend more than those shopping in peripheral areas with 200 € per month in rural central areas. Contrary to this the supermarket in rural peripheral areas shows the smallest figure. In this shop, there is the highest share of shoppers, they only randomly visited this supermarket and bought just few things on their way and it was not their main shopping activity of the day. This fact may influence the results. The average value of the expenditure per mode does not show significant differences (figure 2). Only those arriving with public transport show lower results. Again the effect of a high share of randomly visiting clients, who did not carry out their main shopping here could influence these values.

Table 5

The distribution of the frequency of the shoppers interviewed (visits/month),  
the mode choice and the location type of the supermarket

	rural area – peripheral location	rural area – central location	urban area – central location	urban area – peripheral location	all types
Private car	5.0	9.0	6.6	5.1	6.1
Bicycle	To less values	To less values	To less values	To less values	9.9
On Foot	No values	13.6	8.8	7.7	9.2
Public Transport	No values	No values	6.3	No values	6.3

## 6. RESULTS OF MOBILITY BEHAVIOUR

As expected, the mode choice clearly differs from location type to location type (table 7 and figure 3). To visit car oriented location types, especially in rural peripheral areas, nearly all shoppers used their car. All other modes are not relevant in this case. There is only a small difference between

urban and rural peripheral areas as in urban areas 10% of visitors were not motorised (cycling, walking). Complete different situation in urban central areas, where car is of low importance. Additionally all visitors arrived by car did not start their trip from home just to visit the shop (as it is the standard case in the other locations). In all cases the shop was embedded in a trip chain, where the car was needed for other purpose. In urban central regions – as in all other regions as well – cycling does not play an important role. The highest share of cyclists – but with 5% on low level as well – shows the rural central location type. After the car, second important mode is walking. In total approximately a quarter of all the visitors made their shopping as pedestrians. However, walking is only relevant in central areas, especially in urban areas, where walking is the main mode.

Table 6

The distribution of the average expenses per month of the shoppers interviewed, the mode choice and the location type of the supermarket

	rural area – peripheral location	rural area – central location	urban area – central location	urban area – peripheral location	all types
Private car	104 €	200 €	170 €	140 €	145 €
Bicycle	To less values	To less values	To less values	To less values	146 €
On Foot	No values	162 €	151 €	132 €	151 €
Public Transport	No values	No values	86 €	No values	86 €

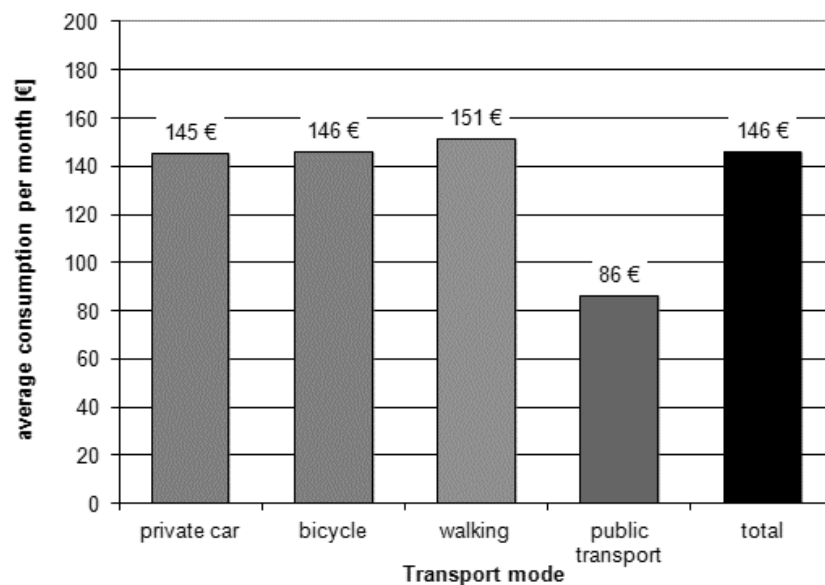


Fig. 2. The distribution of the average expenses per month of the shoppers interviewed and the mode choice  
Rys. 2. Rozkład średnich wydatków na miesiąc dla zapytanych kupujących oraz wybór trybu

Public transport plays no role for daily shopping. It only appears in the central urban location type. This is an interesting aspect, as in most of the planning handbooks (including the internal guidance book for decision where to develop new locations of the supermarket chain concerned [7]), good access to public transport network is prerequisite for a prosper supermarket.

To receive information on the trip chains, where the shopping activity is embedded in, it was asked, if the way to the super market equals the way after the shopping activity. This question allows to analyse, if the destination of the shopping activity was selected based on the place of stay (either place of residence or work place) or if the destination was “on the way” (e.g. between place of residence and

work place). The share of shoppers, they included their shopping activity in a more complex trip chain is higher at peripheral areas (table 8). This higher share proves that peripheral locations are visited more likely on the way from home to work or vice versa or the shopping activity is combined with other trip purposes such as other shopping or leisure activities (compare [5]).

Table 7

The mode choice of the shoppers interviewed and the location type of the supermarket

	rural area – peripheral location	rural area – central location	urban area – central location	urban area – peripheral location	all types
Private car	99%	81%	6%	91%	69,3%
Bicycle	1%	5%	4%	3%	3,4%
On Foot	0%	14%	84%	6%	26,0%
Public Transport	0%	0%	6%	0%	1,4%

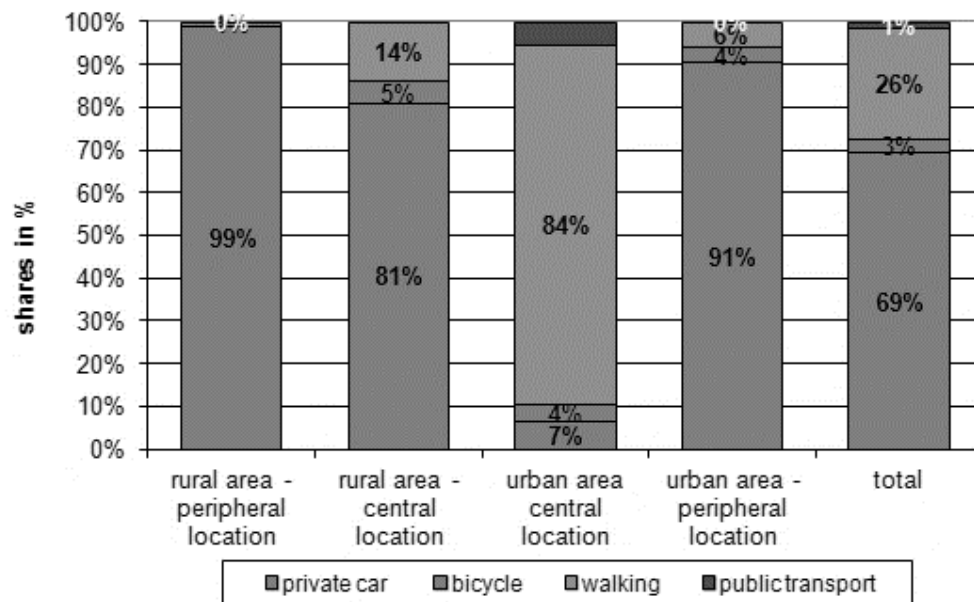


Fig. 3. The mode choice of the shoppers interviewed and the location type of the supermarket  
Rys. 3. Wybór trybu dla zapytanych kupujących oraz typ lokalizacji supermarketu

Table 8

The share of the shoppers interviewed with identical origin and destination before and after shopping and the location type of the supermarket

	Identical origin and destination before and after shopping activity [%]	Shopping activity is embedded in a complex trip chain [%]
urban area – peripheral location	29.0%	71.00%
rural area – peripheral location	34.0%	66.00%
urban area – central location	58.5%	41.50%
rural area – central location	61.5%	38.50%
All types	46.0%	54.00%



The catchment area of each supermarket can be calculated based on two different methods. During the interview, the location of the starting point before, the ending point after the shopping activity and the place of residence were asked for. This means the average trip distances to the supermarket or the average distance between the place of residence and the location of the supermarket could be calculated as catchment area. The distance was estimated by the interviewees and checked based on GIS software after the interview. The distance equals the distance using the road network and not as the crow fly. With the additional information of travel time, the average speed level was calculated. In table 9, the results are shown. In this table, the distance is related to the distance of the trip to the supermarket. The results are not much surprising. Peripheral locations generate longer trip distances as central locations, both in terms distance and time. The average trip length over all location types is 4.9 km, which takes 8.3 min which means an average speed level of 35 km/h. Even if analysing the distribution of the trip length for the rural peripheral area 5% of all shoppers travel a maximum of 1 km to the shop. In rural central and peripheral urban more than 50% of the clients travel less than 3 km. Comparing this values with the mode choice, there is a clear potential towards a significant mode shift towards non motorised modes (additionally if compare with results of weight of purchased goods as seen in figure 1).

Table 9

Average trip distance of the shoppers interviewed and the location type of the supermarket

	rural area – peripheral location	rural area – central location	urban area – central location	urban area – peripheral location	all types
Trip length to supermarket	7.2 km	4.1 km	2.7 km	5.7 km	4.9 km
Duration of trip to supermarket	8.6 min	6.5 min	7.5 min	10.6 min	8.3 min
Average speed level to supermarket	50 km/h	38 km/h	22 km/h	32 km/h	35 km/h

Table 10 shows the average total weight of the purchased goods per visit, segregated after mode choice. There is some correlation between motorised modes and weight, but the difference is not very high.

Table 10

Average weight of goods purchased by the shoppers interviewed and the mode choice

	Average weight (all purchased goods) [kg]
Private car	5.9
On Foot	4.4
Bicycle	3.9
Public Transport	3.3
total	5.4

## 7. CONCLUSIONS

As expected, the location type of a supermarket influences the mode choice of the clients and therefore the traffic demand within their catchment areas. Once more an effective land use planning would be welcomed here. In order to reduce the generated traffic volume, minimum thresholds of the number of potential visitors within a trip distance, where non motorised modes are ready to be used,

should be defined and considered in the building permission practice. As figures showing, if non motorised modes are an option in principle they are used by the clients. This does not mean, no clients will arrive by car anymore, but a significant contribution to reduce negative external effects of car traffic could be achieved without further restrictive measures. Only in areas (e. g. mountainous regions), where such thresholds cannot be achieved within a specific area, exemptions should be made from this rule. Another approach would be to introduce a trip generation tax, to limit the number of parking spaces, to introduce obligatory parking pricing or to limit the number of car trips from and to the location. Supported by such restrictive measures (which all were already introduced in different European cities, mainly Switzerland or the Netherlands), operators of supermarket would take more care on the selection of the location of their supermarkets.

As the survey has shown, the total weight of the purchased goods is less than 5 kg for the majority of shopping visits and practice shows in this surveys as well, such weights can be carried by non motorised modes (bicycle, walking) easily. Additionally more than 50% of all shopping activities starting at home and are not embedded in complex trip chains. Considering the trip length already today a significant group of shoppers could switch to non motorised modes easily without significant loss of travel comfort. Because of location in peripheral areas and missing infrastructure inappropriate framework conditions were created for pedestrians and cyclists in past and present.

Another aspect of the work is to prove, that, if observing a longer period, the total amount of expenses does not vary between the different types of clients arriving by different modes. Contrary to car users, shoppers arriving with non motorised modes are visiting the shop more often. This fact could be an advantage for the shop keepers, as they stay longer in their shops and can better accessed for special offers or other activities.

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Received 14.12.2012; accepted in revised form 20.02.2014