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# Quantitative secondary analysis of MiD 2008: Multimodal individuals in households without cars

**Project** City 2.e

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## TABLE OF CONTENT



## LIST OF FIGURES

# 1 Who are the multimodals without a car in Berlin?

In this section, the focus is on the personal attributes of multimodal individuals in households without cars in Berlin. These are studied using the MiD 2008 dataset. The data analysis approach is the following: the distribution of key socio-demographic variables for multimodal persons in households without cars (*Multimodalen ohne Auto*, MOA in the following) is illustrated and compared with the distribution of the same variables among other (monomodal) carless individuals and for persons in motorised households with cars. Taken together, these three groups account for the whole Berlin MiD2008 sample[1]. The goal is to single out the distinguishing features of the MOA group. In that sense, the question is not (only) "who are multimodal persons in households without cars" bur rather "how are they different from other carless persons and from people in motorised households?"[2].

In this context, MOA are defined as persons who habitually use at least two different transport modes (among bike, car and public transport) during the week. As illustrated in Fig. 1, MOA account for approximately 16% of the sample.

[1] Cases with missing information on the frequency of use of key transport modes and/or household car ownership have been excluded from the analysis. Notably, this means that children under 14 are excluded from the analysis. Since the 14-17 age group accounts for only 2,2% of the analysis sample, the findings illustrated in this report can be applied to Berlin´s adult population.

[2] All differences between groups discussed in the remainder of the report are statistically significant at the 5% level (chi-square tests, t-tests), unless otherwise stated.

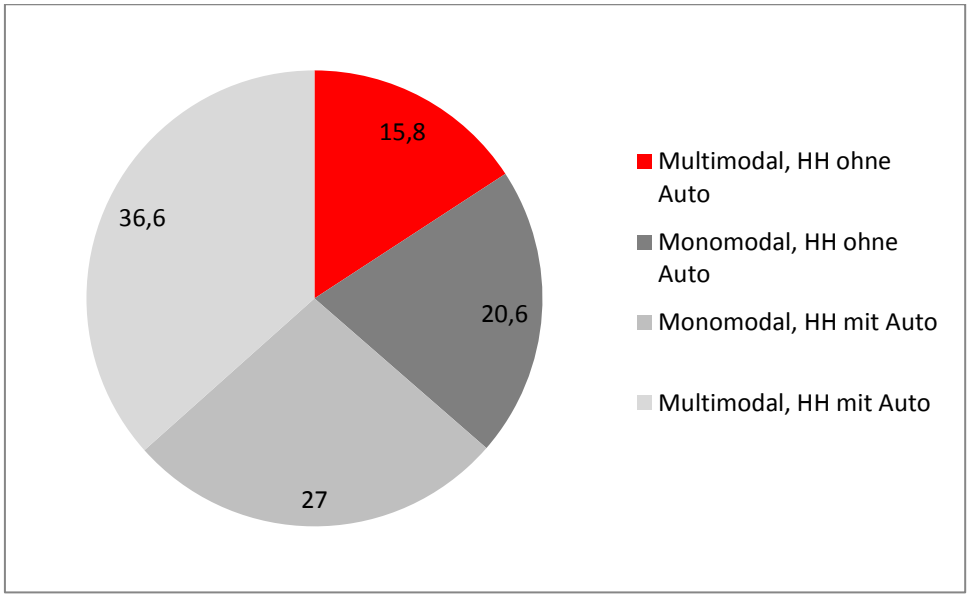


Fig. 1 Household car ownership and travel behaviour typology (N=1.808). Unit of analysis: individuals.

Interestingly, while slightly more than half of the sample reports a multimodal travel behaviour, the majority of multimodal people live in car-owning households. Similarly, the majority of individuals in carless households is not multimodal.

More in depth analysis shows that, within Berlin, the share of multimodal persons varies greatly with population density in the proximity area (in a 1x1km pixel around the residence): while only 10% of adults is MOA in areas with a density of 2.000 to 5.000 in./km$^2$, this figure is as high as 22% in areas with 10.000 in./km$^2$ or more. Since the average population density of Prenzlauer Berg is 13.944 in./km² (source: Amt für Statistik Berlin-Brandenburg), it is reasonable to assume that the share of MOA in Prenzlauer Berg is over 20% of the adult population.

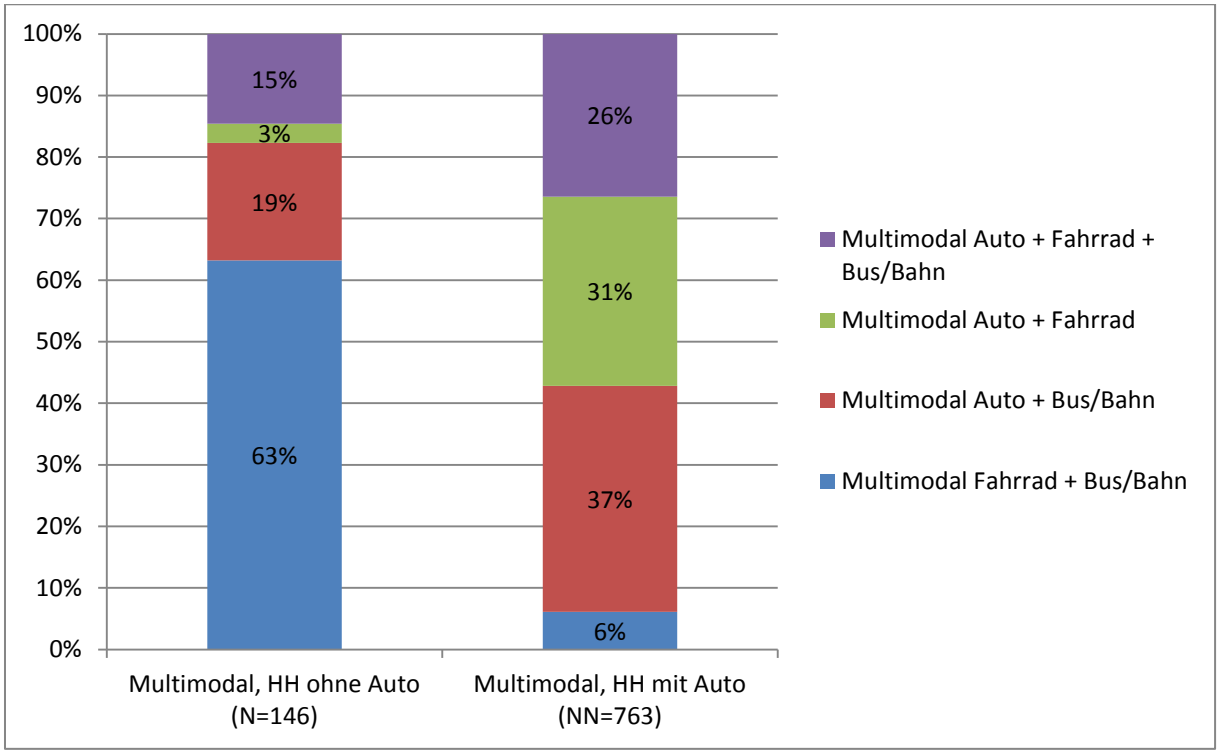


Fig. 2 Typology of multimodal travel behaviour for MOA and multimodal persons in motorized households. Unit of analysis: individuals.

Fig. 2 distinguishes between different types of multimodal persons, and shows the composition of the MOA group, as compared to that of multimodal persons in households with car. Unsurprisingly, the combination of bike and public transport use over the course of the week is the most common multimodal travel behaviour among the MOA. Still, other combinations (implying a weekly use of the car) account for 37% of the group. This contrasts with the group of multimodal persons in motorised households, where the “bike plus public transport” subset accounts for only 6%, and the combination “car and public transport” prevails.

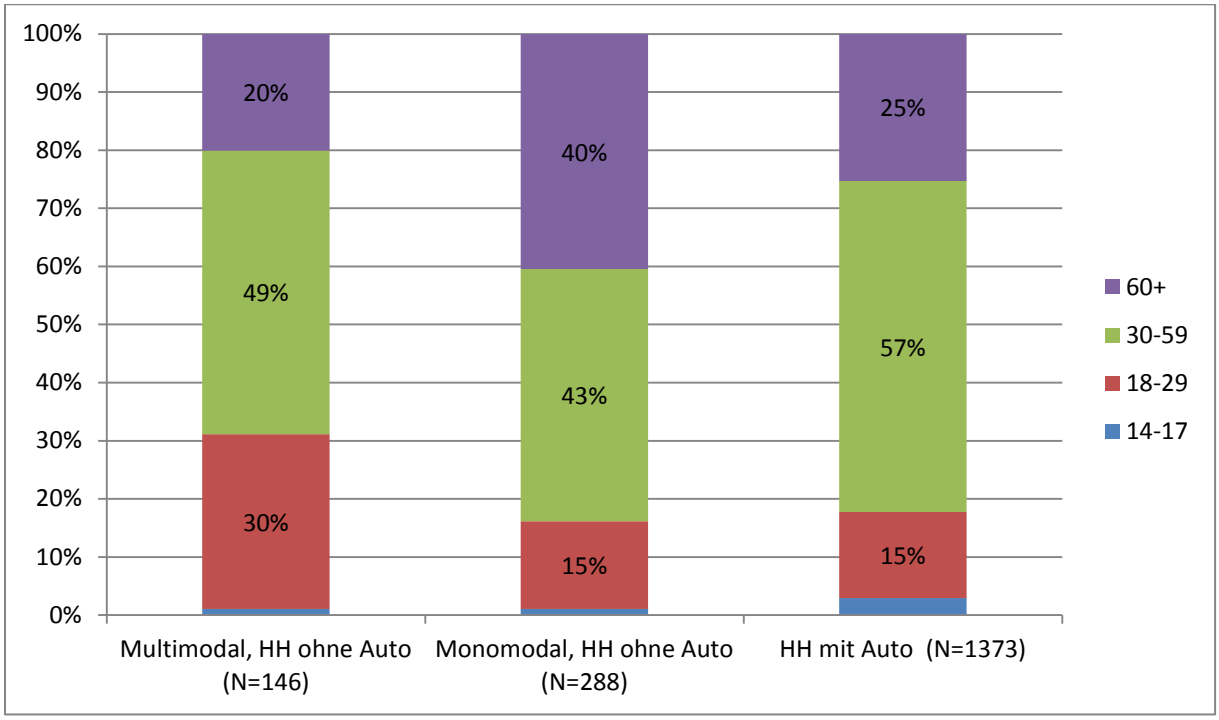


Fig. 3 Age distribution for MOA, monomodals in households without cars and individuals in motorized households. Unit of analysis: individuals.

With regard to the age distribution, the MOA group is younger than the rest of the carless and persons in households with car, with the 18-29 age group accounting for 30% of MOA. Conversely, individuals with more than 60 years old account for only 20%. By contrast, it is older people who are overrepresented among the monomodals in households without car. In other words, it appears that MOA are significantly younger than other groups depicted in Fig. 3. This finding is consistent with previous research on multimodality in Germany and, as argued further below, explains several of the distinguishing features of the MOA group.

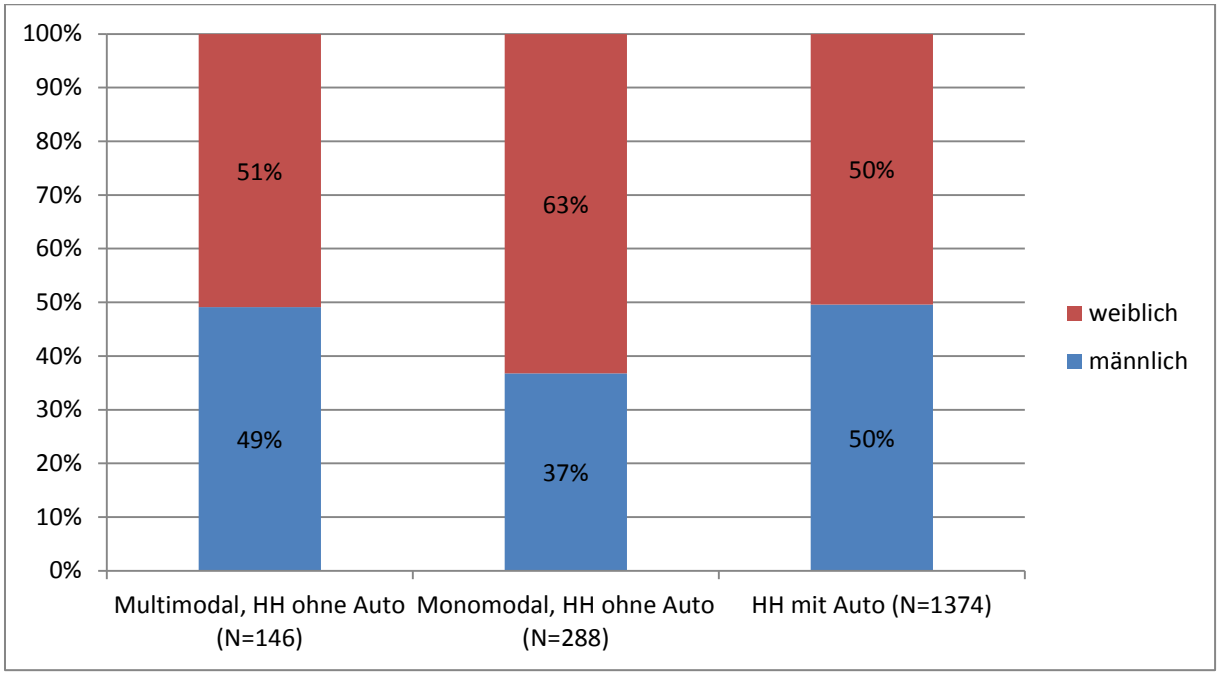


Fig. 4 Gender distribution for MOA, monomodals in households without cars and individuals in motorized households. Unit of analysis: individuals.

This is apparent in Fig. 4, showing the gender distribution of the three groups. While women are overrepresented among the monomodal carless, the MOA group is almost equally split between men and women, and this makes it similar to the group of motorised household members. These differences might be explained by the overrepresentation of older people among the monomodals in households without cars, since women are generally overrepresented among older people.

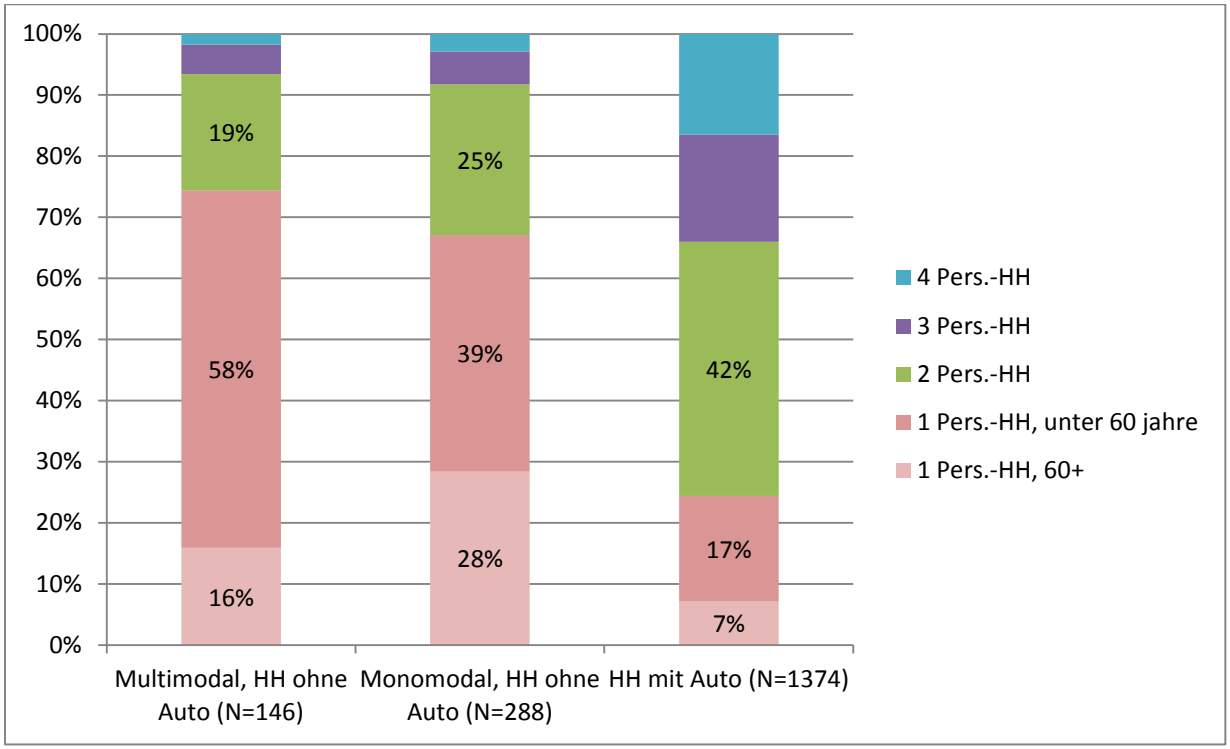


Fig. 5 Household size distribution for MOA, monomodals in households without cars and individuals in motorized households. Unit of analysis: individuals.

With regard to household size, Fig. 5 shows that singles are strongly overrepresented among the carless. This is consistent with the findings of the international research literature on car ownership, showing that small household size is one the main predictors of non-car ownership (see Preisendörfer und Rinn, 2003). At first sight, it appears that there is no significant difference between multimodal and non-multimodal carless individuals in this respect. However, more in depth analysis shows that the share of singles under 60 is higher among the MOA, as compared to the rest of the carless. This reflects the peculiar age distribution of the MOA group.

A reflection of this is that 91% of MOA live in households that do not include any member under 18. In other words, households with children are only rarely to be found in the MOA group. In this respect, there is no significant difference between multimodal and monomodal persons inside the carless households group.

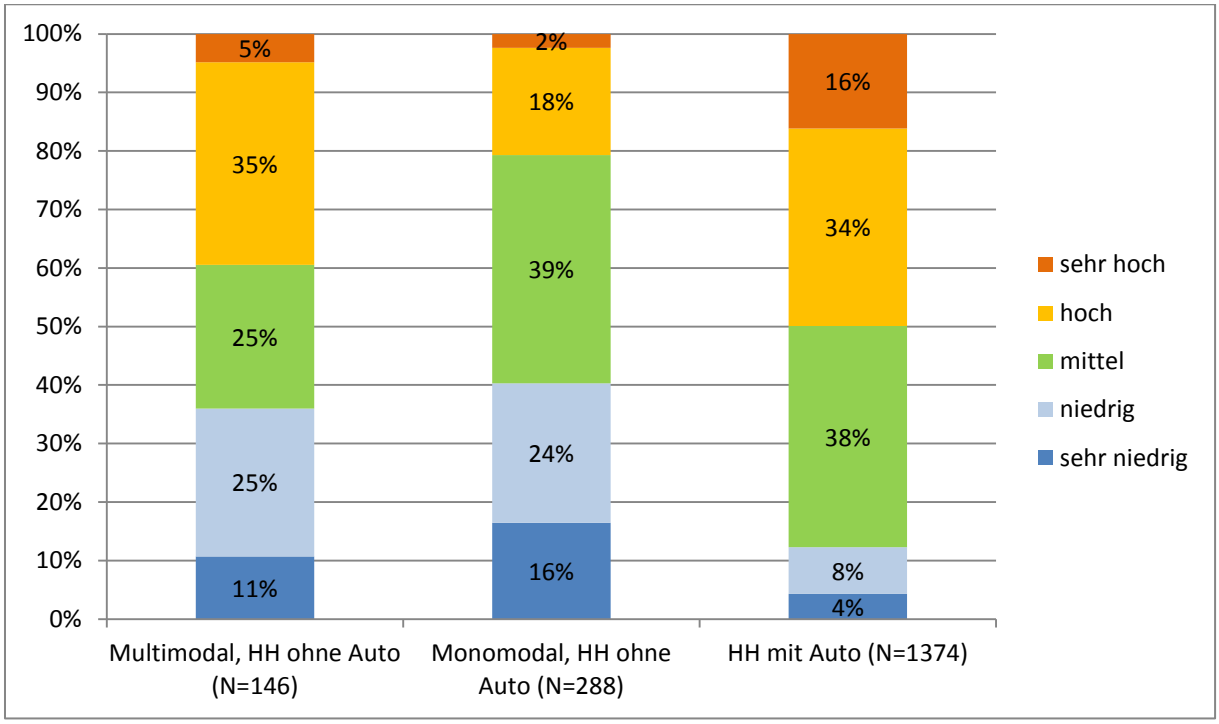


Fig. 6 “Economic status” distribution for MOA, monomodals in households without cars and individuals in motorized households. Unit of analysis: individuals.

Figures for household economic status are illustrated in Fig. 6[3]. Individuals living in households in a low or very low economic condition are strongly overrepresented among the carless (as compared to motorised household members), accounting for more than 35% of individuals. This is consistent with the findings of the international research literature on car ownership, showing that low income is one the main predictors of non-car ownership (see Preisendörfer und Rinn, 2003).

Interestingly, however, the income distribution of the MOA group is quite different from that of other carless: indeed, individuals in a high or very high economic condition account for 40%, while the medium income group accounts for only 25%. As a result, the MOA group is characterized by a more polarized income distribution than the other two groups illustrated in Fig. 6. This is consistent with previous research on multimodality in Germany.

[3] The „ökonomischer status“ variable available in the MiD2008 dataset refers to household equivalised income. This allows the comparison of the income of households with different size.

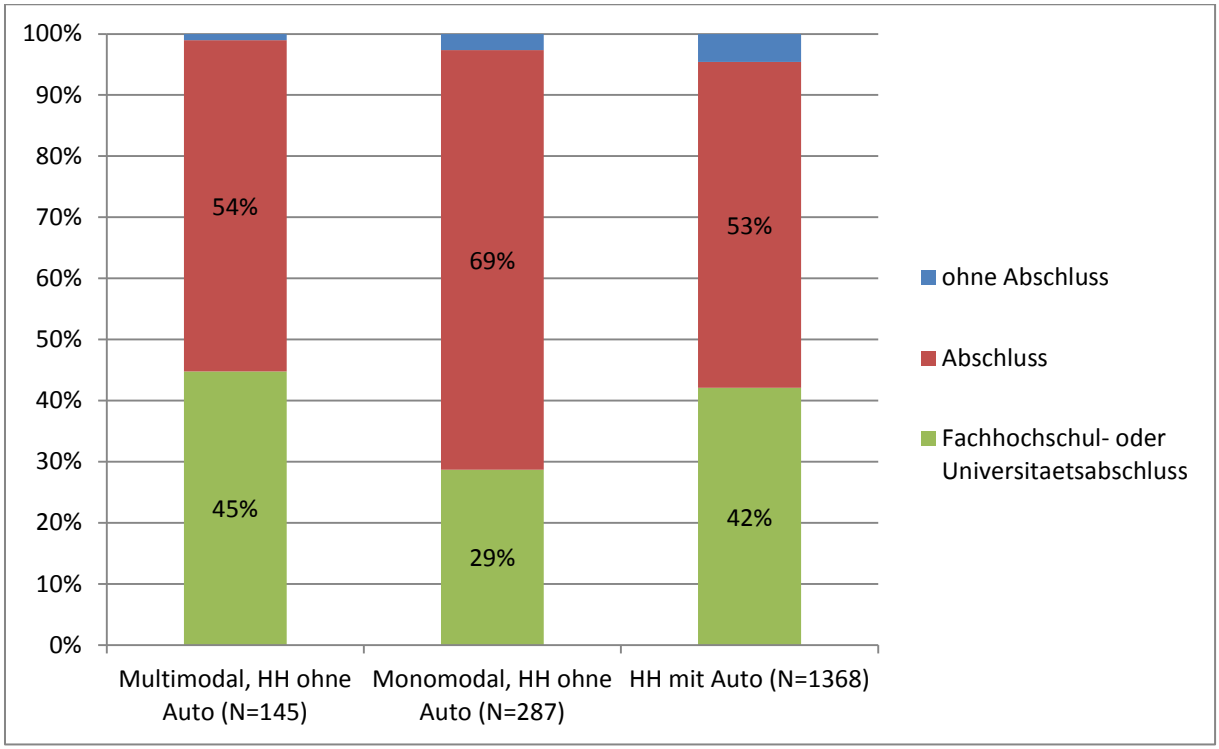


Fig. 7 Education level distribution for MOA, monomodals in households without cars and individuals in motorized households. Unit of analysis: individuals.

With regard to the education level, Fig. 7 shows the percentage of individuals with a university degree, for different groups. It shows that there are more individuals with a university degree in the MOA group (45%) than in the rest of the carless group. This is probably related to the underrepresentation of older people (who are on average less educated) in the MOA group, and is consistent with previous research on multimodality in Germany.

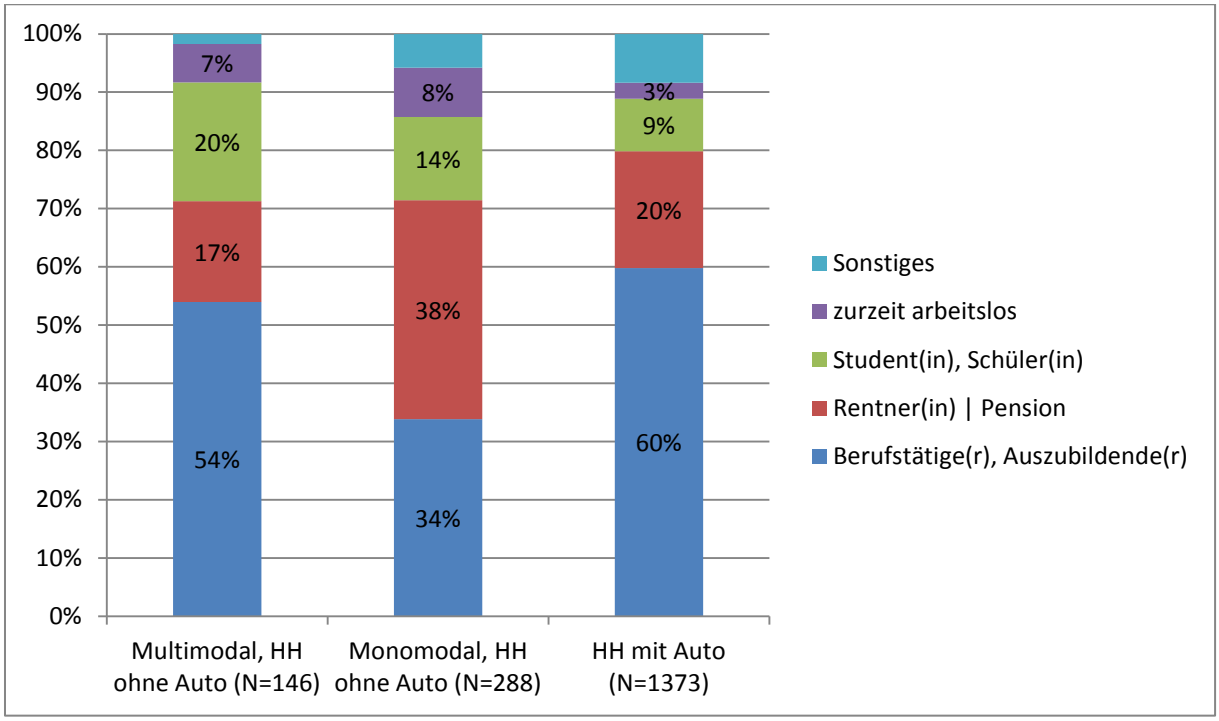


Fig. 8 Type of employment for MOA, monomodals in households without cars and individuals in motorized households. Unit of analysis: individuals.

With regard to employment, Fig. 8 shows that both individuals in paid work and students are more represented in the MOA group, as compared to the rest of the carless, while there are considerably less pensioners. This is consistent with the age composition of the MOA group, where the elderly are underrepresented, and young adults overrepresented.

With regard to the reasons for not owning a car, the MID questionnaire included six binary items (*kein Auto nötig*; *bewusster Verzicht*; *zu teuer*; *gesundheitliche Gründe*; *Altersgründe*; *andere Gründe*). Since the resulting number of possible patterns of response is $2^6$=64, in this section I use the typology of carless households (according to the reasons for not owning a car) proposed by Mattioli (2013) to simplify the analysis[4].

[4] The typology was obtained using Latent class analysis (McCutcheon 1987), which is a latent variable technique that treats categorical variables as such and assumes a categorical latent variable. It is therefore similar to cluster analysis in that its output is a series of classes, i.e. a typology of the sample under analysis. Further details on the typology are found in Mattioli (2013).

In the following, I provide a short interpretation of the clusters. The *car abstinence* group is composed by households who generally mentioned a combination of absence of need, affordability problems and deliberate abstinence (always mentioned). All households in the *economically car deprived* cluster mentioned affordability problems, only a minority chose either "car unnecessary" or "health reasons", while none selected other items. Households in the car free cluster are defined by the strong prevalence of the "car not necessary" response option. The three remaining clusters (*too old to drive*; *no driving licence*; *health impaired*) are defined by the prevalence of old age-related reasons (age reasons, health reasons and other reasons). Descriptive statistics also confirm that the age distribution of these clusters is strongly skewed towards older people. For this reason, they are represented as a single group in Fig. 9, showing the composition of the MOA group, as compared to monomodal persons in carless households.

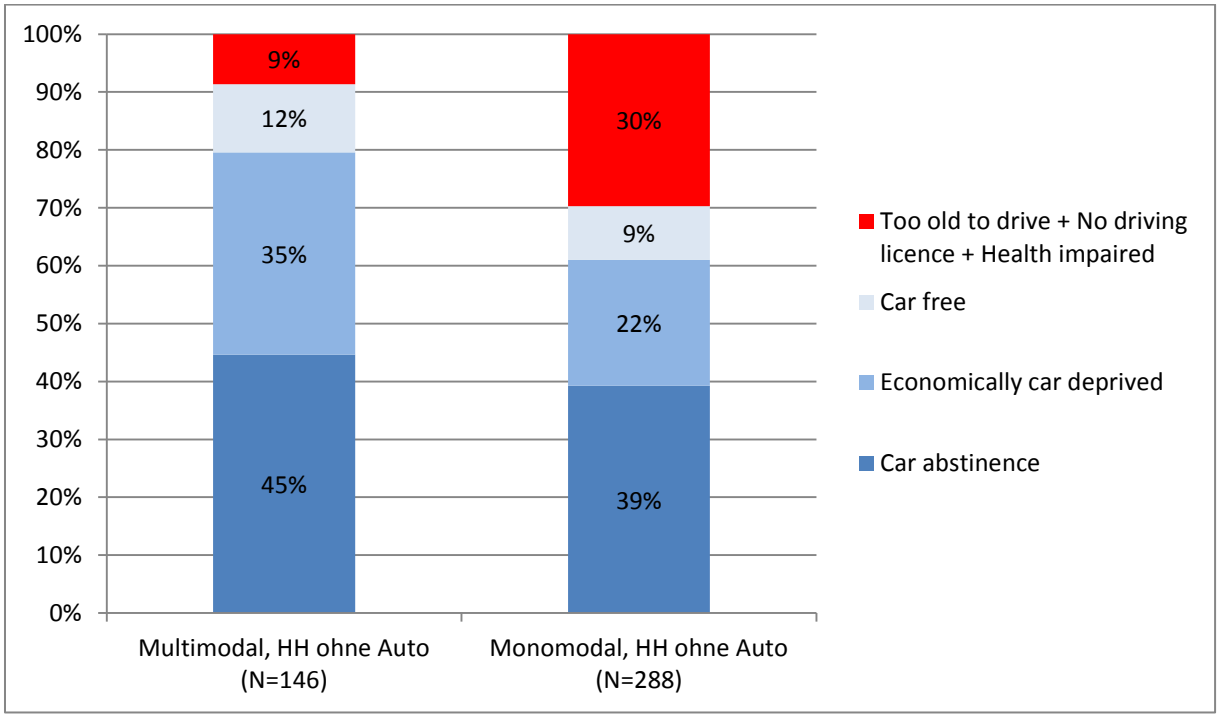


Fig. 9 Typology of reasons for not owning a car for MOA and monomodals in households without cars. Unit of analysis: individuals.

The graph shows that the clusters defined by old age-related reasons are strongly underrepresented among the MOA. This is consistent with the underrepresentation of older people in the group. Conversely, both the 'car abstinence' and the 'economically car deprived' group are strongly overrepresented, accounting for 80% of MOA. This shows that

economic reasons, deliberate abstinence and lack of need are all significant factors behind the non-car ownership of MOA. While for people in the 'car abstinence' group these reasons generally coexist, for the 35% of MOA in the 'economically car deprived' group economic reasons are by far the most important reason.

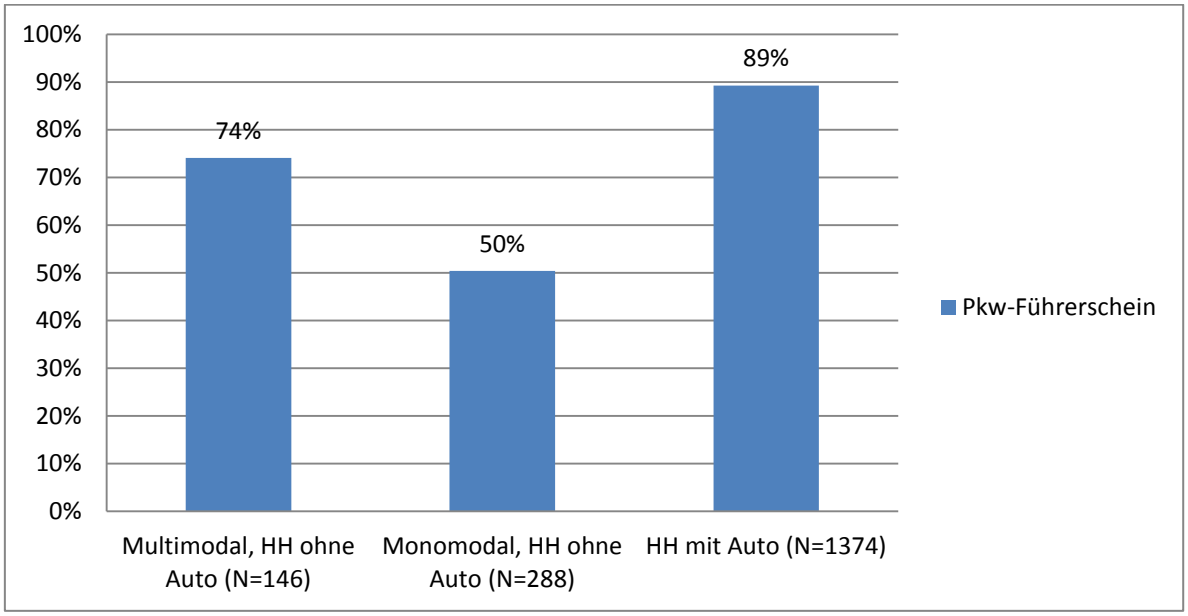


Fig. 10 Car driving licence ownership for MOA, monomodals in households without cars and individuals in motorized households. Unit of analysis: individuals.

As illustrated in Fig. 10, the MOA are more likely to own a driving licence than other persons in households without cars: virtually three quarters of MOA own a car driving licence. This figure is not much lower than the average for individuals in motorised households (89%)[5]. This result is not surprising since MOA are defined (also) by their habitual use of the car, despite the lack of a household car.

Further analysis focused on car availability also shows that MOA are more likely to have a vehicle available than the rest of carless persons. When asked about the availability of a car as driver, 34% of MOA report "occasional" or "regular" availability, as compared to only 15% for other carless persons. Conversely, 66% of MOA have either "no" access to a car as driver

[5] It has to be kept in mind that children under 14, who by definition do not own a driving licence, are excluded from the analysis.

or do not own a driving licence. The results for the availability of vehicles on the travel diary day confirm these differences[6].

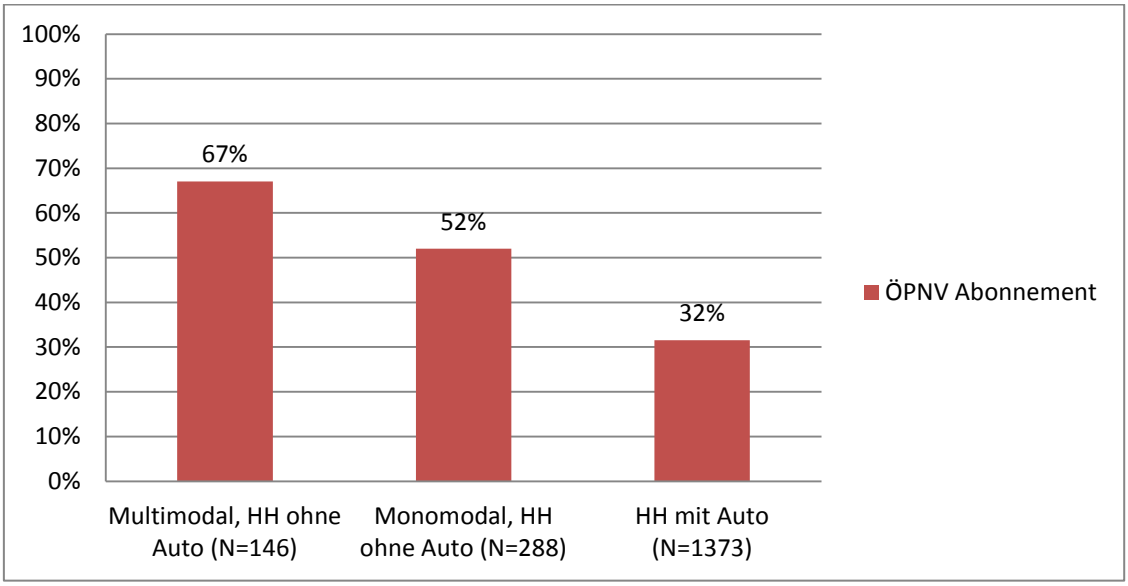


Fig. 11 Ownership of public transport tickets for MOA, monomodals in households without cars and individuals in motorized households. Unit of analysis: individuals.

Public transport tickets are another crucial resource for the mobility of individuals. A public transport ticket that is valid for at least one week is arguably a ”commitment” to a certain modal behaviour, i.e. public transport use (see Simma & Axhausen, 2003). The findings illustrated in Fig. 11 show that approximately two thirds of the MOA own a public transport ticket that is valid for at least one week. This figure is higher than for the rest of the carless (52%) and more than double than that for individuals in households with car (32%). Therefore, MOA appear to be strongly committed to the use of public transport.

With regard to bicycle availability, the results of further analysis show that approximately 90% of MOA own a bicycle, significantly more than the rest of the carless (45%) and slightly more than individuals in households with cars (80%). The use of motorbikes is not common among MOA, as only 5% own a driving licence for motorcycles or motorbikes *and* live in a household with at least one motorised two-wheeler. This is less than the figure for individuals in motor-

[6] The relative graphs are not reported here for the sake of brevity.

ised households (8%), and there is no significant difference between MOA and the rest of the carless in this respect.

Overall, with the exception of motorbike availability, the availability of alternative transport modes, licences and public transport tickets is significantly higher for MOA, as compared to the rest of the carless.

# 2 How do multimodals without cars in Berlin travel?

After having set out the main attributes of the MOA group, in this section the focus is on their travel behaviour. This was studied using the person and trips datasets of MiD 2008. All survey participants were asked to report their travel behaviour in a "travel diary" for a single sampling day. Sampling days were distributed throughout the whole year so as to obtain a representative sample of the travel behaviour of Germans. The data gathered through travel diary are reported in the "trips" database.

The data analysis approach is identical to that used in the previous section: the distribution of key travel behaviour variables for MOA is illustrated and compared with the distribution of the same variables among other individuals living in households without cars and with members of car-owning households. The goal is to single out the distinguishing features of the travel behaviour of MOA.

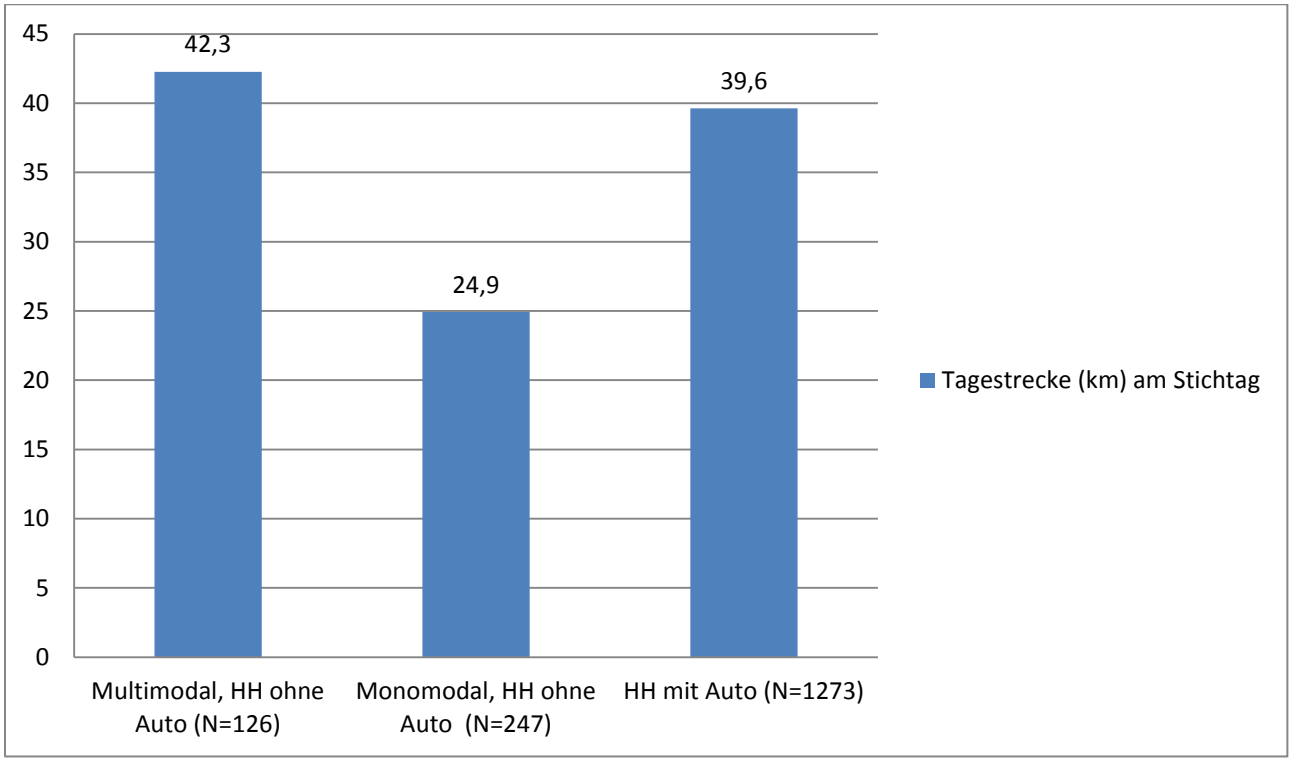


Fig. 12 Travel distance on travel diary day for MOA, monomodals in households without cars and individuals in motorized households. Unit of analysis: individuals.

Fig. 12 shows the average travel distance covered on the travel diary day for the different groups. It shows that MOA are quite a mobile group, covering on average approximately 42 km per day. This figure is much higher than the corresponding figure for the rest of the carless (25) and even slightly higher than the average travel distance for individuals in households with cars (40). Overall, it seems that MOA are able to travel considerable distances, despite the lack of a household car.

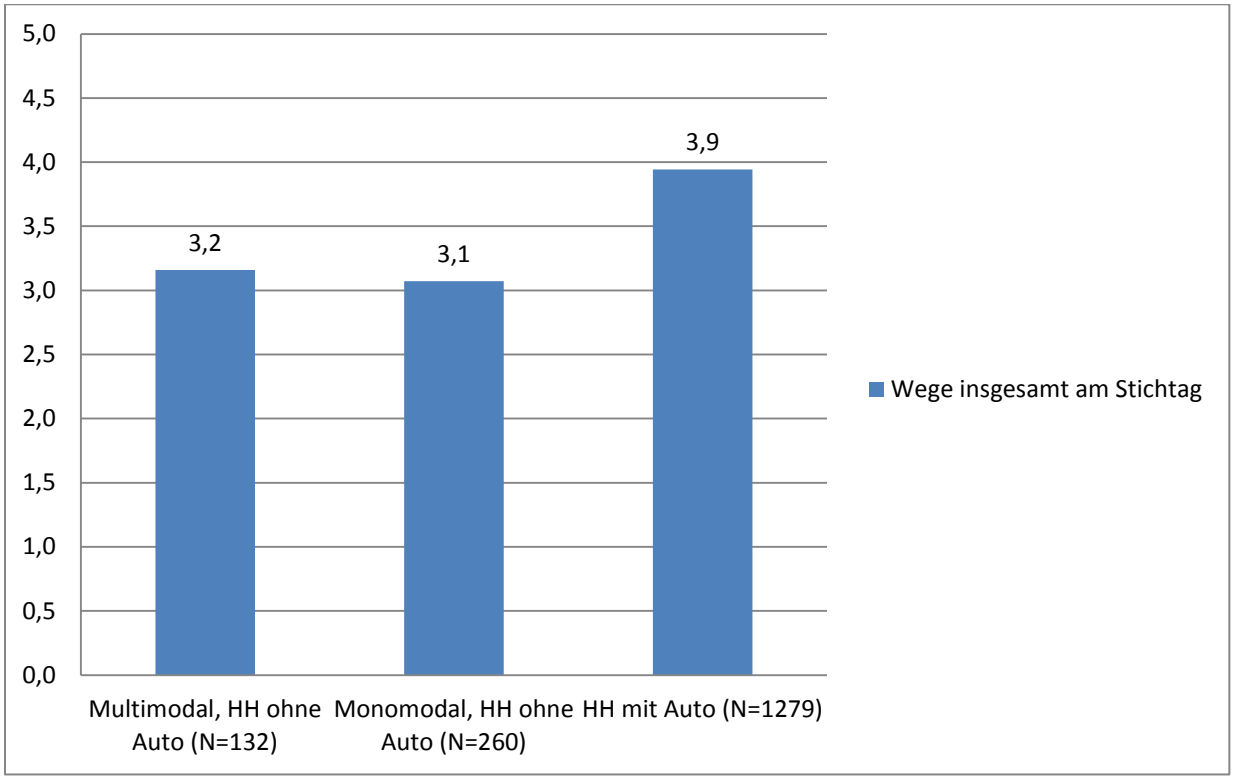


Fig. 13 Trip rates on travel diary day for MOA, monomodals in households without cars and individuals in motorized households. Unit of analysis: individuals.

A different picture emerges from the analysis of trip rates (Fig. 13): the average number of trips on the travel diary day is lower for MOA (3,2) than for individuals in households with cars (3,9). However, there is no statistically significant difference between MOA and other individuals in carless households. This result can be explained as follows: higher trip rates are frequently observed for households with children, due to the range of different activities that adults in these households need to carry out (work, childcare, shopping, etc.) and the need to accompany children. Since singles are strongly overrepresented among the carless (and especially so among the MOA, see Fig. 5), this leads to lower-than-average trip rates for this group. A corollary of this finding is that the average length of trips for MOA (13,5 km) is significantly higher than for all other groups. In other words, MOA tend to carry out few trips, but on longer distances.

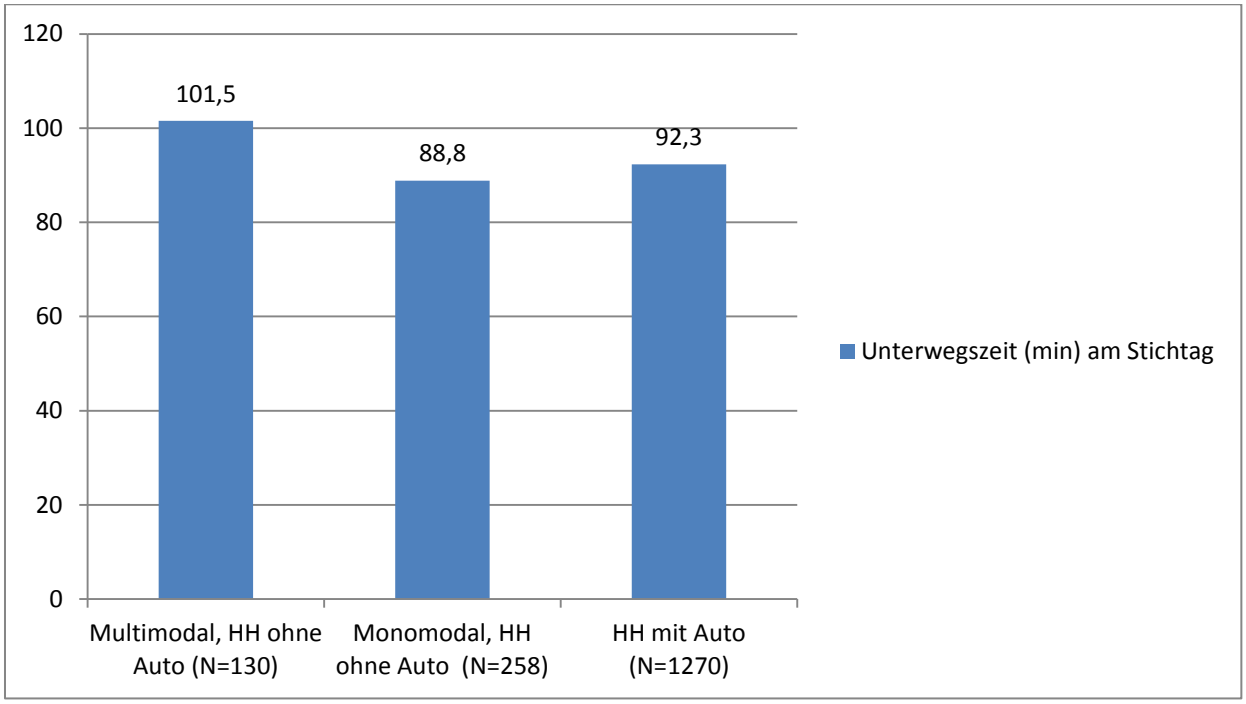


Fig. 14 Travel time on travel diary day for MOA, monomodals in households without cars and individuals in motorized households. Unit of analysis: individuals.

With regard to travel time, the figures illustrated in Fig. 14 confirm that the MOA are quite mobile: indeed, they spend on average 1 hour and 42 minutes per day travelling, approximately 10 minutes more than both monomodal carless and individuals in households with cars. However, the difference between the average travel time of MOA and that of other carless is only marginally statistically significant (p=0,051, t-test) because of small sample size, and should thus be interpreted with care. A possible interpretation for this result is that MOA have to rely (also) on travel modes slower than the car to cover travel distances that are comparable to those of individuals in motorised households: as a result, they end up spending more time travelling than their motorised counterparts. A corollary of this finding is that the average duration of trips for MOA (32 min.) is higher than that of all other groups. In other words, MOA tend to carry out fewer, but slightly more time consuming trips.

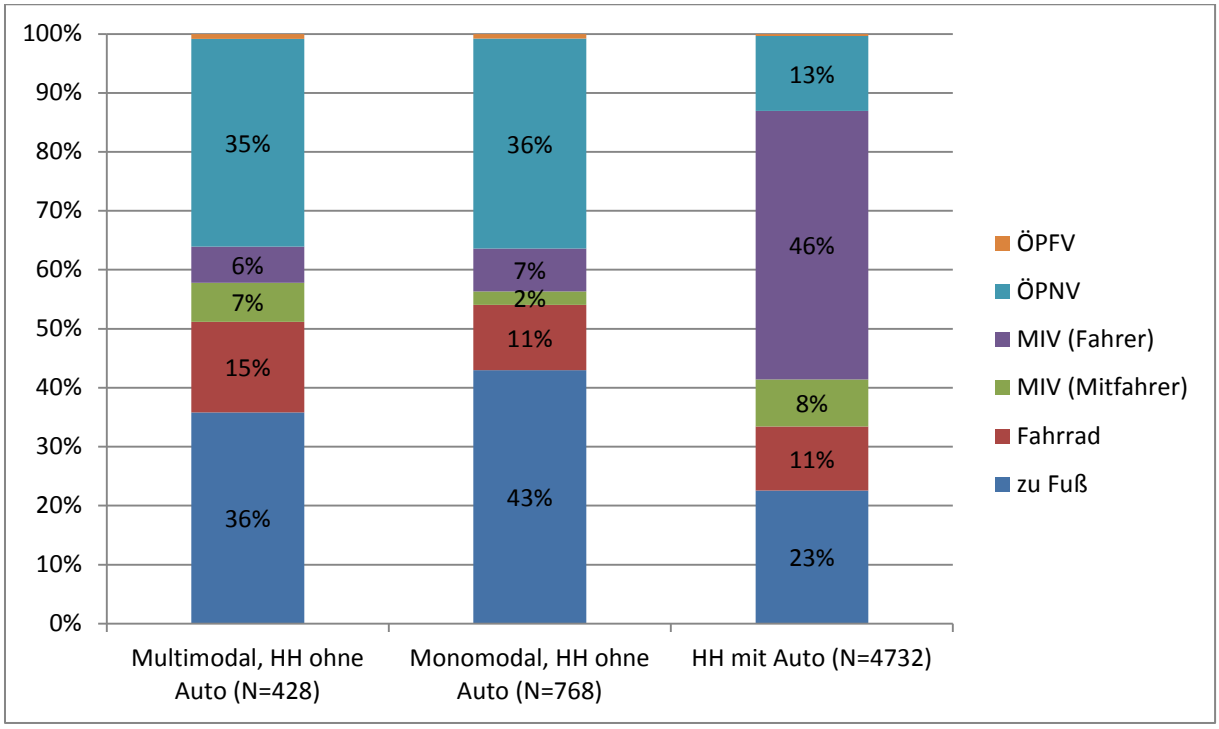


Fig. 15 Modal split (basis: trips) on travel diary day for MOA, monomodals in households without cars and individuals in motorized households. Unit of analysis: trips.

Another key attribute of travel behaviour is modal split. Fig. 15 depicts modal split figures computed on the basis of trips. Unsurprisingly, it shows that individuals in carless households use motorised private modes less, and all other transport modes more, as compared to individuals in households with cars. However, values for MOA are only slightly different from those of the rest of the carless.. In detail, MOA walk less often, but use motorised private modes and the bike more, as compared to monomodal carless individuals.

Since multimodals and non-multimodals were distinguished based on their stated habitual travel behaviour, this lack of difference might seem surprising. It might be interpreted as a “composition effect”, whereby the presence of several “monomodal” groups creates the impression of a “multimodal” travel behaviour in the aggregate.

While Fig. 15 is based on data for the “main travel mode” for each trip, the MiD database also allows to compute the share of trips involving a “combination” of transport modes (e.g. bike and public transport): these are usually referred to in the literature as “intermodal trips”. The share of intermodal trips is low among the MOA (3,7%), although higher than for the rest

of the carless (1,2%) and individuals in motorised households (1,3%). Overall, only approximately 6% of MOA carried out at least one intermodal trip on the travel diary day.

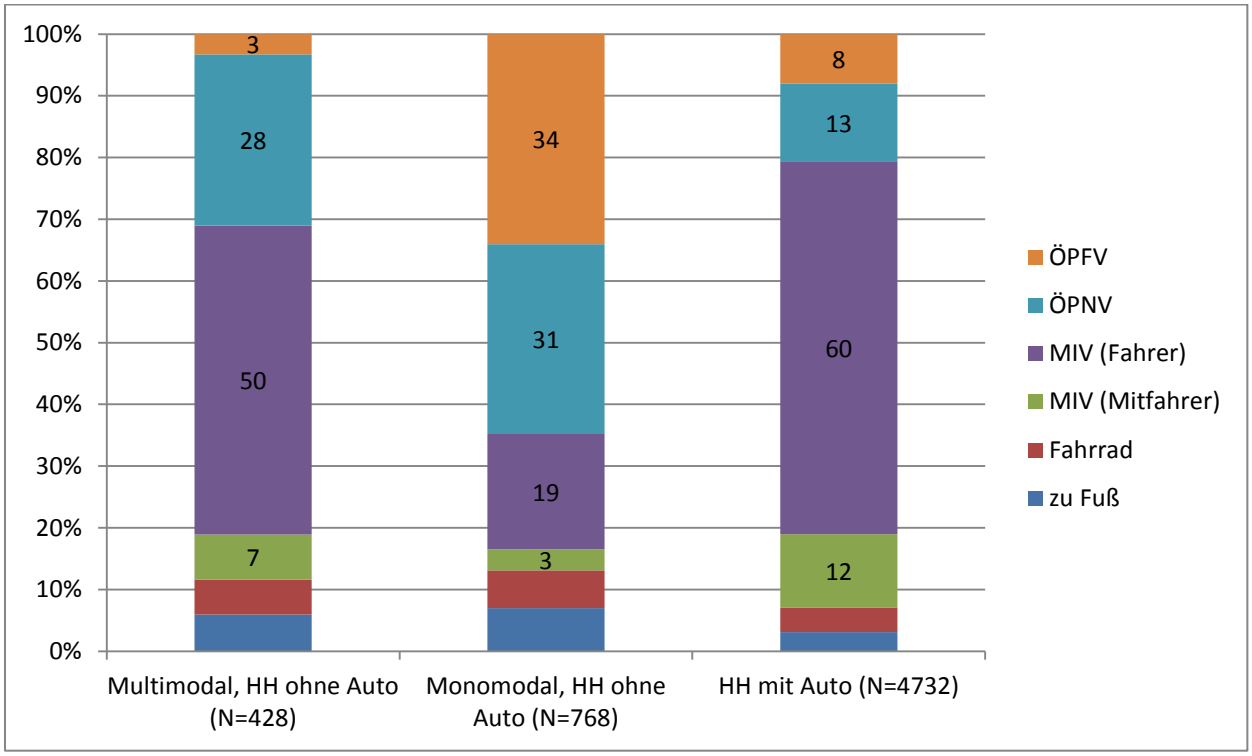


Fig. 16 Modal split (basis: distance) on travel diary day for MOA, monomodals in households without cars and individuals in motorized households. Unit of analysis: trips.

Fig. 16 shows modal split figures computed on the basis of travel distances. Surprisingly, the graph shows the importance of motorised private modes in the modal split of MOA. Motorised private modes account for 57% of the distance travelled by MOA, significantly more than for other carless (22%) and not much less than for individuals in households with cars (72%). However, as shown in Fig. 15, motorised private modes account for only 13% of the trips made by MOA, as compared to 54% for individuals in motorised households. Overall, it appears that MOA use motorised private modes less often, but for longer distances than other people. How to explain this difference? A possible explanation is that MOA manage to carry out most of their daily mobility with modes alternative to the car, but at least some of them use motorised private modes for longer trips such as out-of-town trips during weekends and holidays. This would also help explain their high values for travelled distance (Fig. 12).

This hypothesis is strengthened by Fig. 17, showing the same modal split as Fig. 16 but excluding trips equal or over 50 km[7].

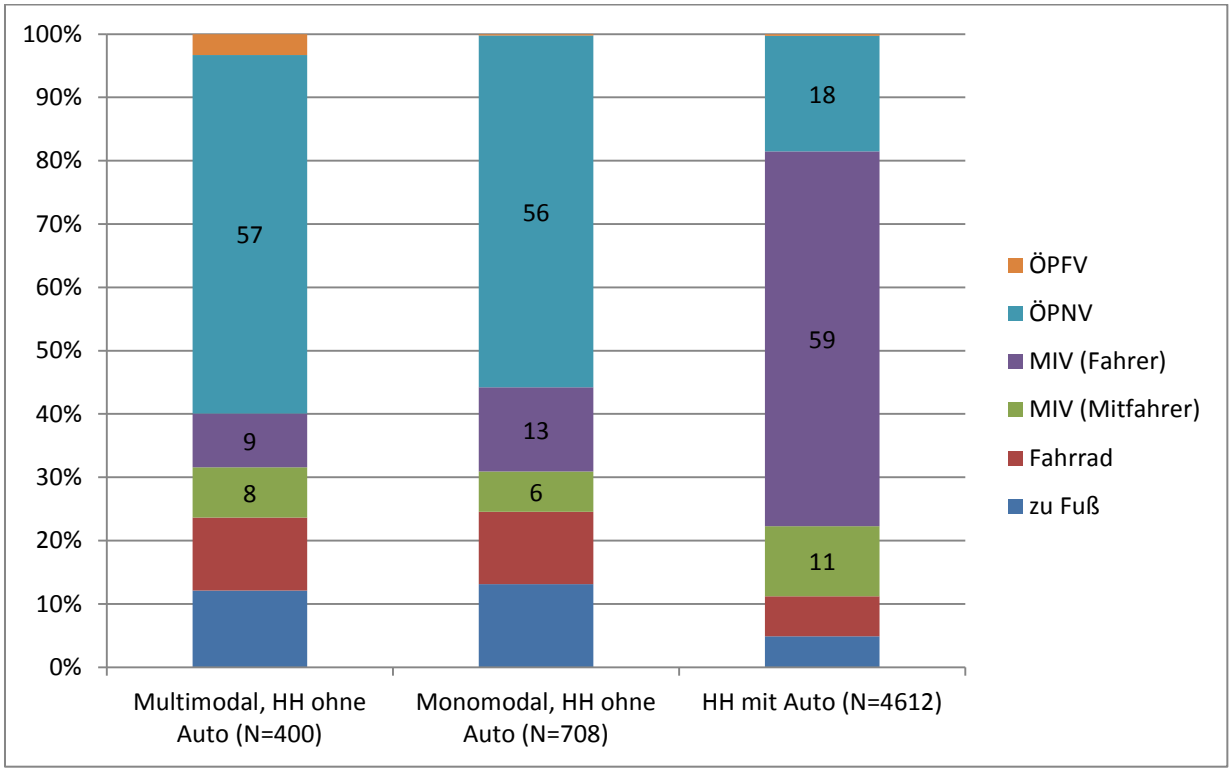


Fig. 17 Trips under 50 km: modal split (basis: distance) on travel diary day for MOA, monomodals in households without cars and individuals in motorized households. Unit of analysis: trips.

The graph shows clearly that, once longer trips are excluded from the analysis, motorised private transport modes account for only approximately 17% of the distance covered by MOA. The importance of public transport is also more apparent, with a modal share of 60%. Also, most of the differences between MOA and other carless observed in Fig. 16 disappear when longer trips are excluded from the analysis. In other words, the modal split of MOA is not particularly different from that of other carless persons, as far as local mobility is concerned[8]. However, there are good reasons to assume that the two groups differ in their modal choices for longer-range travel.

[7] Since the largest diameter of Berlin is 45 km (East-West) and 38 km (North-South), a trip of 50 km or more is likely to be a trip whose destination lies outside the municipality of Berlin.

[8] There are, however, great differences between multimodal and monomodal carless with regard to average travel distance (see Fig. 12). As a result, even when only trips under 50 km are considered, MOA carry out longer distances than the rest of the carless with *all* transport modes.

An hint in this direction is provided by Fig. 16, showing that the modal share of long-distance public transport for MOA is much lower (3%) than for other carless individuals (34%). This suggests that MOA are more likely to use the car rather than long-distance public transport (e.g. trains) for longer trips. Indeed, the average length of MOA's car trips is significantly higher than for all other groups. MOA also appear to be more inclined to long-distance travel: the average number of trips with overnight stay carried out over the three months preceding the interview is 2,2 for MOA, as compared to 0,9 for other carless persons and 1,8 for individuals in motorised households. This might be related to the younger age of the MOA group.

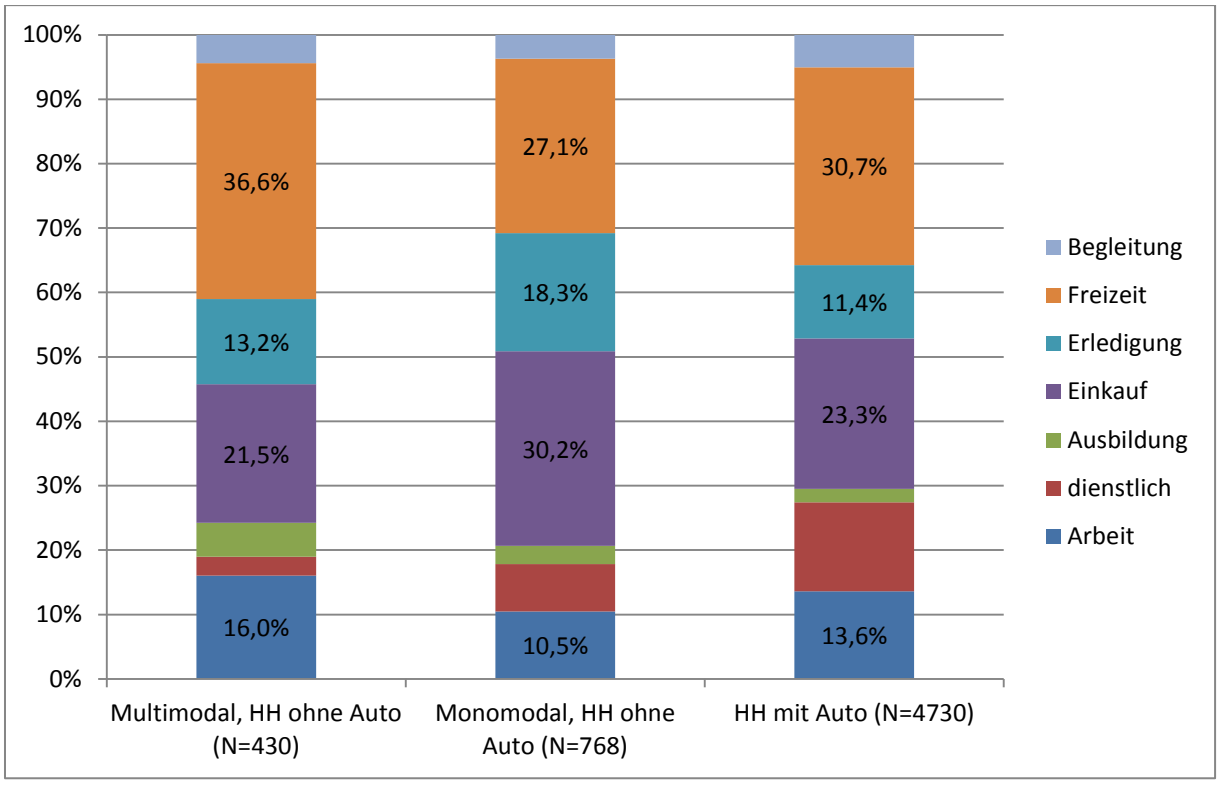


Fig. 18 Distribution of trips on travel diary day, by trip purpose, for MOA, monomodals in households without cars and individuals in motorized households. Unit of analysis: trips.

Fig. 18, showing the distribution of trips by purpose for the different group, suggests that there are no dramatic differences between the trip purpose splits of the different groups. However, carless individuals tend to carry out less business travel (for work-related purposes) and MOA travel more often for leisure activities (accounting for 37% of their trips) than other groups. This in turn might be related to the high proportion of young adults and students in the MOA group. Interestingly, the percentage of trips to and from work is also slightly higher for MOA.

These differences are magnified when travel distance (instead of the number of trips) is considered: on average, MOA cover approximately 27 km per day (accounting for 68% of their daily travel distance) for leisure, as compared to only 6 km for other carless.

Overall, there is suggestive evidence that one of the distinguishing features of MOA is the inclination of at least some of them to use motorised private modes for long-distance leisure trips. However, given the small sample size of the MOA group in this analysis, this conclusion should be taken with caution.

To conclude, it is interesting to observe how differences in travel behaviour translate into greenhouse gases emissions: this is illustrated in Fig. 19.

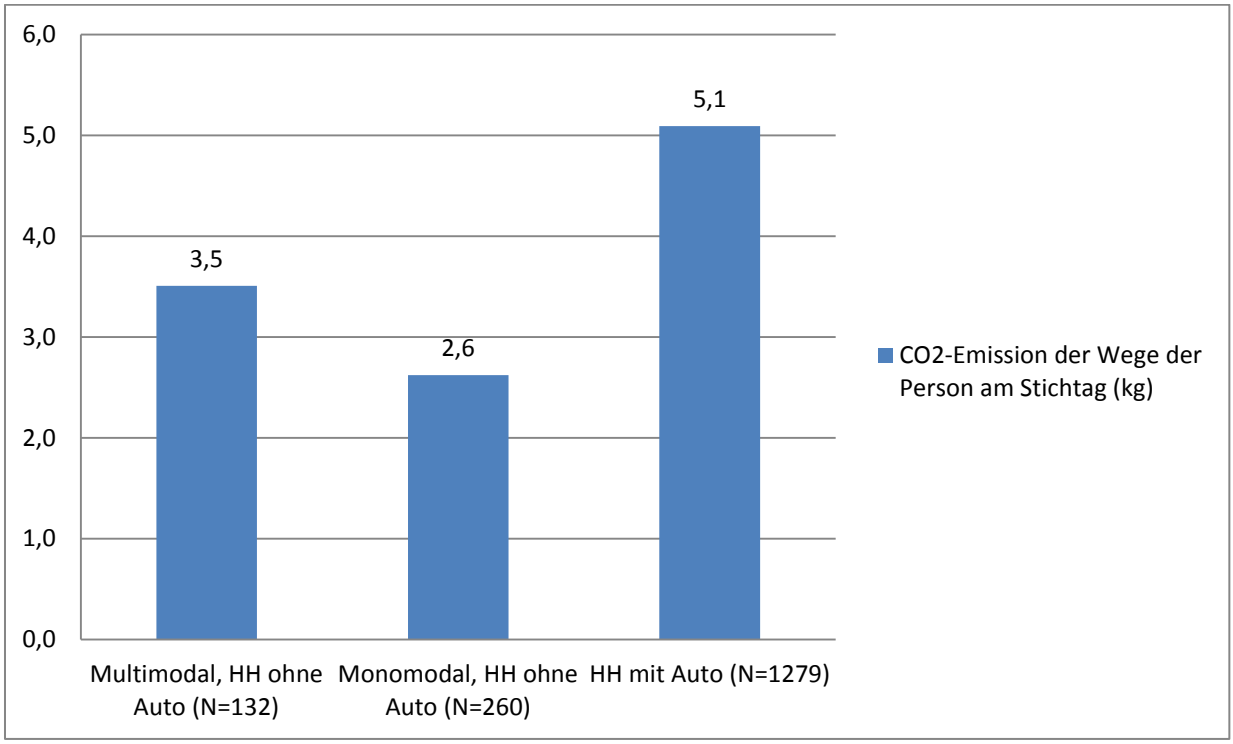


Fig. 19 Travel-related $CO_2$ emissions on travel diary day (kg) for MOA, monomodals in households without cars and individuals in motorized households. Unit of analysis: individuals.

The graph shows that MOA appear to pollute more than the rest of the carless, presumably because of the longer distances they travel[9]. However, they emit less $CO_2$ than persons in motorized households.

[9] However this difference is not statistically significant at the 5% level (t-test).

# 3 Conclusion

To sum up, multimodal persons living in households without cars (MOA) account for approximately 16% of the Berlin population over 13, and for less than half of carless individuals. The share of MOA is higher in the densest neighbourhoods of the city, where it reaches 22%. Among MOA, the prevalent group is people who use both public transport and the bike at least once a week (63%). The remaining 37% uses the car and public transport and/or the bike.

With regard to socio-demographics, the MOA group has several distinguishing features. While older and retired people, women, low-income households and persons without a university degree are overrepresented among the carless, the socio-demographic profile of the MOA group is generally more similar to that of motorised households. Young adults and students are even more represented in the MOA group than among individuals in motorised households. The exception in this context is household size: singles are strongly overrepresented among the carless, and even more overrepresented in the MOA group (58% are singles under 60). Similarly, only less than 10% of MOA lives in an household including members under 18. With regard to economic status, it appears that the income distribution of the MOA group is quite polarized, with both low- and high-income groups overrepresented.

With regard to the reasons for not owning a car, the analysis shows that economic reasons, deliberate abstinence and lack of need are all significant factors behind the non-car ownership of MOA, accounting together for more than 90% of the group (significantly more than for the rest of the carless). While for a relative majority of MOA these reasons coexist, for approximately 35% of MOA economic reasons are by far the most important.

Partly as a result of their socio-demographic characteristics, MOA are quite well provided with mobility resources, with 90% owning a bicycle, 74% a driving licence and 67% a public transport ticket that is valid for at least one week. Many of them are thus able to hop on and off different modes of transport.

With regard to travel behaviour, MOA appear to be quite mobile, with higher-than-average values for both travelled distance and time on the travel diary day. However, they carry out less trips than individuals in motorised households. This is possibly the result of the socio-demographic composition of the MOA group, where households with children (who need to carry out complex trip patterns) are strongly underrepresented. On the other hand, this

means that on average the trips carried out by MOA are longer both in terms of time and space. In terms of modal split, there are no big differences between MOA and other individuals in households without cars, at least when local trips (under 50 km) are considered. However, there is suggestive evidence that, while MOA manage to carry out most of their daily mobility with modal alternatives to the car, at least some of them tend to use motorised private modes for longer trips such as out-of town trips during weekends or holidays. This would be consistent with the high proportion of young adults and students and with the overrepresentation of leisure trips among MOA.

Finally, the data confirm that MOA emit on average less travel-related $CO_2$ than the members of motorised households.

# 4 References

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