

Exploring immigrants travel behaviour: empirical findings from Offenbach am Main, Germany

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Abstract This paper focuses on the everyday travel behaviour of immigrants in Germany. We use data from an empirical study conducted in Offenbach am Main, a city with one of the highest immigrant populations in Germany. We compared the travel behaviour of immigrants and their direct offspring to that of Germans without an immigration background. Compared to non-immigrants, immigrants own fewer cars or bicycles per household, and they were also less likely to be able to ride a bicycle or to drive a car and to have access to these modes of transport. For both groups, the most important transport mode is the private car. Immigrants, especially women, use public transport and ride in a car as a passenger on a regular basis more frequently than non-immigrants. Riding a bicycle tends to be a typical transport mode for non-immigrants, especially for men. We used logistic regression models to identify, in addition to gender and immigration status, factors that influenced the regular use of car (as driver), public transport, and bicycle. These factors include, for example, income, car ownership, household composition, education and socialisation. Our results shed some light on the travel behaviour of immigrants in Germany, but we also emphasize the need for further research to deepen our understanding of the travel behaviour of immigrants in Germany.

Keywords Transport planning · Travel behaviour · Public transport · Bicycle · Immigration · Logistic regression

Introduction

Today, immigration is a highly topical issue all over Europe and especially in Germany. This is due to the currently rapidly increasing numbers of refugees and asylum seekers in central Europe. Irrespective of the recent refugees, forecasts already predict that the

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immigrant share in Germany's population will further increase, both due to further immigration and due to socio-demographic changes. As every other person, immigrants need to travel in their everyday life in order to fulfil their basic needs. When they are granted a permission to stay, they need to get around in order for going to work, shopping for groceries, or taking part in education and in social life. Depending on the local infrastructure and their individual possibilities and mobility options, they therefore need to walk, to use public transport, a private car or a bicycle to get around.

Generally speaking, to be able to travel independently and self-determinedly improves personal quality of life and it increases the opportunities for participation and integration in the society. Normally, walking is the cheapest and most accessible individual mode of transport, but it offers the smallest range, followed by bicycle and private car. Public transport is generally available in German cities, but public transport users need to cope with sometimes complicated timetables or tariff system and for immigrants there might be a particular barrier, that is language.

Our study follows the German definition, first introduced during a national representative population survey in 2005, and defines the population group with an immigration background as a group including all persons who have immigrated into the territory of today's Federal Republic of Germany after 1949. It also includes all foreigners and all persons born in Germany who have at least one parent who immigrated into the country or was born as a foreigner in Germany (Statistisches Bundesamt 2016). To facilitate readability, we use the terms "people with an immigration background" and "immigrants" interchangeably, for the group of Germans without an immigration background, we use the term "non-immigrants."

The regional distribution of immigrants also differs greatly throughout Germany. For historical reasons, the country still is somewhat divided between east and west. With the exception of Berlin, the highest percentages of immigrants can all be found in the western parts of the country. Here, the (former) industrialised areas and large towns are where most immigrants are located (see Fig. 1).

In 2014, 20.3% of the German population were immigrants and their offspring (first and second generation). Today's composition of the immigrant population reflects the variations in origin and numbers of immigrants in Germany in contemporary history. Considerable immigration of labour migrants from Turkey and Southern European countries started in the mid-1950s, and peaked in the early 1970s. Following the Fall of the Wall, the largest immigrant group consisted of the post-war repatriates from the former Soviet Union and from Eastern European states. Nowadays, immigrant numbers are at all-time high, including both, highly-skilled and non-skilled immigrants from Eastern and Southern European-Union countries, especially from Poland (BAMF 2016; Woellert and Klingholz 2014). As will be explained in more detail later, this study presents results of a survey on everyday travel behaviour of immigrants in Offenbach am Main, a typical western city with a large immigration population.

Despite the growing number of immigrants, there is relatively little research on this topic in Germany. Thus, this paper starts with a literature review and description of methodology, which outlines how our approach must be somewhat exploratory, given the topic is previously under-studied, but also explaining how we approach generating concrete data. After explaining the methodology, we present our more descriptive results about socio-demographics, about the preconditions for mode uses such as driving licence and vehicle ownership, and about similarities and differences in transport mode use for immigrants and non-immigrants. We then offer an analysis of factors influencing the usage

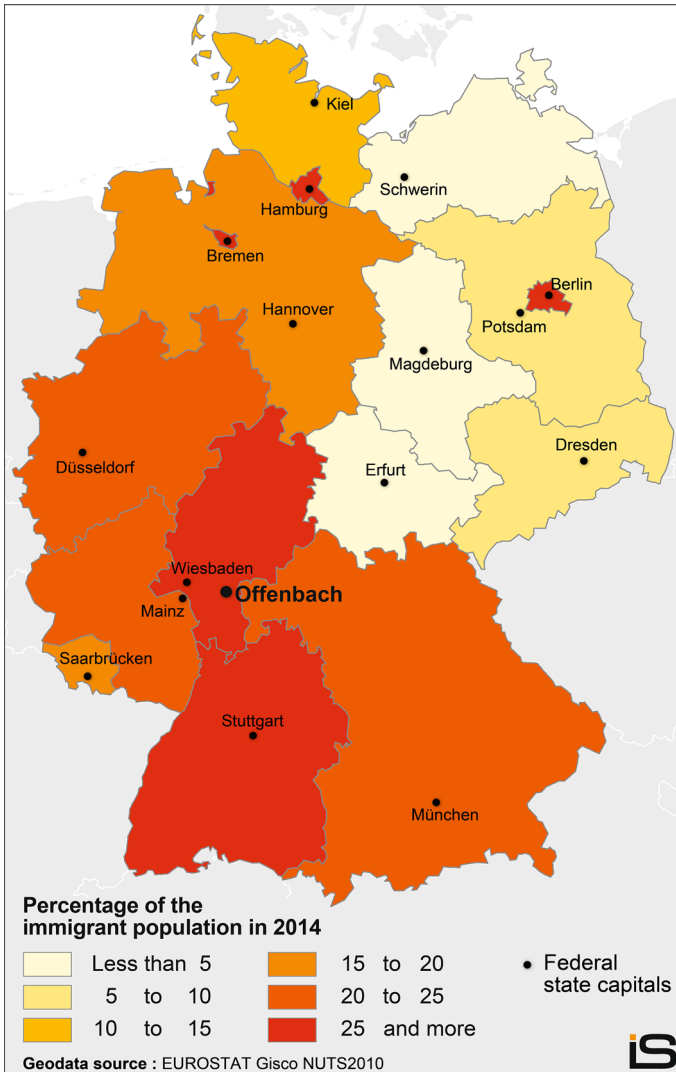


Fig. 1 Percentage of the immigrant population per German federal state in 2014 (Source: Statistisches Bundesamt 2015)

of a car, public transport, and a bicycle. We then conclude with a discussion of our main findings and describe possibilities for further research.

Literature review

The findings of studies conducted in some European countries and especially in the US suggest that travel behaviour may be determined not only by classical factors such as age, gender, income, transport modes or spatial factors such as residential location, but also by national or ethnic background and by immigration circumstances (e.g. duration of stay in

the new country). In the US, studies show that immigrants tend to rely more often on public transport and non-motorised modes. They tend to drive the car (alone) less often and to share the ride more often than native-born citizens. Moreover, the everyday travel behaviour of immigrants seems to change over the course of time. Recent immigrants show greater differences in this respect in comparison to the native-born population. After a few years, an adaption can, however, be observed towards average car and public transport use (e.g. Beckman and Goulias 2008; Blumenberg and Smart 2014; Chatman and Klein 2013; Handy et al. 2008; Tal and Handy 2010). Chatman (2014) points out, that lower car use of immigrants is also correlated with different location choices and thus with neighbourhood characteristics such as distance from central cities, access to stores or transit access. With regards to car ownership, immigrants, but also other groups within US society (e.g. low income, ethnic black), were less likely to own a car and more likely to transition into and out of car ownership (Klein and Smart 2015). In the US, bicycle use is not very common, but immigrants tend to use bicycle more often than the native-born citizens, especially those with a Southeast-Asian and European background (Smart 2010). Interestingly, US students who studied abroad reported that they had adapted to the specific local travel behaviour, e.g. riding bicycles in Europe, but did not tend to maintain this behaviour when back in the US (Burbidge 2012). For the Golden Horseshoe region in Canada Newbold et al. (2015) show that immigrants have slightly shorter commuting distances, but differences decrease with longer durations of stay.

In Europe, only a few studies have focused on immigrants and their travel behaviour. Tsang and Rohr (2011) studied the travel behaviour of immigrants in the UK and found that immigrants' travel behaviour is strongly associated with non-car-driving modes but that there is also a tendency towards transport assimilation, especially in terms of car use. The most recent results of the English National Travel Survey showed that a higher share of adults in ethnic minority groups, especially in the black community, live in households without a car (DfT 2014). A study from the Netherlands found that immigrants were less mobile than non-immigrants (Harms 2007). The results of this study were similar to one from Austria (Fassmann and Reeger 2014). Both studies showed that immigrants use the car as frequently as non-immigrants, but the former tend to use public transport more often. Immigrants in these European countries tend, in contrast to those in the US and the UK, to ride a bicycle less frequently than non-immigrants, especially women. For this reason, Fassmann and Reeger (2014) stated that a typical Austrian cyclist is young, male, well-educated and has no immigration background.

Can these patterns also be observed in Germany? Just like others countries, Germany has its own unique mobility culture and its historically grown settlement patterns and transport systems. In urban areas, there is a good access to public transport, a good pedestrian infrastructure and, in many places, a good cycling infrastructure. As stated above, Germany also has a specific history of immigration, but especially in transport research, there is a general dearth of knowledge about immigrants. German transport surveys (e.g. Mobility in Germany, German Mobility Panel) do not include any information on ethnic or immigration background or foreign nationality. The exception is the survey Mobility in Germany, which included nationality, but only in 2002. Kasper et al. (2007) analysed this survey with a distinct emphasis on the biggest groups with foreign nationality and found that they do not necessarily travel less than Germans but that they do so in a different manner. As in other central European countries, they tend to ride the bicycle much less frequently than Germans. They also use the car less and public transport more frequently than Germans, and gender often has an intensifying effect. These results are in line with an early survey conducted in the western part of Germany that found that

foreigners are also more likely to live in households without a car than Germans. Interestingly, in those cases in which a car was available, it was used more often (Hautzinger et al 1996). A more recent study on immigrants speaking Turkish and Russian offered a more nuanced perspective on the use of cars and public transport. As indicated by this study, the majority of Germans use the car, but less than half of those speaking Turkish or Russian. Germans also tend to drive longer distances. The vast majority of the immigrants speaking Russian use public transport; Germans and immigrants speaking Turkish were less likely to do so (Hunecke and Toprak 2014).

In conclusion, the studies mentioned above have shown that the private car is the primary transport mode for both non-immigrants and immigrants. Immigrants, especially women, tend to travel less frequently and are more dependent on good local pedestrian and public transport infrastructures. The use of bicycles generally tends to vary widely between different countries but also between cities of a single country and between or even within different population groups (e.g. Heinen and Handy 2011; Pucher and Buehler 2012). In contrast to studies from the US and also from the UK, where the bicycle is only of minor importance, studies from central European countries such as the Netherlands, Austria and Germany have shown that it is an important transport mode, but not so much for immigrants. However, statements about differences in travel behaviour, mobility options and mobility needs between people with and without an immigration background, or between different groups of immigrants in Germany, are poorly grounded. The literature review nevertheless provided a basis for our study in general and the analysis of our data in particular.

Methodology approach

Survey description

To address the gaps in the literature mentioned above, that is, to collect data on and to contribute to the empirical scholarship on immigrants' everyday travel behaviour, we conducted an empirical study in Offenbach am Main, a city with about 120,000 inhabitants, in 2010. This city is located in the state of Hesse across the Main river in direct vicinity from Frankfurt am Main (Fig. 1). In 2008, the modal split for all trips in Offenbach was 26% foot, 9% bicycle, 38% car (driver), 14% car (passenger) and 12% public transport (NiO 2012).

We chose Offenbach primarily because its immigrant population is very large. Here, the percentage of people with foreign citizenship (31%) is one of the highest in Germany, and even more people (55%) have an immigration background. In 2010, the Turkish group was the largest immigrant group, representing 19% of the total foreign population in Offenbach. This group was followed by people from Poland, Italy and Greece (Stadt Offenbach 2015).

Interviews were conducted via telephone, and the survey yielded data from 1914 participants. Participants were at least 18 years old. Most of the interviews were carried out in German (94%), although the participants were given the option of responding in Turkish, Russian or Polish. A quota was introduced to make sure that about half of the participants were female.

The survey data includes socio-demographic information such as the household size and the numbers of vehicles, net household income and household location. In order to

determine the immigration background, we asked for their native country, citizenship and parents' background. The survey focussed on individual mobility-related questions, and participants were asked to indicate whether they had driving licences, whether they knew how to ride a bicycle and whether they also had access to these modes of transport. Using a five-point ordinary scale, we asked participants how often they tend to take the car or public transport or ride a bicycle.¹ The retrospective questions on travel socialisation for childhood include whether parents owned a car. Participants also rated statements whether parents accompanied them as children when they were cycling and whether parents often used different modes of transport. They also indicated their attitude towards getting a driving licence and driving a car as young adults. These items and additional statements about perception of the neighbourhood were measured on a five-point likert scale.

Analysis methods

To correct for skewness (asymmetry in a statistical distribution), the sample is weighted and thus reflects the statistical data of Offenbach's population with regard to gender, age-group and immigration background. In addition and in order to reduce uncertainties within the retrospective answers about travel socialisation, only participants up to the age of 66 are included (immigrants $N = 839$, non-immigrants $N = 719$).

To start with, we conducted descriptive analyses of the survey sample and the mobility variables, comparing the results for immigrants and non-immigrants and usually for men and women separately. For calculating the equivalent scale income, we used the OECD-modified scale in order to reflect that the needs of a household grow with each member but not proportionately. The modified scale divides the net income by a factor based on number and age of the household members. The factor value is 1 for the first adult, .5 for other adults, and .3 for children (OECD 2016). By means of factor analysis, socialisation items were grouped into different socialisation factors representing parents' behaviour and the attitude that participants had toward cars when they were young adults.

Moreover, we developed binary logistic regression models to analyse the general mode use or non-use (for detailed information concerning discrete choice modelling see, for example Ben-Akiva and Lerman 1985; Train 2003). For this purpose, we reduced the ordinal scale for general transport use to a dichotomous one, thus separating regular users (at least once a week) from those participants who either seldom or never use the car a driver, public transport or bicycle. The last one of these transport modes was not discussed in greater detail in the previous publications by Welsch et al. (2014) and Welsch (2015).²

Logistic regression modelling is used to analyse travel behaviour and to determine the impact of multiple independent variables such as age, income or car ownership simultaneously. Thus, a relationship between a binary outcome variable and a group of independent variables is established and the logit-transformed probability $\text{logit}(P)$ is calculated as a linear relationship with the independent variables. The regression models are estimated using the maximum likelihood method. As a result of logistic transformation, the estimated probabilities of an event are limited to the range between 0 and 1.

¹ These general mode usages are not mutually exclusive. Below they are analysed independently of one another.

² Both these papers were published in German. Welsch et al. (2014) present separate results for the original study design (three participant groups: Germans, Turkish immigrants and Other immigrants). Welsch (2015) provides results for the two groups "immigrants" and "non-immigrants" and provides further details concerning the aspect of travel socialisation and an additional analysis of the survey results by participants' region of origin.

$$\text{logit}(P) = \ln\left(\frac{P}{1 - P}\right) = \ln\left(\frac{P(Y = 1)}{1 - P(Y = 1)}\right) = \beta_0 + \sum_i \beta_i x_i + \epsilon \tag{1}$$

with P probability of occurrence, x_i independent variable, β_0 constant estimated parameter, β_i independent variable estimated parameter, ϵ random error.

The estimated regression coefficient β reflects the sign (positive or negative influence) and effect size of every independent variable on the logit variable. The binary logit-model can be applied for calculating the probability of choice alternatives by using following regression equation:

$$P_i = \frac{e^{(V_i)}}{1 + e^{(V_i)}} = \frac{1}{1 + e^{(-V_i)}} \tag{2}$$

with P_i probability for choosing an alternative i , V_i deterministic part of the utility function for an alternative i as linear additive combination of the influencing value, e Euler’s number.

The odds (ranging from zero to positive infinity) reflect the ratio of the estimated probabilities for occurrence of the event $Y = 1$ (e.g. car use) and the opposite event $Y = 0$ (e.g. no car use). The odds ratio (OR) is a measure of effect size and describes the strength of association, showing for example to what extent the odds of using the car are increased or decreased if the independent factor is increased by one unit. For dummy variables increase or decrease is described in comparison to the reference category (e.g. for being female in comparison to the reference group i.e. being male).

$$\text{OR} = \frac{\text{odds}(Y = 1)}{\text{odds}(Y = 2)} = \frac{\frac{P(Y=1)}{1-P(Y=1)}}{\frac{P(Y=2)}{1-P(Y=2)}} \tag{3}$$

Unfortunately, odds ratios are not easy to interpret, and the effect sizes can be affected by differences in unobserved heterogeneity when it comes to a comparison between different models or different samples or groups. Hence, we also used average marginal effects (AME), which are computed as means of marginal effects evaluated at each observation. They show the average effect of an independent variable on probability itself and are therefore much easier to interpret. Marginal effects measure the change in the expected value of Y as one independent variable increases by unity or in comparison to the reference group while all other variables are kept constant. The AME of the i th independent variable is:

$$\text{AME}_i = \frac{1}{n} \sum_{k=1}^n \{F(\beta x^k + \beta_i) - F(\beta x^k)\} \tag{4}$$

with βx^k value of the linear combination of parameters and variables for the k th observation, F cumulative distribution function that maps the values of βx to the $[0,1]$ interval, β_i independent variable estimated parameter.

Moreover, AME have been discussed as one of the means of choice when it comes to group or model comparison (Auspurg and Hinz 2011; Mood 2010). We used the statistical software SPSS and Stata. The Stata module ‘margeff’ was used to estimate average marginal effects in general and for those of the specific sets of dummies in particular (e.g. age groups) (for detailed discussion about marginal effects and the margeff module see Bartus 2005).

Empirical findings

Survey sample

In Offenbach, immigrants predominantly are located in or close to the city centre in densely populated districts (defined as equal or above median of 6506 inhabitants per km²). Two-thirds of the immigrant participants, but only 38% of the non-immigrant participants, live in these inner-city districts.

About two-thirds of the immigrants are born outside of the country (first immigrant generation N = 576, second immigrant generation N = 263). Their years of arrival vary between 1959 and 2010. About half of the first immigrant generation arrived before 1987. On average, they have lived in Germany for 24 years at the time of the survey and were 19 years old when they immigrated to Germany. 22% came to Germany as children (age 10 or younger) and 34% as teenagers and young adults (age 10–20).

As shown in Table 1, socio-demographic factors differ between the two groups. As expected, immigrants are younger than non-immigrants, they live in bigger households and they are more likely to live with children under the age of 18. Immigrants have a lower average household income. This is also true for the average equivalent scale income that takes into account that the financial needs of a household increase with each additional member but not proportionately. Immigrants are more likely to state that they are still in school or at university or completing an apprenticeship. They are also more likely to be unemployed than non-immigrants, but less likely to be already retired.

Table 1 Sample description by immigration background

	Non-immigrants	Immigrants
Sex (female) (%)	53	47
Average age (years) ^a	44	40
Average household size (number of persons) ^b	2.47	3.12
Percentage of households with children under 18 ^c (%)	31	46
Average household income per month		
Net income ^d (€)	2860	2379
Equivalent scale income ^e (€)	1842	1339
Percentage of persons		
Full-time or part-time employment (%)	64	60
Unemployed ^f (%)	3	7
In education (%)	11	14
Retired ^g (%)	12	6

Significance level: P < .001

^a $t(1555) = 6.58$

^b $t(1555) = -9.15$

^c $\chi^2(1, N = 1558) = 33.0$

^d $t(1179) = 6.17$

^e $t(1156) = 10.38$

^f $\chi^2(1, N = 1557) = 12.86$

^g $\chi^2(1, N = 1552) = 14.82$

Descriptive results—preconditions and transport mode use

The two main prerequisites for people to drive a car are a valid driving licence and car availability. As shown in Table 2, the vast majority of non-immigrants were found to live in households with at least one private car, and this is also true, albeit to a lesser extent, for immigrants. A similar pattern can be observed when it comes to parents' households with a car, but here, there is a significant difference between the two groups. With regards to the average number of cars per household, there is a small, but statistically significant difference. A smaller share of immigrants has a driving licence. The vast majority of all drivers state that a private car is always or sometimes available. In contrast to driving licences, men and women have access to a car in an almost equal manner.

All participants were asked how often they tend to drive in the car as passengers and those who had access a car were asked how often they tend to drive the car themselves. As shown in Table 3, the majority of drivers use the car either every day or several times a week. Male immigrants are the most frequent drivers, whereas immigrant women are the least frequent ones. When it comes to the use of cars as a passenger, the picture changes: Women were found to be passengers more often than men, and non-immigrants less often than immigrants (Table 4).

Offenbach is known to have a rather good public transport system and 87% of the participants indicated that they walk less than five minutes to the nearest bus stop. As shown in Table 5, irrespective to gender or immigrant status, more than half of the participants stated that they use public transport only on a monthly basis or less. For both groups, the major reasons for not using public transport are that there is a car available and that it is more convenient than public transport.

The preconditions for riding a bicycle are similar to that for driving a car, as a person needs to have the ability and the opportunity to ride a bicycle. As shown in Table 6, bicycle ownership per household is quite high in both groups, but there is a significant

Table 2 Results related to car by immigration background

	Non-immigrants	Immigrants
Percentage of households with at least one car ^a (%)	85	79
Percentage of parents' households (at age of ten) with a car ^b (%)	73	58
Average number of cars per household ^c	1.32	1.13
Average number of cars per household member ^d	.60	.41
Percentage of persons with a driving licence ^e (%)	89	80
Male (%)	92	86
Female (%)	86	73
Percentage of potential drivers with car available (%)	94	92
Male (%)	97	93
Female (%)	91	91

Significance level $P < .050$

Significance level $P < .001$

^a $\chi^2 (1, N = 1557) = 9.87$

^b $\chi^2 (1, N = 1547) = 39.61$

^c $t(1478) = 4.28$

^d $t(1369) = 9.55$

^e $\chi^2 (1, N = 1558) = 22.12$

Table 3 Car use as driver by gender and immigration background^a

	Non-immigrants N = 598		Immigrants N = 617	
	Male (%)	Female (%)	Male (%)	Female (%)
(Almost) everyday	59	56	64	54
1 to several times a week	29	31	29	27
1 to 3 days a month	6	4	4	8
Less than monthly	5	7	2	5
(Almost) never	1	2	1	6

Significance level $P < .001$ ^a $\chi^2 (12, N = 1215) = 32.98$ **Table 4** Car use as passenger by gender and immigration background^a

	Non-immigrants N = 718		Immigrants N = 829	
	Male (%)	Female (%)	Male (%)	Female (%)
(Almost) everyday	5	7	8	9
1 to several times a week	24	34	24	46
1 to 3 days a month	20	24	21	17
Less than monthly	16	13	14	12
(Almost) never	35	22	33	15

Significance level $P < .000$ ^a $\chi^2 (12, N = 1547) = 92.21$ **Table 5** Public transport use by gender and immigration background^a

	Non-immigrants N = 718		Immigrants N = 838	
	Male (%)	Female (%)	Male (%)	Female (%)
(Almost) everyday	20	19	27	24
1 to several times a week	14	18	12	21
1 to 3 days a month	15	16	13	16
Less than monthly	17	20	15	18
(Almost) never	34	28	32	21

Significance level $P < .001$ ^a $\chi^2 (12, N = 1556) = 37.19$

difference: Immigrants more often live in households without any bicycles, and they own, on average, not as many bicycles than non-immigrants. The majority of participants in both groups know how to ride a bicycle, but immigrants, especially women, are less likely to have this ability. The two groups also differ in terms of their access to bicycles. But in each group, there is no difference between men and women.

Table 6 Results related to bicycle by immigration background

	Non-immigrants	Immigrants
Percentage of households with at least one bicycle ^a (%)	86	75
Average number of bicycles per household ^b	2.48	1.85
Average number of bicycles per household member ^c	1.01	.63
Percentage of persons with cycling ability ^d (%)	97	92
Male (%)	99	96
Female (%)	95	88
Percentage of potential cyclist with bicycle availability ^c (%)	90	81
Male (%)	89	81
Female (%)	90	80

Significance level $P < .001$ ^a $\chi^2 (1, N = 1558) = 29.42$ ^b $t (1384) = 6.82$ ^c $t (1552) = 11.16$ ^d $\chi^2 (1, N = 1557) = 15.78$ ^e $\chi^2 (1, N = 1460) = 22.77$ **Table 7** Bicycle use by gender and immigration background^a

	Non-immigrants N = 621		Immigrants N = 619	
	Male (%)	Female (%)	Male (%)	Female (%)
(Almost) everyday	25	21	15	18
1 to several times a week	37	35	36	26
1 to 3 days a month	17	12	18	14
Less than monthly	9	16	15	18
(Almost) never	13	17	16	24

Significance level $P < .001$ ^a $\chi^2(12, N = 1240) = 41.70$

Participants who knew how to ride a bicycle and had access to a bicycle were asked how often they tend to use it. As it is shown in Table 7, bicycles are used more frequently by non-immigrants than by immigrants, especially by men. Even though there are slightly more immigrant women than men who use the bicycle almost every day, the former have the highest share of non-cyclists. For both groups, reasons for not using a bicycle include that they do not enjoy riding a bicycle or it would take too long, that there are health reasons or that it is inconvenient to use it with (small) children or to transport groceries. The lack of safe bicycle paths and of parking facilities was primarily mentioned by non-immigrants. In contrast, immigrants were more likely to state that they do not have access to a (functional) bicycle.

Table 8 Model 1 Parameter estimation for the use of car as driver (at least weekly: yes/no)

Independent variables	Reg. coeff. β	OR	AME
Sex female (male)	-.637***	.529	-.107
Age groups (18–33 years)			
34–49 years	.475**	1.609	.082
50–66 years	.631***	1.879	.106
Household with children (household without children)	.685***	1.984	.111
One-person household (multi-person household)	-.585**	.557	-.101
Household income-equivalent scale ($\text{€} \leq 900$)			
€901 to 1300	.747***	2.110	.147
€1301 to 1800	.966***	2.626	.187
€1801 or more	1.788***	5.980	.311
Employed (not employed)	.653***	1.922	.115
High population density (low population density)	-.792***	.453	-.130
Car-attitude	.507***	1.660	.084
Immigrants (non-immigrants)	-.093	.911	-.015
Constant	-1.965***	.140	

N = 1557

Nagelkerkes pseudo-r-squared: .303

Level of significance: † P < .10; * P < .05; ** P < .01; *** P < .001

Results of logistic regression models—influencing factors on the regular use of car, public transport and bicycle

The results mentioned above point to some important differences in transport behaviour between non-immigrants and immigrants. To arrive at a more nuanced understanding of factors that influence mode use, we developed logistic regression models. We used iterative procedure for parameter estimations. Additional variables such as household income, or immigration background were successively added to the socio-demographic base model to test different model variations and to identify important influencing factors and the biggest effect sizes. Most independent variables were put into the models as dummy variables. Number of bicycles per household, the distance factor, the socialisation factors and a statement addressing participants' sense of security in their respective neighbourhoods were put in as numeric variables. Tables 8, 10 and 11 show the results for the car model 1 and the public transport and bicycle models. They include the immigration background. Car model 2 (Table 9) includes for the first immigrant generation different categories for the duration of stay and the second immigrant generation as dummy variable. All tables provide the estimates for regression coefficient B (reg. coeff. β), odds ratio (OR) and average marginal effects (AME).

Tables 8 and 9 list the results for estimating the parameters of car use (driver). Both models include the same parameters with the exception of immigrant status. In both models the largest positive effect can be observed for household income. The highest income category has the biggest effect, meaning that the probability of car use increases by about 30% if an individual lives in a household with more than €1801 per month at its

Table 9 Model 2 Parameter estimation for the use of car as driver (at least weekly: yes/no)

Independent variables	Reg. coeff. β	OR	AME
Sex female (male)	-.644***	.525	-.106
Age groups (18–33 years)			
34–49 years	.500**	1.649	.084
50–66 years	.606***	1.833	.101
Household with children (household without children)	.743***	2.103	.118
One-person household (multi-person household)	-.631***	.532	-.107
Household income-equivalent scale (€ <=900)			
€901 to 1300	.692***	1.998	.134
€1301 to 1800	.922***	2.515	.174
€1801 or more	1.748***	5.743	.297
Employed (not employed)	.659***	1.932	.114
High population density (low population density)	-.748***	.473	-.121
Car-attitude	.496***	1.641	.080
Immigrants duration of stay (native born: non-immigrants and second immigrant generation)			
Up to 15 years	-.796***	.451	-.140
16 to 30 years	-.301	.740	-.050
More than 30 years	.113	1.120	.018
Second immigrant generation (non-immigrants and first immigrant generation)	.343 [†]	1.409	.054
Constant	-1.912***	.148	

N = 1557

Nagelkerkes pseudo-r-squared: .320

Level of significance: [†] P < .10; * P < .05; ** P < .01; *** P < .001

disposal (AME in comparison to the reference group). The household composition, its location and socio-demographic factors affect car use as well. Three factors—living alone, living in a densely populated area and being female—all considerably decrease the probability of car use. Age is also a significant factor: In comparison to the young reference group (18–33 years), the probability of car use is higher for the two other categories. The socialisation factor car-attitude combines four statements with positive attitudes towards car driving and gaining a car licence as a young adult; here, an increase implies stronger positive attitude. The stronger the attitude, the more likely it is that participants use a car. Immigration background lowers the probability of car use but the effect is very small and not significant (Table 8). In Table 9, the immigrant generations are looked upon separately and duration of stay is taken into account for the first immigrant generation. More recent immigrated participants with a shorter duration of stay were less likely to drive a car on a regular basis. In comparison to those participants who were born in Germany, the two categories with shorter duration of stay both show a negative effect. The effect is significant only for the first category that includes immigrants who lived in Germany for up to 15 years. For those who lived in Germany for at least 30 years, the effect is positive, but very small. Belonging to the second immigrant generation increases the probability of car use.

Table 10 Parameter estimation for the use of public transport (at least weekly: yes/no.)

Independent variables	Reg. coeff. β	OR	AME
Sex female (male)	.200 [†]	1.222	.038
Age groups (18–33 years)			
34–49 years	–.299 [†]	.742	–.059
50–66 years	–.615***	.540	–.118
Household with children (household without children)	–.414**	.661	–.078
Household with at least one car (household without car)	–1.796***	.166	–.386
In education/training/apprenticeship (other occupation)	1.591***	4.909	.336
Car-attitude	–.112*	.894	–.021
Immigrants (non-immigrants)	.144	1.155	.027
Constant	1.477***	4.380	

N = 1557

Nagelkerkes pseudo-r-squared: .264

Level of significance: [†] P < .10; * P < .05; ** P < .01; *** P < .001

Table 10 lists the results for estimating the parameters of public transport use. The variable dealing with education (attending school, going to university or doing an apprenticeship) has the largest positive influence: The probability of public transport use increases by about 34 percentage points. Positive effects can also be observed when it comes to gender and immigration background, but both have only a small effect. All the other variables show a negative effect on the probability of regular public transport use. Living in a household that owns at least one car considerably reduces the probability of using public transport. To a much lesser extent, this is also true for individuals living in households with children. Another negative factor is age. In comparison to the young reference group, belonging to one of the two older age groups has a negative effect on the probability of using public transport on a regular basis. An increase in car-attitude reduces the probability of using public transport on a regular basis, as suggested by a small but statistically significant effect.

Table 11 lists the results for estimating the parameters of bicycle use. The largest positive influence is the factor of living in a household that owns at least one bicycle, which considerably increases the probability of riding a bicycle on a regular basis. Similar to car use, age is a positive factor: In comparison to the young reference group, the probability for the use of bicycle is higher for the two other categories. A positive influence can also be observed for an increase in the bicycle-socialisation factor, which combines the statements on parents' bicycle use with the one that asked whether participants' were accompanied by their parents when riding a bicycle as a child. A similar effect has the neighbourhood statement about feeling secure even when it gets dark, but to a smaller extent. A decrease in probability can be observed for those participants who live together with children. Being a woman, having an immigration background or travelling further to locations for work, education or grocery shopping affects the likelihood of regular bicycle use in a negative way, but only to a smaller extent.

Table 11 Parameter estimation for the use of bicycle (at least weekly: yes/no)

Independent variables	Reg. coeff. β	OR	AME
Sex female (male)	−.254*	.775	−.049
Age groups (18–33 years)			
34–49 years	.351*	1.421	.067
50–66 years	.450**	1.568	.086
Household with children (household without children)	−.526***	.591	−.098
Number of bicycles in household	.596***	1.814	.114
Ln mean distance (workplace, education, grocery store)	−.145*	.865	−.028
Feeling secure in the neighbourhood even when it gets dark	.156***	1.169	.030
Bicycle-socialisation	.243***	1.275	.047
Immigrants (non-immigrants)	−.228 [†]	.796	−.044
Constant	−2.378***	.093	

N = 1557

Nagelkerkes pseudo-r-squared: .277

Level of significance: [†] P < .10; * P < .05; ** P < .01; *** P < .001

Discussion

The results of this study yielded new insights concerning similarities and differences between non-immigrants and immigrants in Offenbach am Main in terms of travel behaviour. When it comes to the use of cars or public transport, our results are similar to those in the US and also the UK. Regardless of participants' immigration background, if and when a car is available, it is likely that it will be used very frequently. But what happens when this is not the case? Immigrants are less likely to own a driving licence and to have access to a car than non-immigrants. Sharing the ride and using the car as a passenger could be seen as a means to mitigate these disadvantages. Concerning the use of bicycles, the results are more in line with other findings from Germany and also from the Netherlands and Austria. Here, one of the surprising findings of our study is that almost all male and most of the female participants stated that they know how to ride a bicycle, irrespective of immigrant status. In general, non-immigrants own more bicycles and use these more frequently than immigrants. However, if immigration status and gender are considered, the percentage of people using their bike on a weekly basis is higher than for weekly public transport users. The exception in this respect is the group of immigrant women; in this case, the numbers are similar. This group also has the highest percentage of non-cyclists.

Using logistic regression models allowed us to provide new insights concerning factors influencing the regular use of car (as driver), public transport and bicycle. By distinguishing between members of the first immigrant generation in terms of duration of stay, this study showed, in line with studies on the US and the UK, a tendency for assimilation with regard to car driving over time. More recent immigrants were less likely to use this transport mode. As only a few of the participants had only recently immigrated to Germany, rather broad categories had to be used. The second immigrant generation was more likely to use the car (as driver). For the other two transport modes, no tendencies with regards to duration of stay or immigrant generation could be observed. For this reason,

immigration background was used instead, but compared to other factors it had a rather small effect. Therefore further research is needed to clarify the aspect of transport assimilation for all kinds of transport modes. With regards to the more explorative socialisation factors, we found that an increase in car-attitude as young adult is positively correlated to car use but negatively to public transport use. The statements in the interviews on parental transport mode were analysed to gain insights concerning the families' mobility culture during participants' childhood and to check whether this might also be a factor influencing travel behaviour by immigrants. As shown in Welsch (2015), the car-socialisation factor had only negligible effect on regular car use and was therefore not included in the present model. For the same reason, public transport socialisation was not included in the public transport model. However, for regular bicycle use, the factor bicycle-socialisation was shown to have a significant positive effect. Further studies are needed to determine whether socialisation plays a particularly important role in establishing the regular use of bicycle. This question might be of interest especially when it comes to those countries (or population groups) in which bicycles represent only a marginal transport mode. This study was not able to answer the question whether bicycle use is influenced more than other transport modes by norms or specific attitudes related to bicycles or, possibly, the role of women in different population groups or different cultures.

Due to the lack of nationwide surveys, we had to conduct our own, which is, to some extent, explorative, and comparatively small, as it focuses on only one city. The participants' general educational level is above average, which can be explained by the fact that well-educated people tend to be more willing to participate in surveys. We also assume that immigrants with a good language skill are more willing to be interviewed in a telephone survey. These limitations should be kept in mind when interpreting the results. Furthermore, immigrants in Germany are an increasingly diverse population group, and they differ with regards to their countries of origin, their spatial distribution, their cultural background and level of education.

Despite these limitations, our study provides important new empirical findings concerning the travel behaviour of people with an immigration background in Germany, a group that has been rather neglected by mobility research but that has become increasingly important as its numbers has grown in recent decades and will continue to do so in the future. As many aspects of the travel behaviour of immigrants are still not fully understood or even completely unknown, there is an urgent need for further research. It is crucial to identify the mobility needs and the travel behaviour of all population groups; otherwise, there is an increased risk of transport policy or transport planning decisions that will not be effective. In Germany's larger cities, where the majority of immigrants live, reasonable public transport is typically available. Promoting the use of this and of non-motorized modes of transport could help to guarantee independent mobility for those immigrants who do not have a driving licence and/or do not have access to a car. For low-income families, encouraging walking and the use of bicycles could offer an affordable alternative for shorter trips. Here, a number of German cities and organisations already offer cycling courses for immigrants, especially for women. Together with improvements to the cycling infrastructure, these kinds of initiatives should be supported to a greater extent and extended in order not only to encourage immigrants but all population groups to bicycle use. That said, we want to emphasise that immigrants, especially recent refugees, would greatly benefit from improvements towards an easily accessible, barrier-free, affordable, sustainable and intermodal transport system.

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