Gender structures in car availability in car deficient households

Joachim Scheiner and Christian Holz-Rau

PD Dr. Joachim Scheiner (corresponding author), Technische Universität Dortmund, Faculty of Spatial Planning, Department of Transport Planning, 44227 Dortmund, Germany

phone ++49-231-755-4822, fax ++49-231-755-2269, e-mail joachim.scheiner@tu-dortmund.de

Prof. Dr.-Ing. Christian Holz-Rau, Technische Universität Dortmund, Faculty of Spatial Planning, Department of Transport Planning, 44227 Dortmund, Germany

phone ++49-231-755-2270, fax ++49-231-755-2269, e-mail christian.holz-rau@tu-dortmund.de

This is an author produced version of a paper from **Research in Transportation Economics**. This version is uploaded with kind permission of the publisher. The final version can be downloaded at: doi:10.1016/j.retrec.2011.12.006

Published paper:

Scheiner, Joachim / Holz-Rau, Christian (2012): Gender structures in car availability in car deficient households. In: Research in Transportation Economics 34(1), S. 16-26.

Please reference this paper as shown above.

Abstract

This paper studies the intra-household allocation of cars in car deficient households from a gender perspective. An individual's car access is measured in terms of duration of car use over a week. Car deficient households are defined as households with fewer cars than drivers. We develop a set of hypotheses that serve to explain gender differences in car availability, and empirically test some of these hypotheses by using multiple regression analysis. The data we use is the German Mobility Panel 1994 to 2008. Our findings provide evidence for the importance of social roles and economic power in intra-household negotiations about the limited resource of the household car. We cannot clearly decipher whether patriarchal structures and/or gender preferences are relevant as well, but our data suggest that both may play a role.

Keywords: gender, car availability, car deficient households, time use, intra-household car allocation

1 Introduction

In transport studies the purchase or disposal of a car is typically thought of as being a household decision, rather than the individual decision of any single household member. Since the 1970s several studies have investigated the number of cars (Lerman and Ben-Akiva, 1976; Roorda et al., 2000; Dargay, 2002; Bhat and Guo, 2006; Potoglou and Kanaroglou, 2008), or the vehicle types (Manski and Sherman, 1980; Mannering and Winston, 1985; West, 2004) households own.

The reasoning behind this household-based approach is based on neoclassical economics. In a unitary household model households are treated as actors composed of individuals acting collectively on behalf of the household, rather than following their individual reasoning (Becker, 1981). The household as an actor makes investments (or decisions) and shares the goods purchased (or responsibility for the decisions). This is particularly true for large-scale, long-term investments and decisions such as the purchase of a car (Lerman and Ben-Akiva, 1976) or residential choice (Mincer, 1978). This perspective implies that households are a black box, and it is also typical in other research areas, such as development studies (Bolt and Bird, 2003). However, it masks intra-household inequalities in access to goods such as cars when these goods are scarce.

The black box is broken up in household economics by studying the intra-household allocation of resources (Katz, 1997). The focus of such studies is mainly on allocation of time, sometimes also of money, to household members. Feminist research and gender studies also focus on intra-household division of labour, particularly between two partners (e.g. Baxter, 1997). While the allocation of time and activities in partnerships has also attracted attention in transport studies in recent years (Wen and Koppelman, 2000; Kato and Matsumoto, 2009), this is less true for the allocation of cars (exceptions are Petersen and Vovsha, 2005; Anggraini et al., 2008).

This paper studies the question as to which conditions shape car access in car deficient households. Car deficient households are defined as households with fewer cars than drivers (licenced adults). To put it briefly, we study the questions: Who gets the (only) car? Which conditions increase the chances for one of two partners to get car access? Which role do gender structures play in this context?

In the next section we give a brief overview of related research. Section 3 is devoted to methodological issues. Section 4 describes the results. The paper finishes with some conclusions and an outlook to further research.

2 State of the research

2.1 Car availability among women and men

In various recent studies the number of cars (Roorda et al., 2000; Dargay, 2002; Bhat and Guo, 2006; Potoglou and Kanaroglou, 2008), or the vehicle types (West, 2004) owned by a household have been examined at the household level. Car ownership has been studied as being conditional on household and individual socioeconomic and demographic attributes and spatial context at the residence (plus, in some cases, at the household members' workplaces). Sometimes, albeit rarely, attitudes and lifestyles have been taken into account (Cao et al., 2007). Gender may be included in such studies, e.g. as gender of the household head, but clearly gender is hardly a household level variable.

Studies of travel behaviour on the individual level or trip level often control for individual car availability or number of cars in the household. This is typically done by including car ownership or availability as an explanatory variable for travel behaviour in addition to sociodemographics, spatial context and transport supply attributes, sometimes plus lifestyles and preferences (Bagley and Mokhtarian, 2002; Scheiner, 2006, among many others). This approach does not permit conclusions to be made on gender specific access to the car.

More recently, car availability has also been modelled as a person level variable mediating the relationship between sociodemographics/lifestyle and travel behaviour (Scheiner and Holz-Rau, 2007; Scheiner, 2009; Van Acker and Witlox, 2010). This approach fits the intermediate role of car availability being dependent on individual or household resources and responsibilities, as well

as being a long-term commitment affecting daily travel behaviour (Salomon and Ben-Akiva, 1983; Simma and Axhausen, 2001). Some of these studies show gender as having only moderate (Scheiner, 2009) or even non-significant (Scheiner, 2010; Van Acker and Witlox, 2010) effects on car availability. Other studies find lower levels of car availability among women (Simma and Axhausen, 2001).

Despite mixed findings it seems that car availability being higher among men than women is somehow common knowledge. This is true for descriptive gender comparisons as well as for more complex approaches (Holz-Rau, 1990 for Germany, Noble, 2005 for the UK, Cao et al., 2007 for the USA), even if gender differences have been seen to decline over time (Noble, 2005).

Significant gender differences are also found for car use, particularly as a driver (Bagley and Mokhtarian, 2002 for the USA, Polk, 2004 for Sweden, Vance et al., 2005 for Germany). These differences may not merely be an outcome of gendered access. Even women with easy car access use public transit (PT) more than men, and they are more inclined to reduce their car use than men (Matthies et al., 2002; Polk, 2004). These findings may be traced back to women's more prevalent ecological norms and sustainability goals, and to their less ingrained car habits (Matthies et al., 2002; Hjorthol, 2008).

However, overall findings are again inconclusive. Gordon et al. (1989) report little gender difference in travel mode choice for the USA and reject the idea of patriarchal constraints in commuting. Dargay and Hanly (2007) find no significant gender effect on the probability of commuting by car in the UK. In their Cologne study Best and Lanzendorf (2005) find significantly less car use among women for maintenance trips, but not for commuting.

Besides car availability and mode choice, there is some research on gender specific vehicle type choice. Mohammadian (2005) finds that women tend to prefer spacious and safe vehicles that meet their own and their children's 'practical' needs for goods transport and safety, while men prefer vehicles exhibiting more power and performance. Choo and Mokhtarian (2002) add that women are overrepresented among drivers of relatively small cars. Men's preference for powerful cars may also serve as an explanation for car use being more important to them psychologically, as men are more motivated to car use than women by affective motives such as getting a kick out of driving, while women exhibit more instrumental motives such as making visits or going out (Bergstad et al., 2011) .

2.2 Intra-household allocation of resources and gender – some hypotheses

Theoretical explanations for gender differences in access to resources within households, such as cars, may be summarised in a limited number of key hypotheses (for discussions in the transport field see Camstra, 1996; Clark and Wang, 2005; Crane, 2007). These hypotheses may be assigned to various disciplines and perspectives, although there is a large amount of overlapping.

1. Economic power hypothesis. In feminist research and economics gender differences in economic resources and related gendered power structures are highlighted. Women's relatively low incomes and restricted access to labour markets because of workplace segregation in 'typical female' sectors are most prominent (Blumen, 1994).

2. Social roles hypothesis. Sociological theories highlight social roles that may commit women to taking on household and family responsibilities that limit their economic independence more than is the case for men. The hypothesis of household commitment is based on the distinction between paid work (employment) that is primarily done by men, and unpaid non-market household work that is primarily accomplished by women (Bauer et al., 2007). In transport studies

this hypothesis was developed mainly in the 1980s (Hanson and Johnston, 1985); it is empirically supported by Turner and Niemeier (1997).

3. Preference hypothesis. Over and above resource and role-based approaches, social psychology and some sociologists study the importance of gender attitudes and norms based on preference (e.g. Hakim, 2000). In recent years, a small number of related studies have emerged in the transport field that explicitly make an empirical distinction between the binary variable sex and gender attitudes (Ettema and Van der Lippe, 2009; Özkan and Lajunen, 2006).

4. Patriarchy hypothesis. Feminist theory also highlights gender specific hierarchical, patriarchal power relations that may operate over and above economic inequalities (hypothesis of a 'dual system oppression' borne by capitalism and patriarchy) (Hartmann, 1979; Walby, 1990). These power relations impact social role patterns, the availability of resources, and norms likewise. As a result, observed gender differences in car availability, travel mode choice or activity patterns are subject to these power relations, more specifically to women's weak negotiating position in the household or on the labour market.

2.3 Intra-household allocation of cars and gender

In empirical transport research, intra-household interactions are primarily studied in terms of time use for activities and/or trips, rather than in terms of the allocation of transport means (e.g. Golob and McNally, 1997; see Buliung, 2005 for a comprehensive overview). Srinivasan and Athuru (2005) explicitly recognise the role of household car availability in their study of maintenance activity allocation, without however studying car allocation as a target variable. One result is that in households with more than one car maintenance activities are allocated more equally among the household heads.

Similarly, Scott and Kanaroglou (2002) study activity patterns, distinguishing between households with one car and multiple-car households. From their findings they conclude that in the former females are more committed to maintenance, while in the latter maintenance tasks are allocated in a more egalitarian way due to the missing car constraints.

Golob et al. (1996) study vehicle use in households where there are two vehicles, aiming to distinguish between vehicle types. The analysis is based on vehicles rather than individuals, i.e. it is a driver allocation rather than a vehicle allocation model. They find fewer vehicle miles travelled per year for vehicles principally driven by females.

Although not specifically focused on gender relations, the modelling framework proposed by Wen and Koppelman (2000) provides a useful approach to the intra-household allocation of vehicles. Starting from a household economics framework in which subsistence (here: maintenance) activities are allocated among household members, they argue that in households with less cars than drivers the allocation of cars is dependent on activity allocation. Accordingly, 'male roles' as well as 'female roles', i.e. employment as well as maintenance activity obligations (household work, childcare) may increase a household member's chance of getting access to a car. There is some empirical evidence for this suggestion. In a qualitative study in Germany Heine and Mautz (2001) find children to be a key factor increasing female access to the car. This is partly due to the more complex tasks associated with childraising, and partly to transport safety concerns associated with children. The quantitative study by Vance et al. (2005) supports this notion. They find that the likelihood for a woman to make a trip as a car driver increases with the number of her children, while the equivalent likelihood for men decreases with the number of his children.

Anggraini et al. (2008) explicitly focus on within-household car allocation for work trips. They consider activity schedule and space-time setting (number and duration of work episodes,

weekday, travel time ratio PT/car, price of parking, density at residence), individual and household characteristics (e.g. age, socioeconomics, number of employed individuals in the household, age bracket of youngest child) as impact factors. They find higher probabilities for males to get access to the car for the work trip than for females, with little intervention of other household or person characteristics. However, their focus is more on improving transport modelling frameworks than on gender relations.

The same is true for Petersen and Vovsha (2005, 2006) and Roorda et al. (2009). Petersen and Vovsha (2005) also study intra-household vehicle allocation. They are interested in estimating the number of tours a household makes when competition between drivers in the household concerning access to the car is taken into account. Gender does not play a key role in this study. In the same framework Petersen and Vovsha (2006) focus on vehicle type choice. Roorda et al. (2009) model vehicle transactions on the household level in a dynamic framework. They explicitly recognise and simulate household conflicts that occur about the limited number of vehicles and acknowledge the importance of such conflicts for the probability of purchasing another car, but they are not interested in the gendered nature of the conflicts.

To sum up, there are few studies on car allocation in auto deficient households, and none of these studies aims to explicitly focus on gender relations. This is despite long-standing anecdotal evidence for gender inequality in access to household cars. Pickup (1984) notes that 'the general pattern is for husbands to have first choice of car use, usually for commuting' (p. 63, similarly: Giuliano, 1983). This notion is supported for Germany by the observation that cars are more often registered for men than women, while female partners more often have limited car access (Brennecke, 1994; similarly: Noble, 2005 for the UK).

What is more, car access is likely to depend on travel conditions that may affect the need for car use and, accordingly, a person's intra-household bargaining position. For instance, commute trip distance, the complexity of activity and trip patterns, and the availability of alternatives to the car (e.g. PT access to the workplace or other important destinations) may play a role here.

Finally, spatial effects may be at play, although mothers' and fathers' participation in child escort (as an indicator of gender equality) has been found to vary little by spatial context (Schwanen, 2007). Modern egalitarian attitudes and lifestyles may be more prevalent in urban contexts, while more traditional gender divisions of labour and access to resources may prevail in rural areas. This is reflected in women's relatively high labour force participation in cities (Camstra, 1996).

3 Methodology

3.1 Data

The data we use is the German Mobility Panel (GMP) 1994 to 2008[1]. The GMP is a household survey with the sample organised in overlapping waves. Every household is surveyed three times over a period of three consecutive years (Chlond and Kuhnimhof, 2005). A trip diary is used to collect information on trips over a whole week from all household members aged ten years or over. Sociodemographic attributes for the household and its members are collected as well as spatial context attributes at the residence and at the household members' places of work or education.

[1] The GMP is conducted by the University of Karlsruhe on behalf of the Federal Ministry of Transport, Building and Urban Development (BMVBS). The data are provided for research use by the Clearingstelle Verkehr (www.clearingstelle-verkehr.de).

An important data limitation that has to be kept in mind is that the data are limited to trips within one week. Untypical weeks may affect the results, e.g. when a wife was sick and her husband for once did the shopping and children escort. However, given the considerable effort of data report for the respondents, a trip diary over one week may be considered a very good data base. For instance, the results of Schad et al. (2001) indicate a high degree of stability in travel mode use over the week. In any case, the data include a dummy variable with a self-reported measure of whether or not the week of report was 'more or less as always'. This variable allows untypical weeks to be identified for control analysis.

A second limitation is the lack of information on personal income, as is typically the case in travel surveys. Even information on household income has only been available since 2002. We thus exclude income from the analysis (see below).

We ask which variables help explain access to the car. As our focus is on gender, we limit our analysis to households with a male and a female partner. Furthermore, in our regression models we consider only licenced individuals living in households with at least one car, but with less cars than licenced adults. In addition, we exclude households without an employed individual (mostly retirees). This is because we use intra-household work-sharing arrangements as explanatory variables. From a total sample of 11,380 individuals this procedure results in 2,569 individuals, of whom the complete information required for our regressions is available for 1,969 individuals.

Our analysis refers to one third (33.0%) of all German adults making up 21.9% of households. Licenced adults living in households with at least as many cars as drivers account for 32.8% of all adults, non-licenced adults make up 4.7%. These figures are complemented by individuals living in households in which neither of the partners is employed (27.1%), those identified as homosexual couples (0.8%), and licenced adults living in non-retiree households without a car (1.6%).

3.2 Analysis approach

It is important to note that the panel nature of our data means that we face non-independent (clustered) observations, thus violating one of the most basic assumptions in statistical analysis. Although it is standard practice in transport studies to ignore cluster structures in data that emerge from observing multiple trips made by one person, or from multiple persons living within the same household, the problem of non-independence is likely to be even more marked in repeat observations of the same individuals. The use of OLS regression with such data may result in underestimation of standard errors because the amount of independent information available is inflated. Thus, the significance of parameters may be overestimated (Hedeker et al., 1994).

There are basically two ways of treating panel data in regression. Either one can employ a random effects model or work with cluster-robust estimation based on pooled data. A disadvantage of the random effects regression modelling approach is that it assumes constant correlation between successive observations of the same unit. In contrast, clustered regression with pooled data allows for arbitrary correlation. The estimates are less efficient, and, similar to OLS, the standard errors may be too small when the number of clusters is finite (Nichols and Schaffer, 2007; Wooldridge, 2003). Both these issues should not be serious problems here due to the relatively large sample size and cluster number.

It is also important to note that the cluster-robust standard error estimator converges to the true standard error as the number of clusters (not the number of observations!) approaches infinity (Nicols and Schaffer, 2007; Kézdi, 2004). Rogers (1993, p. 23) concludes from simulation experiments that 'as long as the largest cluster is 5 percent or less of the sample, this bias should be negligible'.

We use a pooled data approach and account for clustering by using a robust estimation method controlling for autocorrelation within subjects emerging from the temporal order (sequence) of records. As our analysis is at the person level, this means that the correlation matrix of within-subject dependencies is estimated as part of the model. We use the SPSS procedure GEE (generalised estimating equations) for our analysis.

Concerning model specification (see Garson, 2010 for details), we use the autoregressive correlation type, as we have a temporal order of within-subject measurements, which means that values at a given point in time are a function of prior values plus error term. We work with continuous dependent variables and assume normal distribution with untransformed variables ('identity link' in SPSS) in order to keep interpretation on an intuitive level. There is no reason to test for a certain sequential order of model predictors, which technically means we choose SPSS analysis type 3.

For comparison we estimate OLS regressions with a reduced sample of independent observations, drawing one random year of observation for each household. The results are very similar to the ones reported here in the models of trip duration, while in the models of trip plus activity duration the differences in effect magnitudes are more notable. These models are available from the authors upon request.

Unlike OLS regression, there is no determination coefficient in cluster robust regression. SPSS reports a quasi likelihood under independence criterion (QIC) which is an extension of the Akaike Information Criterion (AIC) for repeated measures (Garson, 2010). It is available in corrected form (QICC) that penalises model complexity and small sample size. QICC works in a 'the smaller the better' form. We report this for our models as well as for the intercept models. However, there is no formal test of significance in model improvement available. Thus, for intuition, we also report R^2 values from our OLS regressions.

3.3 Variables

Access to the car may be measured in various ways. An obvious measure is self-reported car availability. However, neither the question wording nor the answer categories in the GMP are entirely clear[2]. Nonetheless, we present a brief descriptive analysis of this variable. Another measure for car availability is the amount of time a person uses the car plus the time she or he has it available at the destination. This suggests travel time by car plus associated activity times during the report week (except for housing – assuming that if the car is parked at the household's residence, it is available for other household members as well). This approach may be further sharpened by considering only trips and associated activities undertaken as the car driver, rather than as a passenger. However, including activity times means that the outcome is starkly affected by activities with long durations (work). In the light of these considerations, we use four measures of duration of car use as dependent variables (all in minutes per week):

(1) Trip time as car driver plus activity time at the destination, except for housing

(2) Trip time by car as driver or passenger plus activity time at the destination, except for housing

(3) Trip time as car driver

(4) Trip time by car as driver or passenger.

[2] The answer categories are 'yes, regularly', 'occasionally or upon agreement', and 'no'. The word 'regularly' may be understood in German as 'virtually always' or as 'at specific times throughout the day or week'. It is left up to the respondent whether the question be understood in terms of having a car available to drive, or having it just available (as driver or passenger).

	Mean	Std. deviat-ion	Mini-mum	Maxi-mum
Duration of car use over the week of report (minutes)…				
…as a driver (trips and activities)	1,466.5	1,343.8	0	8,545
…as a driver or passenger (trips and activities)	1,903.8	1,347.9	0	8,545
…as a driver (trips only)	240.4	232.7	0	3,063
…as a driver or passenger (trips only)	327.0	239.6	0	3,109
Respondent's share in…				
…household work: household work trip plus activity duration as percent of couple's total; includes shopping and escort trips	0.50	0.26	0	1
…employed work: employment trip plus activity duration as percent of couple's total; includes commute and business trips	0.50	0.35	0	1
…household work * female	0.30	0.34	0	1
…employed work * female	0.17	0.28	0	1
Age difference (years, respondent minus partner)	0.01	5.30	-38	38
Age difference (years, respondent minus partner) * female	-1.52	3.39	-38	24
Number of children in household (< 10 yrs)	0.50	0.83	0	4
Number of children in household (10-13 yrs)	0.19	0.47	0	3
Number of children in household (14-17 yrs)	0.19	0.44	0	2
Number of children in household (< 10 yrs) * female	0.25	0.64	0	4
Number of children in household (10-13 yrs) * female	0.10	0.34	0	3
Number of children in household (14-17 yrs) * female	0.10	0.33	0	2
Relative activity and trip patterns: Difference in... (for each variable: respondent minus partner)				
...number of trips	0.00	1.71	-7.3	7.3
...distance to work / education (mean of job/education trips)	0.10	25.96	-160	160
...entropy in activity pattern (Shannon)*	0.00	0.37	-1.5	1.5
...time spent out-of-home (minutes)	2.70	1,464	-10,080	10,080
...number of trips per trip chain (mean of trip chains)	0.00	0.81	-10.3	10.3
...number of trips * female	0.05	1.20	-7.3	7.0
...distance to work / education * female	-3.93	17.85	-160	100
...entropy * female	0.02	0.26	-1.5	1.4
...time spent out-of-home * female	-78.20	1,029	-10,080	8,705
...number of trips per trip chain * female	-0.03	0.57	-10.3	7.6
Variety of facilities in neighbourhood that are accessible on foot (number of 'yes'-counts of groceries, other shops, restaurants/ pubs, leisure facilities, sports facilities; Cronbach's α=0.73)	3.25	1.36	0	5
Year of observation (first year=0)	6.97	3.91	0	14
Year of observation (first year=0) * female	3.47	4.45	0	14

Table 1: Continuous variables used in regression: definitions and descriptive statistics

All activity and trip records refer to one week of report.
* The Shannon entropy is a measure of qualitative variance. It is defined as $-\sum (p_i * \log_2(p_i))$ (Coulter, 1989). In our case the p_i are the shares of time spent for an activity plus associated trips in the week of report. Six activity classes are available for analysis plus 'housing', which remains unconsidered here.

We start with some descriptive gender comparisons. For regression analysis we use household and individual sociodemographics, spatial context, individual activity and trip measures as explanatory variables. Table 1 and Table 2 give an overview of the variables used plus their definitions and descriptive statistics. As we assume car access to be subject to intra-household negotiation, we use relative measures for as many variables as possible, i.e. relative dominance of one partner over the other in terms of education, employment, housework, quality of the PT connection to the workplace and so on. We also add level variables for the household, e.g. household education level is represented by the highest school level qualification achieved by one of two partners.

	Per cent 'yes'
Gender female	0.50
Relative education level; constructed out of five categories: (1) no qualification; (2) elementary school qualification without apprenticeship; (3) elementary school qualification plus apprenticeship; (4) secondary school qualification level I; (5) final secondary school qualification (university entrace)	
Respondent dominates strongly: respondent's qualification is at least two categories higher than his/her partner's, and respondent achieved at least category 4	0.05
Respondent dominates somewhat: respondent's qualification is one category higher than his/her partner's, or respondent achieved no more than category 3	0.20
Partner dominates strongly: see above	0.05
Partner dominates somewhat: see above	0.20
Respondent dominates strongly * female	0.01
Respondent dominates somewhat * female	0.08
Partner dominates strongly * female	0.03
Partner dominates somewhat * female	0.11
Education level of household. At least one partner has…	
…secondary school level I	0.34
…final secondary school qualification (university entrace) or university degree	0.45
Large car deficiency in household (2+ cars too few)	0.08
Large car deficiency * female	0.04
Municipality with 20,000-100,000 inh.	0.28
Municipality with 100,000-500,000 inh.	0.16
Municipality with > 500,000 inh.	0.13
Central residential location within city (self-report)	0.15
Large variety of PT systems in neighbourhood: 3+ out of five different systems (bus, tram, tube, regional train, long-distance train) are accessible on foot	0.48
Requirement of car use for commute, depending on PT connection to both partners' places of work or education ('PT good' means that the respondent reports a fast direct connection; 'PT poor' means that there is a slow direct connection, a connection where (s)he has to change, or no PT connection at all)	
Neither partner needs car (PT good or person not employed/in education)	0.17
Partner needs car (PT poor), while respondent does not (PT good or respondent not employed)	0.21
Respondent needs car (PT poor), while partner does not (PT good or partner not employed)	0.21
Neither partner needs car * female	0.08
Partner needs car, while respondent does not * female	0.15
Respondent needs car, while partner does not * female	0.06
n	3,230

Table 2: Dummy variables used in regression: definitions and descriptive statistics

All variables are coded as yes=1, no=0. Reference categories are listed in regression table.

Gender is represented in our framework in terms of a binary variable plus two variables measuring the respondent's share in both partners' total out-of-home household work and his/her share in total out-of-home employed work. Simultaneously including the latter plus employment status results in excessive variance inflation due to multicollinearity. We thus exclude employment status. Effects of the household work and employed work variables reflect a respondent's social roles, but as employed work is strongly correlated with personal income (about which we have no information), employed work should also to a certain extent reflect effects of economic power. Effects of the binary gender variable should therefore support hypotheses other than social roles or economic power, i.e. either preferences or patriarchal power, which we cannot separate from each other with our data.

As we are interested in gender specific effects, we also include interaction terms with gender. As an outcome of patriarchal power hierarchies we expect that factors which improve a respondent's chances of getting car access are less effective for women than for men, while factors which decrease car access should be more effective for women. Due to the use of interaction terms, the interpretation of coefficients is not straightforward. Main effects in our models should be interpreted as effects for men, while interaction terms with gender should be interpreted as effects for women as compared to men (Aiken and West, 1991).

There is also strong multicollinearity between gender and other starkly gendered variables, particularly the variable 'interaction between gender and respondent's share in household work'. As this interaction effect was not significant in any model, we tentatively excluded it from the models. The result was that all variance inflation factors (VIF) fell below the usual threshold of acceptance (VIF<10, Schendera, 2008, p. 105), while all coefficients and significance levels were robust. Again this supports the reliability of our findings. For theoretical reasons we report the full models with all interaction terms, whether significant or not.

4 Results

4.1 Descriptive analysis

We start with some descriptive analysis for adults living in couples or families.

Men have larger values than women for duration of car use in virtually all sub-groups (Table 3). The gender differences are minor in households without a car, in which car use is low for both men and women. In car deficient households car use as a driver (whether including or excluding activity duration) is more than twice as strong for men than for women. The difference is smaller, albeit still considerable, when car use as a passenger is taken into account, reflecting the increased prevalence of passenger car use among women.

It is of essential importance for the interpretation that car use is markedly higher among men than women even in households without a car deficiency, although the gender differences are somewhat smaller in these households. Lower levels of car use among women thus appear to have to do with activity patterns, trip durations and/or mode choice, rather than just resulting from limited access.

Another observation worth mentioning is that car use is stronger among men than women even for individuals without a licence. Even more striking is that this is even true when the analysis is limited to trips made as a driver. This suggests that effects of false reporting are at play here. Men may tend to report having made trips as a driver even when they are not licenced. Social status effects possibly play a role in this respect. Obviously, false reporting of licence holding may also be relevant.

Results for self-reported car availability partly confirm and partly differ from those for duration of car use. Gender differences in non-car households are again minor. In these households only few people report having a car regularly available. However, no less than a quarter of licenced respondents in non-car households report having car access regularly or according to agreement.

In car deficient households, car access among licenced men is clearly higher than among licenced women. This clearly supports anecdotal evidence that men are first in line for the household car.

In households without car deficiency there is no relevant gender difference among licence holders. This supports the notion that the strong gender difference in car use duration that we found in these households is not a matter of limited car access but rather of patterns of usage – 'behaviour' rather than 'opportunities'.

	Adults without licence			Licenced adults		
	M	W	all	M	W	all
Household has...	Car use as driver (trips plus activities)					
...no car at all	142	103	119	202	183	195
...less cars than drivers				1,662	701	1,207*
...as many cars as drivers (or more)	957	109	250*	2,383	1,554	2,039*
Total	402	104	187*	1,964	1,051	1,558*
	Car use as driver or passenger (trips plus activities)					
...no car at all	286	242	260	451	438	446
...less cars than drivers				1,917	1,301	1,625*
...as many cars as drivers (or more)	1,501	830	942*	2,590	1,996	2,344*
Total	673	612	629	2,195	1,576	1,920*
	Car use as driver (trips only)					
...no car at all	22	12	17	41	16	32*
...less cars than drivers				307	132	224*
...as many cars as drivers (or more)	196	23	52*	423	270	360*
Total	78	19	35*	355	188	281*
	Car use as driver or passenger (trips only)					
...no car at all	45	44	45	74	76	75
...less cars than drivers				356	274	317*
...as many cars as drivers (or more)	299	216	230*	464	378	428*
Total	126	153	145	399	314	361*
	n (including repeat observations)					
...no car at all	168	210	378	116	80	196
...less cars than drivers	1	31	32	2,884	2,864	5,748
...as many cars as drivers (or more)	143	796	939	2,954	2,325	5,279
Total	312	1,037	1,349	5,954	5,269	11,223

Table 3: Duration of car use (minutes in report week, means) by gender, licence status and household car ownership

M: men. W: women. Empty cells are due to the small sample.
* gender difference significant (p=0.05)

Similar to duration of car use, car availability is higher among men than women for non-licenced adults. The gender difference is significant here in the subgroup of households without car deficiency despite the small sample. Again this may reflect some kind of psychology of social status – men may be less inclined than women to admit that they do not have access to a car.

4.2 Regression analysis

We turn our attention to regression models, seeking to disentangle the factors that impact car availability in car deficient households (Table 5). As noted above, there is no exact measure of model fit for cluster robust regression. The R^2 values from our OLS models suggest relatively good performance for individual level duration models, ranging from 16.0 percent (Model 4) to 30.1 percent (Model 1).

We also estimated models using self-reported 'normality' of the week of report ('was more or less as always') as a filter variable. These models support the findings reported here; no significant effects change their signs. Interestingly, however, some effects tend to increase in magnitude. Thus, the adjusted R^2 values from OLS models slightly increase, ranging between 18.0 (trip

duration as driver or passenger) and 30.5 percent (trip plus activity duration as driver). This seems to suggest that limiting the analysis to 'normal' daily life increases social difference, while 'non-normality' tends to blur clearly defined social roles and fixed arrangements.

	Adults without licence			Licenced adults		
Car availability	M	W	all	M	W	all
	Household owns no car					
Yes, regularly	0.0	3.2	1.5	5.0	7.8	6.1
Upon agreement	3.4	2.9	3.1	18.2	19.4	18.7
No	96.6	94.0	95.4	76.8	72.8	75.2
n (unweighted)	34	38	72	98	72	170
	Household owns less cars than drivers					
Yes, regularly				72.0	58.3	65.5
Upon agreement				24.0	34.6	29.0
No				4.0	7.1	5.4
n (unweighted)	0	7	7	2,772	2,701	5,473*
	Household owns as many cars as drivers (or more)					
Yes, regularly	61.7	32.3	40.5	94.3	93.9	94.2
Upon agreement	2.9	12.0	9.5	2.9	3.3	3.0
No	35.4	55.7	50.0	2.8	2.8	2.8
n (unweighted)	58	167	225*	2,853	2,278	5,131

Table 4: Self-reported car availability by gender, licence status and household car ownership

Sample size refers to individuals including repeat observations. M: men. W: women. Empty cells are due to the small sample.
* gender difference in car availability significant (p=0.05)

Turning to the coefficient estimates, there are no cases of significant effects with signs differing between the models. However, there are many instances of effects being significant in one model, but not in another one. A number of key findings may be highlighted.

1. Relative education level: We expect educational dominance over the partner to be associated with increased chances of getting access to the car. However, having a partner who strongly dominates in educational achievement results in *increased* access to the car for men, but *reduced* access for women (Model 1). One could rapidly assign this finding to patriarchy, but male respondents who dominate somewhat in educational terms also appear to have reduced car access (Model 2), while their female counterparts may have increased car access (Model 2, although the effect just fails to reach significance). As the effects of relative education level overall do not provide a clear picture, we suspect that education level represents a mixture of economic power plus green attitudes, as green voting is correlated closely with high levels of education (Forschungsgruppe Wahlen, 2011), this may lead to inconclusive results.

2. The household educational level is positively correlated with duration of car use, but only as far as trip duration is concerned (Models 3+4).

3. Age difference is negative for men, indicating that elder male partners tend to use the car less. For women it is the other way round (significant in Models 2+4), suggesting that elder female partners tend to use the car more. Thus, 'authority by age' seems to be at work for women.

4. Spatial effects are in the expected direction. Municipality size categories suggest less car use in towns and cities compared to villages. On the more finely grained level of neighbourhood structure, the only significant variable is the number of different facilities accessible on foot from the residence (all models). Each additional type of facility reduces the duration of car use as a driver by 45 minutes on average (trips plus activities, Model 1) or 11 minutes (just trips, Model 3), respectively.

	Duration of car use (trips and activities)				Duration of car use (trips)			
	as driver (model 1)		as driver or passenger (model 2)		as driver (model 3)		as driver or passenger (model 4)	
	B	Sig.	B	Sig.	B	Sig.	B	Sig.
Intercept	1,464.6	0.00	2,037.3	0.00	319.5	0.00	451.7	0.00
Gender roles								
Gender (female=1)	-811.8	0.00	-614.7	0.00	-196.2	0.00	-166.7	0.00
Respondent's share in household work	417.4	0.02	167.4	0.32	106.5	0.00	47.0	0.16
Respondent's share in employed work	1,343.0	0.00	1,304.3	0.00	50.8	0.07	-14.3	0.65
Respondent's share in household work * female	-56.2	0.79	244.5	0.25	-41.9	0.27	13.5	0.75
Respondent's share in employed work * female	-438.1	0.03	-184.6	0.38	32.2	0.47	101.9	0.03
Age difference (respondent minus partner)	-20.7	0.01	-25.1	0.00	-2.6	0.06	-3.1	0.03
Age difference * female	14.0	0.20	28.6	0.01	3.0	0.11	4.9	0.01
Number of children in household (< 10 yrs)	-223.6	0.00	-230.8	0.00	-35.8	0.00	-37.5	0.00
Number of children in household (10-13 yrs)	12.0	0.88	47.4	0.57	-19.1	0.11	-10.2	0.45
Number of children in household (14-17 yrs)	168.5	0.05	268.2	0.00	1.8	0.89	15.4	0.25
Number of children (< 10 yrs) * female	259.9	0.00	142.3	0.02	61.0	0.00	32.5	0.06
Number of children (10-13 yrs) * female	11.3	0.90	-144.3	0.13	43.4	0.01	3.4	0.85
Number of children (14-17 yrs) * female	0.8	0.99	-144.7	0.20	28.5	0.08	-5.4	0.76
Relative education level (reference: both partners have same level)								
Respondent dominates strongly	110.6	0.46	47.2	0.74	-25.4	0.30	-39.9	0.10
Respondent dominates somewhat	-193.3	0.03	-290.6	0.00	-18.6	0.27	-30.6	0.09
Partner dominates strongly	453.6	0.03	383.4	0.09	57.9	0.25	39.3	0.43
Partner dominates somewhat	-112.4	0.28	-172.2	0.10	-28.5	0.09	-38.8	0.03
Respondent dominates strongly * female	-209.7	0.33	-259.2	0.22	-17.4	0.64	-5.9	0.87
Respondent dominates somewhat * female	195.3	0.09	210.6	0.07	5.4	0.80	1.2	0.96
Partner dominates strongly * female	-542.0	0.01	-485.9	0.05	-86.0	0.10	-81.2	0.12
Partner dominates somewhat * female	134.7	0.27	135.7	0.28	27.7	0.21	35.9	0.13
Education level of household (reference: both partners elementary school or no qualification)								
At least one partner has...								
...secondary school level I	1.1	0.99	25.4	0.71	10.7	0.33	17.4	0.14
...final secondary school qualification (university entrace) or university degree	-29.1	0.68	8.8	0.90	29.8	0.01	44.9	0.00
Car deficiency (ref.: one car too few)								
Large deficiency (two or more cars too few)	17.6	0.90	-42.7	0.76	31.9	0.30	39.0	0.22
Large deficiency * female	152.9	0.36	220.8	0.20	-1.8	0.96	-12.6	0.73
Municipality size category (ref.: < 20,000 inh)								
20,000-100,000 inh	-123.3	0.04	-158.1	0.01	-17.2	0.10	-22.9	0.05
100,000-500,000 inh	-33.5	0.63	-53.4	0.47	-6.6	0.61	-14.9	0.28
> 500,000 inh	-196.1	0.01	-260.1	0.00	-20.7	0.14	-27.0	0.09
Central residential location within city	-62.1	0.33	-49.6	0.46	-11.4	0.31	-7.2	0.57
Large variety of PT systems in neighbourhood (3+ different systems) (yes=1)	-46.4	0.30	-35.3	0.45	-12.6	0.12	-11.1	0.22
Variety of facilities in neighbourhood	-44.9	0.00	-63.1	0.00	-11.4	0.00	-13.6	0.00

Table 5: Regression models of car availability (part 1)

* excluding multiple observations of the same individuals

PT system quality to place of work or education; ref.: both partners need car (poor PT connection)								
Neither partner needs car	-472.6	0.00	-508.2	0.00	-54.7	0.00	-59.9	0.00
Partner needs car, while respondent does not	-382.2	0.00	-367.9	0.00	-19.0	0.36	-20.0	0.36
Respondent needs car, while partner does not	7.3	0.93	-67.0	0.47	4.4	0.78	-4.2	0.80
Neither partner needs car * female	262.2	0.04	163.9	0.22	16.6	0.39	17.7	0.44
Partner needs car, while respondent does not * female	56.3	0.66	-37.6	0.77	-22.5	0.34	-9.9	0.70
Respondent needs car, while partner does not * female	-53.2	0.66	-65.5	0.62	-16.3	0.44	-10.5	0.66
Activity and trip patterns (for each variable: respondent minus partner). Difference in...								
...number of trips per week	20.4	0.43	2.9	0.91	16.7	0.00	15.3	0.00
...distance to work / education	-1.0	0.62	0.0	0.99	1.1	0.00	1.7	0.00
...entropy	108.8	0.27	148.4	0.13	93.3	0.00	116.9	0.00
...time spent out-of-home	0.0	0.72	0.0	0.88	0.0	0.31	0.0	0.74
...number of trips per trip chain	87.3	0.28	121.5	0.14	28.1	0.00	35.8	0.00
...number of trips per week * female	79.8	0.01	62.6	0.04	7.3	0.16	6.0	0.27
...distance to work / education * female	0.5	0.84	-2.0	0.42	-0.5	0.24	-1.0	0.04
...entropy * female	-204.2	0.09	-403.8	0.00	-88.7	0.00	-136.4	0.00
...time spent out-of-home * female	0.0	0.36	0.1	0.05	0.0	0.25	0.0	0.06
...number of trips per trip chain * female	-73.7	0.40	-99.9	0.28	-30.2	0.01	-39.9	0.00
Year of observation (base year=0)	11.0	0.24	2.9	0.77	0.8	0.65	-0.7	0.69
Year of observation * female	-2.5	0.83	2.5	0.84	0.6	0.79	1.5	0.54
(Scale) (div. by 10^3)	1,258.6		1,369.5		39.9		48.1	
QICC adj. (div. by 10^6)	4,002		4,355		127		153	
QICC adj. (div. by 10^6), intercept model	5,833		5,869		175		185	
R^2 adj. (OLS regression)*	30.1		25.0		25.3		16.0	
n (observations)	3,230		3,230		3,230		3,230	
n (individuals)	1,969		1,969		1,969		1,969	

Table 5: Regression models of car availability (part 2)

* excluding multiple observations of the same individuals

5. The quality of the PT connection to the place of work or education points towards gendered intra-household negotiations. When a respondent's partner needs the car, while the respondent does not, this reduces the respondent's car use (Models 1+4). When neither of two partners need the car for commuting, this strongly decreases car use (all models) – but less so for women (significant interaction term in Model 1). Apparently, access to workplaces serves as an argument for negotiating car access. The positive interaction term for women when neither of two partners need the car means that in these negotiations women seem to have more rather than less power than men, at least when it comes to commuting[3].

6. Most trip and activity pattern characteristics play a relatively minor role in models of trip plus activity duration (Models 1+2), but gain importance when trip duration is studied (Models 3+4). Three issues may be highlighted here.

[3] These PT effects may also explain why not all municipality size categories are significant. To some extent the 'large city' effect is hidden in these PT effects that better capture small-scale differences than city size category does. When PT and neighbourhood facilities are excluded, municipality size categories become significant in many more cases.

First, making more trips than one's partner increases car use significantly for men and women likewise.

Second, a relatively long commute trip increases car use. When all car trips are studied regardless of being driver or passenger (Model 4) there is a negative interaction with gender, i.e. the positive effect of commute distance on car use is weaker for women than for men, suggesting men have a relatively strong bargaining position.

Third, both entropy in activity patterns and trip chain complexity increase car use for men, but not for women, again suggesting that men have a better bargaining position. This finding suggests at least two competing interpretations. Either men with complex activity/trip patterns use these patterns for negotiating access to the car, while women do not. Or else some men tend to take on more responsibilities that result in complex patterns, just because they have the car readily available anyway for other reasons. We are not able here to disentangle causality, but mean trip distances for women are considerably shorter than for men particularly among individuals with extremely high entropy (9.4 km as opposed to 17.5 km). Thus, these women seem to have relatively limited activity spaces while their male partners make long trips and thus need the car, but may only be able to get it by taking on certain responsibilities that result in entropy and complex trip chains. This observation supports the notion that men's complex patterns are an outcome of negotiating responsibilities as a consequence (rather than a cause) of having the car anyway.

7. Having small children in the family decreases men's car use, but not women's (Models 1-4). Again this may reflect some kind of bargaining in which two partners agree that the car should be available for the mother as long as the youngest child is relatively small.

8. A number of key gender issues have to be discussed.

First, doing household work increases a person's chances of getting the car (Models 1+3), lending support to the social roles hypothesis.

Second, taking on the breadwinning role of employed work increases a person's chances of accessing the car much more, as long as activity duration is considered (Models 1+2). The observation that the impact of employed work is stronger than the impact of housework reflects the additional role of economic power over and above social roles.

Third, there is a significant negative interaction effect for employed work in Model 1. This means that contributing to breadwinning increases men's chances of getting the car more than women's, which would support the notion of patriarchy, were it not for two other observations that point in the opposite direction. The first is that in Models 3 and 4 the interaction effects are positive, rather than negative, and one is even significant (Model 4). Accordingly, contributing to breadwinning increases women's chances of accessing the car more than men's. The second observation is that although in Model 2 household work has no significant effect, separate models for men and women show that contributing to household work significantly increases the chances of accessing the car for women, but not for men.

Fourth, gender per se ('sex') is strongly significant. Keeping all other control variables including social roles and economic power constant still results in women using the household car as a driver some 812 minutes per week less than men (Model 1). This figure well reflects the descriptive analysis, in which the gender difference was 962 minutes. The same is true for Models 2 to 4. In Model 4 the 'sex' difference is even stronger (167 minutes) than in the descriptive analysis (82 minutes). The effects are somewhat weaker in the combined driver or passenger models, and stronger in the driver models, again supporting the descriptive results. What would this 'sex' difference be about? Social role effects and economic power effects should (albeit perhaps

crudely) be covered by worksharing arrangements. Referring to personal capabilities would obviously be misleading, as all individuals under study have a licence. We can nevertheless not completely rule out the idea that some sort of 'sex' effect may be behind this. Men may feel more attached to the car, they may just 'love' the car (or the driving, or the technology) more than women. This interpretation would support some kind of preference notion. A second, perhaps more obvious interpretation would be patriarchy – some deeply rooted gender norms that go beyond social roles and economic power, fuelling a strongly significant gender difference in all models presented.

9. Last, but not least, the year of observation has no notable effect, suggesting that there is little change over the study period with respect to the issue under study.

5 Conclusions and outlook

5.1 Summary of findings

Guided by some key hypotheses on gender relations, this paper has empirically studied individual car access in households with fewer cars than drivers. Measuring car access in terms of duration of car use over a week, we found evidence for:

- the social role hypothesis: bearing responsibility for household work increases an individual's chances of getting access to the car, being responsible for bringing home the bacon does likewise, supporting Wen and Koppelman (2000). The observation that the presence of small children in the household increases women's, but decreases men's car access is also likely to reflect traditional social roles;
- the access to resources hypothesis: being responsible for employed (marketed) work has a stronger effect on car access than being responsible for household (non-marketed) work. This suggests that economic power plays a key role over and above social roles;
- the patriarchy hypothesis: being responsible for employed (marketed) work has a much stronger effect on car access as a driver for men than for women. This observation suggests that patriarchal power relations play a key role over and above social roles and economic power. However, there is also evidence for women having a better negotiating position than men, i.e. for some kind of 'matriarchal power', e.g. when neither of two partners need the car for commuting women seem to have more rather than less power than men;
- an inconclusive 'there is even more behind this' hypothesis: the strong effect of 'sex' on car use while controlling simultaneously (albeit perhaps crudely) for social roles and economic resources, means that there must be additional underlying gender difference. We suggest that deeply rooted gender norms are at play. Unfortunately we cannot decipher whether these norms once more reflect patriarchal power, or deliberate preference, or a mixture of both. We suspect that preferences play an important role, given that Germany has achieved a relatively high level of gender equity, and given the stark gender differences in car use that we found even in fully equipped households owning at least as many cars as drivers. In any case, this issue of 'more behind this' remains unsatisfactory.

As well as commitment to household and/or employed work, the effects of trip and activity patterns found suggest that daily requirements are relevant in negotiations about car access. These patterns are themselves closely linked to housework and employed work responsibilities, but only to a limited extent. For instance, the correlation between a respondent's share in household work and entropy is r=0.24, the correlation between a respondent's share in household work and trip chain complexity (number of trips per trip chain) is a mere r=0.01. This means that

intra-household negotiation is also fuelled by individuals' 'been there and done that' over and above the worn-out trails of household responsibilities and economic power.

5.2 Reflections – one step beyond

Beside the findings presented, this study has a number of notable shortcomings. However, rather than a detailed discussion of limitations, we would like to take this opportunity to extend our empirical framework, starting with the key limitation. Clearly, the most unsatisfactory outcome of our study is the inconclusive 'there is even more behind this' effect of 'sex'. To better disentangle gender relations would require better data in at least three respects.

First, we have overwhelming evidence from the literature that women's daily lives are more complex than men's (for Germany see Statistisches Bundesamt, 2004). The interpretation of this observation is typically based on women's responsibility for a multitude of tasks, while men 'just go to work and return home'. However, in empirical studies (no matter whether based on trip diaries or activity/time budget diaries) employed work is mostly treated as a black box. That is to say, we do not know about complexity within employed work.

Second, in the data typically used in transport studies we rarely have information on personal income. This means that intra-household economic structure is a black box, poorly reflected in variables such as a respondent's share in a couple's total employed work, which we used in our study.

Third, there is a lack of information on gendered attitudes, norms, or preferences that could help improve our understanding of the rationales underlying behaviour.

However, we believe that even with the best control variables practically imaginable, we would still face the problem of 'what's behind'. Even if we had control items covering, say, gender norms, we would still be unsure whether these norms reflected some kind of short-term preference (i.e. freedom of choice) or certain deeply rooted power relations. People are only able to connect their own attitudes to causes to a certain extent, and we suspect that, if asked, they overstate the amount of freedom and self-determination in their attitudes. Ultimately, we have only very limited scientific tools with which to understand the emergence of differences in gender specific behaviour, because we have little access to the mechanisms and rationales of action. More in-depth qualitative studies focussing on gendered negotiations, taking into account each of the two partners, could help here. Gender/travel studies are to a certain extent caught in the trails of feminist perspectives that generally interpret their findings from a notion of women's weakness, whatever the findings may look like. Other interpretations are practically non-existent, although gender studies have claimed a relational rather than a women's perspective for a long time (see Law, 1999 for transport studies).

Thus, in future research the main question should not be whether and how the travel behaviour of men and women is different or similar. The focus should be on the emergence of such differences or similarities. In this respect, it is of particular importance to ask the extent to which unequal power relations are at play here, or whether rather preference or agreement as an outcome of negotiations between two equal partners is evident. In the case of the latter, a further question would be whether such agreement is based on conflicting or shared interest, e.g. in terms of optimisation of worksharing arrangements in the household. Only in the former case of unequal power relations would there be reason to blame a deficit in sustainability in terms of social inequity. Preference or agreement between two equal partners would instead point towards the liberation of both genders being reality, no matter whether women's and men's observed behaviour is similar or different.

Acknowledgement: This research was funded by the German Research Foundation (DFG) as part of the project 'Alltag im Wandel des Geschlechterverhältnisses: Aktivitäten, Wege, Verkehrsmittel und Zeitverwendung' (Everyday life in the context of changing gender relations: activities, trips, travel modes and time use, 2009-2011).

6 Literature

Aiken, Leona S., West, Stephen G., 1991. Multiple Regression: Testing and Interpreting Interactions. Sage, Newbury Park.

Anggraini, R., Arentze, T.A., Timmermans, H.J.P., 2008. Car allocation between household heads in car deficient households: a decision model. European Journal of Transport and Infrastructure Research 8(4), 301-319.

Bagley, M.N., Mokhtarian, P.L., 2002. The impact of residential neighborhood type on travel behavior: a structural equations modeling approach. Annals of Regional Science 36(2), 279-297.

Bauer, F., Groß, H., Oliver, G., Sieglen, G., Smith, M., 2007. Time Use and Work-Life Balance in Germany and the UK. Anglo-German Foundation for the Study of Industrial Society, London.

Baxter, J., 1997. Gender equality and participation in housework: a cross-national perspective. Journal of Comparative Family Studies 28(3), 220-247.

Becker, G.S., 1981. A Treatise on the Family. Harvard University Press, Cambridge.

Bergstad, C.J., Gamble, A., Hagman, O., Polk, M., Gärling, T., Olsson, L.E. 2011. Affective-symbolic and instrumental-independence psychological motives mediating effects of socio-demographic variables on daily car use. Journal of Transport Geography 19(1), 33-38.

Best, H., Lanzendorf, M., 2005. Division of labour and gender differences in metropolitan car use: an empirical study in Cologne, Germany. Journal of Transport Geography 13(2), 109-121.

Bhat, C.R., Guo, J.Y., 2006. A comprehensive analysis of built environment characteristics on household residential choice and auto ownership levels. Transportation Research B 41(5), 506-526.

Blumen, O., 1994. Gender differences in the journey to work. Urban Geography 15(3), 223-245.

Bolt, V.J., Bird, K., 2003. The Intrahousehold Disadvantages Framework: A Framework for the Analysis of Intra-household Difference and Inequality. CPRC Working Paper No 32. Chronic Poverty Research Centre, Manchester.

Brennecke, J., 1994. Alltagsmobilität Wiesbadener Frauen. In: Bracher, T. et al. (Eds.), Handbuch der kommunalen Verkehrsplanung. Kap. 2.2.1.3. Wichmann, Heidelberg.

Buliung, R.N., 2005. Activity/Travel Behaviour Research: Approaches and Findings with Identification of Research Themes and Emerging Methods. Working Paper Series, CSpA WP 008. Centre for Spatial Analysis, Hamilton.

Camstra, R., 1996. Commuting and gender in a lifestyle perspective. Urban Studies 33(2), 283-300.

Cao, X., Mokhtarian, P.L., Handy, S.L., 2007. Cross-sectional and quasi-panel explorations of the connection between the built environment and auto ownership. Environment and Planning A 39(4), 830-847.

Chlond, B., Kuhnimhof, T., 2005. Panelhandbuch. Das Deutsche Mobilitätspanel: Informationen sowie Anleitung und Anregungen zur Datennutzung. Universität, Karlsruhe.

Choo, S., Mokhtarian, P.L., 2002. The Relationship of Vehicle Type Choice to Personality, Lifestyle, Attitudinal, and Demographic Variables. Report for the DaimlerChrysler Corporation. Davis, CA.

Clark, W.A.V., Wang, W.W., 2005. Job access and commute penalties: balancing work and residence in Los Angeles. Urban Geography 26(7), 610-626.

Coulter, P.B., 1989. Measuring Inequality. A Methodological Handbook. Westview Press, Boulder.

Crane, R., 2007. Is there a quiet revolution in women's travel? Revisiting the gender gap in commuting. Journal of the American Planning Association 73(3), 298-316.

Dargay, J., Hanly, M., 2007. Volatility of car ownership, commuting mode and time in the UK. Transportation Research A 41(10), 934-948.

Dargay, J.M., 2002. Determinants of car ownership in rural and urban areas: a pseudo-panel analysis. Transportation Research E 38, 351-366.

Ettema, D., Van der Lippe, T., 2009. Weekly rhythms in task and time allocation of households. Transportation 36(2), 113-129.

Forschungsgruppe Wahlen, 2011. Wahlanalyse Rheinland-Pfalz. (http://www.forschungsgruppe wahlen.de/Aktuelles/Wahl_Rheinland-Pfalz/, 14.4.2011)

Garson, G.D., 2010. Generalized Linear Models and Generalized Estimating Equations. (http://faculty.chass.ncsu.edu/garson/PA765/gzlm_gee.htm, 31.03.2011)

Giuliano, G., 1983. Getting there: Women and transportation. In: Zimmermann, J. (Ed.), The Technological Woman. Interfacing with Tomorrow. Praeger, New York, pp. 102-112.

Golob, T.F., Kim, S., Ren, W., 1996. How households use different types of vehicles: a structural driver allocation and usage model. Transportation Research A 30(2), 103-118.

Golob, T.F., McNally, M.G. 1997. A model of activity participation and travel interactions between household heads. Transportation Research B 31(3), 177-194.

Gordon, P., Kumar, A., Richard, H.W. 1989. Gender differences in metropolitan travel behavior. Regional Studies 23(6), 499-510.

Hakim, C., 2000. Work-Lifestyle Choices in the 21st Century: Preference Theory. Oxford University Press, Oxford.

Hanson, S., Johnston, I., 1985. Gender differences in work-trip length: explanations and implications. Urban Geography 6(3), 193-219.

Hartmann, H., 1979. Capitalism, patriarchy, and job segregation by sex. In: Eisenstein, Z.R. (Ed.), Capitalist Patriarchy. Monthly Review Press, New York, pp. 206-247.

Hedeker, D., Gibbons, R.D., Flay, B.R., 1994. Random-effects regression models for clustered data with an example from smoking prevention research. Journal of Consulting and Clinical Psychology 62(4), 757-765.

Heine, H., Mautz, R., 2001. Möglichkeiten und Grenzen des Autoverzichts. Die Wahl des Verkehrsmittels angesichts der Mobilitätszwänge und normativen Ansprüche der heutigen familiären Lebensweise. Soziologisches Forschungsinstitut, Göttingen.

Hjorthol, R., 2008. Daily mobility of men and women – a barometer of gender equality? In: Uteng, T.P., Cresswell, T., 2008. Gendered Mobilities. Ashgate, Aldershot, pp. 193-210.

Holz-Rau, H.-C., 1990. Bestimmungsgrößen des Verkehrsverhaltens. Technische Universität, Berlin.

Kato, H., Matsumoto, M., 2009. Intra-household interaction in a nuclear family: a utility-maximizing approach. Transportation Research B 43(2), 191-203.

Katz, E., 1997. The intra-household economics of voice and exit. Feminist Economics 3(3), 25-46.

Kézdi, G., 2004. Robust standard error estimation in fixed-effects panel models. In: Hungarian Statistical Review, Special, 9, 96-116.

Law, R., 1999. Beyond 'women and transport': towards new geographies of gender and daily mobility. Progress in Human Geography 23(4), 567-588.

Lerman, S.T., Ben-Akiva, M., 1976. Disaggregate behavioural model of automobile ownership. Transportation Research Record 569, 34-51.

Mannering, F., Winston, C., 1985. A dynamic empirical analysis of household vehicle ownership and utilization. Rand Journal of Economics 16(2), 215-236.

Manski, C.F., Sherman, L., 1980. An empirical analysis of household choice among motor vehicles. Transportation Research A 14(5-6), 349-366.

Matthies, E., Kuhn, S., Klöckner, C.A., 2002. Travel mode choice of women: the result of limitation, ecological norm or weak habit? Environment and Behavior 34(2), 163-177.

Mincer, J., 1978. Family migration decisions. Journal of Political Economy 86(5), 749-773.

Mohammadian, A., 2005. Gender differences in automobile choice behavior. In: Transportation Research Board (Ed.), Research on Women's Issues in Transportation Vol. 2: Technical Papers. Transportation Research Board Conference Proceedings 35. National Research Council, Washington, D.C., pp. 41-48.

Nichols, A., Schaffer, M., 2007. Clustered Errors in Stata (www.docstoc.com, 18.01.2011)

Noble, B., 2005. Women’s travel: can the circle be squared? In: Transportation Research Board (Ed.), Research on Women's Issues in Transportation Vol. 2: Technical Papers. Transportation Research Board Conference Proceedings 35. National Research Council, Washington, D.C., pp. 196-209.

Özkan, T., Lajunen, T., 2006. What causes the differences in driving between young men and women? The effects of gender roles and sex on young drivers’ driving behaviour and self-assessment of skills. Transportation Research F 9, 269-277.

Petersen, E., Vovsha, P., 2005. A framework for a joint mode choice-household car allocation model. Paper presented at the European Transport Conference, Strasbourg, 3-5 October 2005.

Petersen, E., Vovsha, P., 2006. Intrahousehold car-type choice for different travel needs. Transportation Research Record 1985, 207-219.

Pickup, L., 1984. Women's gender-role and its influence on travel behavior. Built Environment 10(1), 61-68.

Polk, M., 2004. The influence of gender on daily car use and on willingness to reduce car use in Sweden. Journal of Transport Geography 12(3), 185-195.

Potoglou, D., Kanaroglou, P.S., 2008. Modelling car ownership in urban areas: a case study of Hamilton, Canada. Journal of Transport Geography 16(1), 42-54.

Rogers, W.H., 1993. Sg17: Regression standard errors in clustered samples. Stata Technical Bulletin 13, 19-23.

Roorda, M.J., Carrasco, J.A., Miller, E.J., 2009. An integrated model of vehicle transactions, activity scheduling and mode choice. Transportation Research B 43(2), 217-229.

Roorda, M.J., Mohammadian, A., Miller, E.J., 2000. Toronto area car ownership study: a retrospective interview and its applications. Transportation Research Record 1719, 69-76.

Salomon, I., Ben-Akiva, M., 1983. The use of the life-style concept in travel demand models. Environment and Planning A 15(5), 623-638.

Schad, H., Funke, C., Rommerskirchen, S., Vödisch, M., 2001. Konstanz und Variabilität des Mobilitätsverhaltens im Wochenverlauf. Prognos, Basel.

Scheiner, J., 2006. Does individualisation of travel behaviour exist? Determinants and determination of travel participation and mode choice in West Germany, 1976-2002. Die Erde 137(4), 355-377.

Scheiner, J., 2009. Objective and subjective socio-spatial inequalities in activity patterns. Swiss Journal of Sociology 35(3), 525-549.

Scheiner, J., 2010. Social inequalities in travel behaviour: trip distances in the context of residential self-selection and lifestyles. Journal of Transport Geography 18(6), 679-690.

Scheiner, J., Holz-Rau, C., 2007. Travel mode choice: affected by objective or subjective determinants? Transportation 34(4), 487-511.

Schendera, C., 2008. Regressionsanalyse mit SPSS. Oldenbourg, München.

Schwanen, Tim 2007. Gender differences in chauffeuring children among dual-earner families. The Professional Geographer 59(4), 447-462.

Scott, D.M., Kanaroglou, P.S., 2002. An activity-episode generation model that captures interactions between household heads: development and empirical analysis. Transportation Research B 36(10), 875-896.

Simma, A., Axhausen, K.W., 2001. Structures of commitment in mode use: a comparison of Switzerland, Germany and Great Britain. Transport Policy 8(4), 279-288.

Srinivasan, K.K., Athuru, S.R., 2005. Analysis of within-household effects and between-household differences in maintenance activity allocation. Transportation 32(5), 495-521.

Statistisches Bundesamt (Ed.) 2004. Alltag in Deutschland. Analysen zur Zeitverwendung. Wiesbaden, Statistisches Bundesamt.

Turner, T., Niemeier, D., 1997. Travel to work and household responsibility: new evidence. Transportation 24(4), 397-419.

Van Acker, V., Witlox, F., 2010. Car ownership as a mediating variable in car travel behaviour research using a structural equation modelling approach to identify its dual relationship. Journal of Transport Geography 18(1), 65-74.

Vance, C., Buchheim, S., Brockfeld, E., 2005. Gender as a determinant of car use: evidence from Germany. In: Transportation Research Board (Ed.), Research on Women's Issues in Transportation Vol. 2: Technical Papers. Transportation Research Board Conference Proceedings 35. National Research Council, Washington, D.C., pp. 59-67.

Walby, S., 1990. Theorizing Patriarchy. Blackwell, London.

Wen, C.-H., Koppelman, F.S., 2000. A conceptual and methodological framework for the generation of activity-travel patterns. Transportation 27(1), 5-23.

West, S.E., 2004. Distributional effects of alternative vehicle pollution control policies. Journal of Public Economics 88(3), 735-757.

Wooldridge, J.M., 2003. Cluster-sample methods in applied econometrics. The American Economic Review 93(2), 133-138.