MOBILITY CULTURES IN URBAN AREAS – A COMPARATIVE ANALYSIS OF GERMAN CITIES

DRAFT 2010-06-15

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ABSTRACT

INTRODUCTION

Climate change, peak oil and sustainable development are serious challenges for the future development of metropolitan areas worldwide. While the international debate still discusses the role and contribution of the transport sector for these developments and, furthermore, appropriate policies for guiding the future development in certain directions, an international comparison of metropolitan areas suggests that even under the same regulatory framework cities have options for shaping their own future developments. For example some cities like Kopenhagen, Groningen or Münster are well-known 'good practices' for communities with high shares of bicycling usage, while others are 'transit metropolises' (Cervero 1998) like Munich, Curitiba or Tokyo. Additional to national and international policies, thus, local policies and traditions become important for shaping a more sustainable transport system in metropolitan areas.

Urban form and transport infrastructure are generally acknowledged as key factors for the observed differences in the travel patterns of metropolitan areas. Since the 1970ies transport academics analyzed the impact of urban form characteristics and infrastructure supply on travel (for overviews see Boarnet and Crane 2001, Hickman and Banister 2005, van Wee 2002). In this view spatial features like density and diversity influence individual travel behavior, for example in terms of average trip length or modal choice. Complementary to these studies mainly during the 1990ies another line of reasoning emerged focusing much more on individual's preferences and attitudes to explain travel behavior. This research field emerged from the observation of an increasing individualization and pluralization of lifestyles in modern societies giving more options for individual's decision-making (Scheiner, Holz-Rau 2007: 491, van Acker et al. 2010: 225). However, only a limited number of studies combine both approaches for explaining actual travel behavior, at least not on a aggregate analysis level.

The aim of this paper is to combine the rather 'objective' urban form with the rather 'subjective' attitude and lifestyle approach to develop and test empirically a theoretical and integrated framework, the mobility culture approach, for the analysis of metropolitan areas. We derive a set of objective and subjective indicators for assessing the mobility culture of cities. With the sample of 44 German cities, we apply the indicators empirically and derive six clusters with distinct 'mobility cultures'. Eventually we discuss the profiles of the specific mobility cultures with a focus on the interdependence between objective and subjective data. With the empirical case study we want to show the usefulness of the mobility culture theory both for empirical work and for policy applications.

The paper is structured as follows. After reflecting both strands of research (section 2) this paper draws upon the mobility culture concept, which tries to bridge the explanatory gap by including both, objective parameters like urban form and aggregate socio-economic variables as well as subjective characteristics such as travel behavior and mobility-related attitudes and preferences. The term urban mobility cultures encompasses both material and symbolic elements of a transport system as part of a specific socio-cultural setting, which consists of mobility-related discourses and political strategies on the one hand and institutionalized travel patterns and the built environment on the other hand (Deffner et al. 2006: 16, Götz and Deffner 2009). The concept will be discussed in section 3. In section 4 we operationalize the theoretical approach of urban mobility cultures by choosing a set of 25 indicators, which reflects the particular elements of the concept. Subsequently we apply the indicator set to a sample of 44 German cities (section 5). In the last section we refer to our initial assumption of mobility related differences between cities, which we are now able to address as particular types of mobility cultures. We do so by applying a factor and cluster analysis and eventually identifying six groups of similar mobility cultures within our city-sample. We conclude by discussing the developed typology of German cities concerning the similarities and dissimilarities of their mobility cultures, especially with regard to its policy and planning implications and pointing out the need of further in-depth-research on urban mobility cultures.

2 OBJECTIVE AND SUBJECTIVE DETERMINANTS OF TRAVEL BEHAVIOR – A LITERATURE REVIEW

2.1 The Objective Dimension:Urban Form, Transport Infrastructure and Socioecomics

It is a prominent debate within transport geography whether spatial and material characteristics such as urban form or transport infrastructure influence individual travel behavior. When Torsten Hägerstrand introduced in 1970 the notion of activity space, he defined the geographical distribution of opportunities and destinations as well as the supply of infrastructure and means of transport as 'capability constraints' determinating an individual's daily mobility and activity options (Hägerstrand 1970). Other publications from this period reflect the interdependence between specific means of transport and their corresponding infrastructure systems on the one hand and urban form characteristics on the other hand and identify different levels of car-dependence and transit-effectiveness for the first time (Thomson 1977). Although the debate is ongoing for decades now, no agreement

regarding the impact of urban design for travel behavior has been reached yet (see for overview Boarnet and Crane 2001, Hickman and Banister 2005, van Wee 2002). One group of scholars states that urban form features often referred as the 3 D's density, diversity and design (Cervero and Kockelman 1997) do explain travel behavior to a considerable extent (Frank and Pivo 1995, Gordon 1997, Newman and Kenworthy 1989, 1999, Stead 2001)[1], whereas other researchers are very sceptical about such an impact (especially Gordon and Richardson 1997, Snellen 2001). Regarding the policy implications the two parties have been described as 'interventionists' respective as 'sceptics' (Schwanen et al. 2001, Hickman and Banister 2005: 103) since the former argue, that planning policies and urban design measures like rail-based settlement development are able to change travel behavior and thus lead to more sustainable mobility patterns, while the latter doubt the usefulness of such policy strategies. We continue by a brief discussion of the existing research related to the interdependencies between the 3 D's of urban form on the one hand and travel behavior on the other hand.

City Size and Density

The size of a city has been regularly interpreted as an indicator which allows a first orientation regarding the density and diversity of urban agglomerations. It has been argued that a growing population size leads to increasing accumulation of people and destinations (density) and a higher differentiation of activities and mobility patterns (diversity). Consequently the implementation of more efficient infrastructure and transport systems becomes more likely, which in many cases influences travel behaviour as can be seen, for example, in relatively high modal shares of public transport in big metropolises (Barrett 2000: 174). Accordingly several comparative city studies have identified a relatively low transport-related energy consumption per capita in big metropolises (Newman and Kenworthy 1999: 14-18, Næss 1993, 1995), as well as for increased modal shares of public transit in those bigger cities. In earlier work it has been suggested to compare these interdependencies with the development of ecological systems, which emanate from a stage of a few pioneering species with high energy consumption to very complex systems including high diversity and a lot of interconnections between their individual components (Newman and Kenworthy 1999: 15-16). The presented correlation between city size, efficiency of transport systems and modal choice remains rather broad, as many exceptions illustrate[2], and needs to be complemented by further influencing factors. Nonetheless it can be seen as a rule of thumb that the capability of transport systems is increasing together with population size of a city[3].

Since the isolated analysis of city size doesn't reveal anything about the distances between different land-uses within a settlement, urban density, defined as number of opportunities per

[1] Studies have explained approximately one third of variation of both, travel distance and transport-related energy consumption by applying land-use characteristics (van Wee 2002: 262).

[2] Examples such as the tramway system of French city Valenciennes (ca. 41.000 inhabitants) or the S-Bahn-like train-tram-system in just a medium-sized German city as Karlsruhe (see Cervero 1998: 343-361), show that innovative and high-performance transport infrastructures can be established in relatively small cities, as well.

[3] Textbooks of Urban Planning provide guidelines regarding adequate public transport systems, which fit to cities of a specific population size. It is for example recommended that tram systems work profitably in cities with more than 50.000 – 100.000 and metro systems in metropolises with more than 1 mio. inhabitants (see Korda 2005: 278).

spatial unit (van Wee 2002: 261) is another indicator, which often has been considered when analyzing spatial influence on mobility (Banister 1997, Frank and Pivo 1995, Næss 1993 and 1995, Newman and Kenworthy 1989, 1999, Stead 2001). The argument is as simple as convincing. Since it is assumed that travel time is evaluated negatively, the increased vicinity of destinations leads to a decrease of average trip length. In this line of arguing the density of the built fabric is often referred to as a key factor shaping the discussion about sustainable and resource-saving city development and transport planning. The idea of a "compact city" has clear transport and mobility implications such as the reduction of distances, the suitability for specific modes of transport such as walking, cycling and public transit (, Apel et al. 1997, Jenks et al. 1996, Newman and Kenworthy 1999b: 102-103) and as a result the reduction of transport-related energy consumption (Gordon 1997, Newman and Kenworthy 1989 and 1999).

The presented relationship between urban density, average trip length, modal choice and energy consumption has been challenged in several ways. Thus has been criticized, that the reduced travel distances are at least partly being compensated by an expansion of activity spaces and accessing more remote destinations (e.g. van Wee 2002: 261). In the same line of reasoning the notion 'flight mobility' has been developed, which states that people living in relatively dense neighborhoods tend to longer trips for leisure purposes, e.g. to reach a second home or an allotment garden at the edge of the city (Dijst et al. 2005). Moreover the geographical scale of the analysis has to be taken into account since the relatively short trips of the cities' inhabitants might be outweighed by the long-distance trips of commuters living in the greater metropolitan region (Scheiner and Holz-Rau 2007: 492). Although these critics can be interpreted as a first advice, that the influence of spatial structures towards travel behavior should not be analyzed without including the subjective dimension of perception, evaluation and appropriation processes, the degree and distribution of urban density remains an important structural framing, which makes particular behaviors likely and others unlikely.

Studies within the research field offer several possibilities to operationalize density. Most common are the concepts of population density and job density which are calculated as persons per hectare respective jobs per hectare (Newman and Kenworthy 1999: 96-98). In both cases it is advisable to draw upon the urbanized and not upon the administrative city area, a method that leads to a value, which has been addressed as 'urban density' or 'settlement density' (Newman and Kenworthy 1999: 33). Further variables to indicate urban density are the average distance from residential or work places to the city centre (Næss and Jensen 2004, further Fouchier 1998, Schipper et al. 1994) and the distribution of particular housing typologies like, for example, the share of detached or semi-detached houses (Ryley 2006: 369).

Diversity and Design

Besides urban density the intensity of mixed land uses is widely been regarded as a factor which has a considerable impact on travel distances and modal choice. Again the underlying processes are quite plausible. It is assumed that a more dispersed distribution of destinations such as workplaces, schools and shops throughout the area of a city leads to lower travel distances and thus to higher shares of 'slow modes' as walking and cycling compared to a more centralized distribution pattern (van Wee 2002: 261-262, Banister 1996). This principle

is a core element of planning strategies such as 'decentralized concentration', which are applied in the context of sustainable urban planning. Even if competing factors might relativise this relationship (van Wee 2002), the provision and mix of services remains an important variable influencing travel behavior. One popular figure to describe the mix of land uses is the so-called activity intensity which means the sum of population and jobs per hectare (Newman and Kenworthy 1999b: 109)
Despite the more apparent characteristics of density and diversity the design of urban quarters is referred to as another feature to change travel behavior. It encompasses the whole range of planning public space like, for example, the configuration of parks and squares or the location of bicycle stands and parking spaces. Studies tried to address the influence of urban design, for example, by simulating travel distances in two fictional neighborhoods, one with an open grid-like street pattern and one with a rather inaccessible network of dead ends (Boarnet and Crane 2001: 824, further Khattak and Rodriguez 2005, Kulash et al. 1990, McNally and Ryan 1993).

Socioeconomics

Socio-economic attributes such as wealth, age distribution or labour-market characteristics are regularly referred to as explaining factor in analyses of urban mobility and travel behaviour. These characteristics are used in several ways, for example as restriction toward the activities and mobility of the individual (Chapin 1974), which refers to the concept of constraints developed by Hägerstrand. Moreover socioeconomic and demographic characteristics are often described as structural factors determining individual lifestyles and attitude patterns, e.g. by using the notion of the life situation (Scheiner and Holz-Rau 2007, Simma and Axhausen 2001). Thus, although socioeconomics differ from spatial characteristics by the individual dimension and from lifestyles by the objective character, the can be considered as closely linked with both aspects. Therefore they are regularly used as control variables when analyzing the impact of land use patterns on the one hand and lifestyles, preferences and attitudes on the other hand.
The most often applied socioeconomic characteristics in empirical work are income and wealth (Newman and Kenworthy 1999: 111-114, Pucher and Lefévre 1996, Ryley 2006: 374, Schäfer and Victor 2000: 171-205), gender (Best and Lanzendorf 2005) and age (Ryley 2006).

2.2 The Subjective Dimension: Lifestyles, Attitudes and Perception

The emphasis of the discussed spatial characteristics, which has been described as "urban form euphoria of transportation research" (Scheiner and Holz-Rau 2007: 487-488) was followed since the 1990ies by a disillusion since a growing number of researchers stated that not urban form characteristics might be not the actual determinants of travel behavior but itself strongly influenced by the attitudes of the residents. These considerations led to the concept of residential self-selection which basically assumes, that people choose their residential location as a consequence of their preferences towards features like residential environment, provision of local services, local accessibility or specific means of transport

(Mokhtarian and Cao 2008, Scheiner and Holz-Rau 2007: 491-492, Schwanen and Mokhtarian 2005, van Acker et al. 2010: 224, Waddell et al. 2001). In this view members of rather hedonistic and fun-oriented milieus prefer to live in rather central, dense and mix-used quarters, which offer a large selection of bars, museums and other culture-related venues whereas people, who emphasize rather traditional and family-related values tend to live in more quiet suburban-like settlements.

In this perspective the built environment is not anymore the crucial factor to explain travel behavior but the attitude and preferences towards the built environment and the neighborhood design becomes the focus of interest. Analogical not the means of transport but the attitude towards this specific mode, not the distance towards specific destinations but the attitude towards distances are the decisive features when analyzing travel behavior.

Consequently a growing number of authors include preferences towards urban form and travel characteristics in addition to the rather objective variables such as urban density or socio-economic data (e.g. Bagley and Mokhtarian 2002, Collantes and Mokhtarian 2007). Other studies aimed to proof the assumed relevance of underlying attitudes and lifestyles by analyzing travel behavior before and after a residential relocation (Krizek 2003, Handy, Cao and Mokhtarian 2005, Scheiner 2005). Joachim Scheiner, for example, showed that the motorization rate of city residents who moved to the outskirts was already higher than the one of their neighbors who stayed in the inner city, even before the relocation (Scheiner 2005 and 2009a). This result leads to the assumption that even among the residents within the same quarter different lifestyles and consequently different transport behaviors can be found. Tim Schwanen and Patricia Mokhtarian identified some people within their sample of residents of the San Francisco region, who stand for a mismatch between the spatial characteristics of the neighborhood they live and the neighborhood setting they actually prefer. Consequently they achieved a continuum of four groups (consonant urbanites, dissonant urbanites, dissonant suburbanites, consonant suburbanites), whereas the modal share of transit and non-motorized modes is declining continuously towards the latter (Schwanen and Mokhtarian 2005).

All this acknowledgement of individual preferences and attitudes toward land use and travel in the end can be referred back to the concept of lifestyles. The notion of lifestyles has been developed out of a critic of conventional models of social differentiation such as classes and ranks. The debates of modernization (Giddens 1990) and individualization (Beck 1992) advised the consideration of taste, attitudes and values. Therefore lifestyles have been defined as “group specific forms of organization of daily life that are expressed in cultural taste and leisure activities” (Spellerberg 1996: 57). Other authors emphasize the behavioral dimension of the lifestyle concept even more, when they note that “lifestyle is considered as a pattern of observable and expressive behaviours” (van Acker et al. 2010: 225). Lifestyles have been analyzed as factor influencing travel behavior in several studies (Bagley and Mokhtarian 2002; Collantes and Mokhtarian 2007, Lanzendorf 2002).

Although we can conclude, that a notion of relative freedom of action and individuality is crucial to the lifestyle concept it is far from being able to completely replace or outweigh objective characteristics such as urban form or socioeconomic variables. Objective criteria remain an important context and framing for individual action like the following somewhat simple but convincing example illustrates. Even members of a lifestyle group, which shares positive attitudes toward rail based public transport won’t use any rail-based services, if they

don't exist in the city they live in (for more examples see Scheiner 2009b: 44 and Scheiner 2007: 491).

3 INTEGRATING OBJECTIVE AND SUBJECTIVE FACTORS – THE CONCEPT OF URBAN MOBILITY CULTURES

As shown before the concentration on either only objective characteristics such as urban form or merely subjective factors such as attitudes or lifestyles is not useful to explain travel behavior properly. Focusing only on spatial characteristics tends to neglect the processes of perception and evaluation, which might lead to different forms of travel behavior, although the objective factors are constant. On the opposite an overestimation of individual preferences suggests that the individual is able to act and travel nearly free and independent from objective framings such us urban form and infrastructural supply. Therefore we choose the concept of urban mobility cultures (Deffner et al. 2006, Götz and Deffner 2009) as a theoretical framework of our analysis, because it integrates objective and subjective elements on a city-level.
The concept can be understood as an integrative approach incorporating both routinized practices, including underlying preferences, life styles and mobility styles, as well as rather objective and structural components such as social and political formations and strategies, as well as infrastructural and spatial characteristics. Moreover, mobility- and city-related discourses and images are added to the concept of urban mobility cultures (see fig. 1).

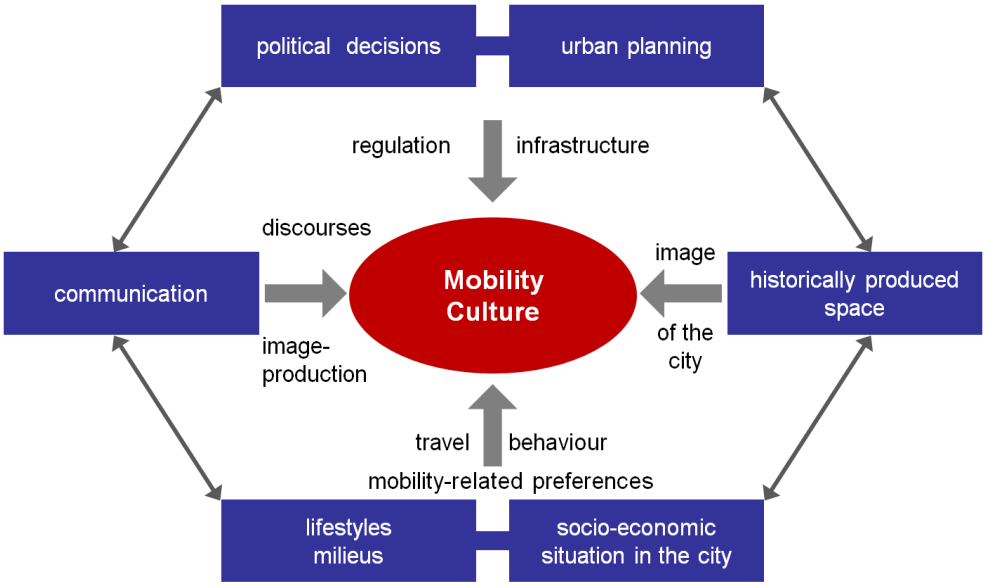

Fig. 1: Concept of Urban Mobility Cultures
(Source: Deffner et al. 2006, 16, own translation)

It is important to note that the concept is not meant as a fixed and homogenous entity, but as a model which includes dynamic processes and conflicts and is very able to be modified over time and space. In this context it is helpful to take into account the definition of culture, which Deffner et al. (2006) are referring to. They characterize culture as commonly shared knowledge which facilitates the organization of day-to-day life by suggesting particular

practices as feasible and excluding others as notfeasible (see Janowicz 2006, 5-7 and Hörning 1999, 99). In sum, although urban mobility cultures are not fixed but contingent, they are regarded as rather inertial structures which are related to a high level of path dependence. This is mainly because two of its core elements, urban form and life style patterns, are also rather complex and stable constructs, which are far from being changeable in a short term period.

It is crucial to analyze the configuration and interdependencies of the particular components of the concept in order to understand how specific types of mobility culture develop and become persistent. Moreover, in a policy perspective the understanding of mobility cultures may help to identify key factors for influencing the cultural setting in a certain way, whereas must not be understand as a direct determination but rather as a creative and flexible governance process. Deffner et al. suggest doing so by either a historical reconstruction of the development of specific mobility cultures or by the comparison of different cultural settings. We are inspired by the latter proposal and try to generate a comparative data set in the next section.

4 OPERATIONALIZATION OF THE MOBILITY CULTURES CONCEPT

In the following section we aim to increase the understanding of urban mobility cultures by operationalizing them with an adequate set of indicators, which include objective and subjective variables. We restricted our analysis to urban form, socioeconomics, transport infrastructure, travel behaviour as well as transport-related attitudes and excluded in this first study further elements of the mobility cultures concept such as discourses and policy strategies. This has to be done because of pragmatic reasons since these features are difficult to quantify, so that a qualitative policy analysis might be more appropriate here.

For the operationalization of urban mobility cultures, we analyzed a set of 44 German cities with more than 100.000 inhabitants. The sample includes cities varying considerably in terms of size, geographical location and socio-economic structure. Names and locations of the analyzed cities are summarized in the map, shown in fig. 2.

Fig. 2: Cities included in factor and cluster analysis

4.1 Transport demand indicators / travel behaviour

As argued before the subjective dimension can be described by attitudes as well as by behavioural characteristics which a both closely linked by the lifestyle concept. We start with indicators related to the latter.

Motorization and share of high-engine capacity cars

Motorization data are often used and well-documented indicators, which are linked in complex ways to a wide range of socio-economic and mobility-related aspects in urban settlements. Motorization has long been perceived as an expression of economic growth and wealth, whereas meanwhile several studies illustrate, that both developments not necessarily have to be coupled. Newman and Kenworthy for example have shown that the number of cars per 10.000 $ GRP already in 1990 differed from approx. 120 in affluent Asian and European cities up to nearly 250 vehicles in U.S.-American metropolises (Newman and Kenworthy 1999). This indicates that motorization is not only linked to economic capability

but also to policy and planning priorities. Another aspect is highlighted by Lötscher et al., when they refer to the 'American way of life' and the related image of the car as a symbol for freedom and individuality (see Lötscher et al. 2001: 62). It is argued that this symbolic meaning of private car use is still and also in Germany present, but increasingly contested by alternative priorities and lifestyle options like transit and bike-oriented mobility, which are especially often found in big metropolises like Berlin, where up to 40% of all households don't own a car. The discussion about the symbolic and lifestyle-related dimension of car use leads us to the second indicator, we refer to in our analysis, the share of highly motorized cars (more than 2.000 cc). Whereas this attribute is closely linked to private wealth, expressed by household income (r=0,72), we argue that, in addition, it can be interpreted as an indicator for individual preferences regarding the type of vehicle and consequently also regarding the attributes and meanings of this car type such as luxury and individuality.
The indicator for motorization is defined as cars per 1.000 people. Data for both indicators are taken from the vehicle-registration database of the Federal Motor Transport Authority ('Kraftfahrt-Bundesamt') and refer to the year 2009.

Modal split

Modal split variables distinguished by the most common modes of transport (walking, cycling, transit, car use) are central factors dealing with aspects of urban mobility and travel behaviour. This is because modal choice reflects a wide range of spatial dimensions, economic conditions and socio-cultural preferences. For example, private car use refers to the financial capability to own a car as well as to spatial characteristics such as infrastructural provision and urban density which can build in car dependence and – last but not least – to particular car-oriented lifestyles and attitudes.
As several studies illustrate, modal split characteristics differ to a significant extent even within the same political and socio-economic framing (see e.g. Lötscher et al. 2001a for German cities and Apel et. al. 1997 for a sample of international cities) due to varying planning and policy priorities or differing lifestyle patterns. This conclusion can be confirmed with regard to our sample of 44 German cities (see. tab. 1).

Tab. 1: modal split - descriptive statistics

mode of transport	min. share of all trips (%)	max. share of all trips (%)	mean value (%) (n = 44)
walking	19	40	30
cycling	0	28	9
transit	4	19	12
car use	29	65	48

It has being argued that a reinforcing positive feedback exists between the modal split in a city and the individual decision to use a particular mode. In this view a high share of a specific transport mode can be interpreted as an indicator of high quality and reliability, "just as a full restaurant is a sign of good food and satisfied customers" (Goetzke 2008: 416),

which makes the choice of this means of transport more likely. In the same direction points an empirical finding in a study of Ganzeboom, who argues, that practices and routines of friends and neighbours determine individual behaviour more than socialization and the milieu someone grew up in (see Ganzeboom 1990: 220 and Spellerberg 1996: 66).
In sum, the highly related modal split variables are a core element of our analysis as well as the concept of mobility cultures. We took the relating data from the national travel survey 'Mobilität in Deutschland', conducted in 2002 (see infas and DIW 2004).

Work trip distance and speed of car trips

Two more variables from the 'Mobilität in Deutschland' survey have been included: the average distance of trips related to the purposes 'job' or 'education' as well as the average speed of trips, made by private car. The former attribute has been selected, because it is supposed to be linked to spatial and social characteristics. As discussed above, average distance of work trips has been regularly considered as an indicator of urban density and intensity of mixed land-use, because trip distances tend to be shorter in dense and mix-used cities and neighbourhoods (see e.g. Fouchier 1998, Newman and Kenworthy 1989, Schipper et al. 1994). As a consequence average trip distance is related to the likelihood to use a particular mode of transport since some modes such as walking and cycling become less likely as trip distance increases. Consequently in our sample of German cities we found a significant negative correlation between average distance of journey-to-work trips and modal share of walking (r=-0,34).

The last variable, recruited from the 'Mobilität in Deutschland' survey, is the average speed of trips made by private car. It is believed that cities with a high share of highway infrastructure lead to an increased speed of car traffic. On the other hand, it is a well-accepted planning principle that continuing extension of the road network leads to more traffic and in the long run to more congestion, so that the direction of the linkage between road construction and average car speed is not clear. Cities within our sample which are known as planned by the principles of car-friendliness and highway-accessibility (Leitbild der 'autogerechten Stadt') such as Bochum or Frankfurt are characterized by car speeds slightly below the average of all cities, which is 29.4 km/h. This finding supports the congestion hypothesis, but it is advisable to back-up these subjective perceived speeds by actual measured or modelled speeds, as well as to check the assumed relation to car-friendly infrastructure planning by collecting data about the provision of highway and other road infrastructure in the context of future research.

Number of ADFC members

The biggest and most influential federation in Germany to promote the interests of cyclists is called ADFC ('Allgemeiner Deutcher Fahrrad Club' / General German Cycle Club) and has nationwide approx. 125.000 members. We added the number of members per city to our set of attributes following the assumption that it could serve as an indicator for the bicycle-orientation of the particular urban community. The expected relation between ADFC membership and high modal shares of cycle trips has been confirmed (r=0,44). Moreover,

interesting is the relation between ADFC support and evaluation of cycle-related infrastructure and service. This link is complex in the way that we found relatively high membership rates in cities, well-known for high quality cycling infrastructure like Münster (4.2 members per 1.000 people) or Bremen (5.1 members per 1.000 people) but also in cities like Hamburg (3.37 members per 1.000 people), which have been repeatedly attested as having poor quality of cycling infrastructure. This pattern raises the question if people join this interest group in order to enjoy extra service and information in an already cycle-friendly environment, or because they want to change poor conditions of cycling in the particular city. We try to shed light on this issue by discussing the results of a survey among ADFC members in the next section.

Mobility-related perceptions and evaluations

It has been argued that besides behavioural components preferences and attitudes are crucial to the subjective dimension of mobility cultures. We aim to capture this dimension by including perceptions and evaluations which have been identified by mobility-related surveys.

ADFC survey: 'cycling climate'

The mentioned stakeholder group ADFC has repeatedly conducted surveys among its members and other cyclists asking them to evaluate the 'cycling climate' in the city they live in. In sum, more than 20.000 cyclists participated in the surveys in 2003 and 2005, so that even on a city-level a sufficient numbers of cases have been recruited (see ADFC 2003, 2005). Besides infrastructure and security-related questions, it has also been asked, how accepted cycling is among the inhabitants of the city. Explicitly it has been asked if cycling is rather fun or rather stressful and if only children and tourists or all population groups are cycling. Respondents could choose from a scale between 1 and 6. We added the average response per city to our set of indicators. High correlations of the response patterns for both questions with the modal share of cycling trips (r=0.46 resp. 0.73), which indicates that a 'cycling climate' perceived as positive is linked to a high share of cycling. This finding confirms the close link between attitudes and behaviour.
Regarding the question raised above, if ADFC membership is related to satisfaction or dissatisfaction with local 'cycle climate', results of the ADFC survey reveal that there are positive correlations between membership and both cycling perceived as fun (r=0.29, sign. at 0.1 level) and the impression that all population groups cycle (r=0,35, sign. at 0.05 level).

Survey 'Perspektive Deutschland'

Also in 2005 McKinsey Germany, together with media partners, has conducted a nationwide online survey regarding perceived quality of life. Within an extensive set of questions it has also been asked, how people perceive the quality of the road network and the public transit system in their city or region. Again the link between attitude and behavioural patterns has been confirmed in so far that a positive perception of road infrastructure highly and

significantly correlates with a high share of car trips (r=0.71) and the same is true for perception of transit systems and transit use (r=0.49).

Transport supply indicators

In order to reveal transport- and mobility-related priorities characterizing and influencing urban mobility structures, we decided to include attributes characteristic of the transport-related supply of goods and services. Depending on the character of the examined element of transport supply, it can refer to very different aspects of the concept of urban mobility culture. The provision of public infrastructure such as public transit systems as well as roads and bicycle tracks refers more to transport-related policy and planning priorities and strategies, whereas private and market-oriented services such as the number of bicycle and car traders are more directly linked to the transport demand and the related travel behaviour priorities and mobility styles of a city's population. We selected four indicators as discussed below to cover both aspects of urban mobility cultures. At the same time we aimed to use a set of indicators, which for now represents a reasonably balanced recognition of different modes of transport, notwithstanding the possibilities for improving on this.

public transit indicators

As a first approach to capture the quality and standard of public transit systems in the analyzed city sample we decided to incorporate two binary variables which are 'existence of a tramway system' and 'existence of another transport system except bus services'. We chose these indicators, because several examples of local public transport planning illustrate that the existence of rail services and especially of surface-based tramway systems makes usually a big difference in both capability and perception compared to only bus-based public transport supply. This finding applies to different aspects of public transport systems, such as maximum number of passengers (e.g. Hesse and Nuhn 2006: 190, Kenworthy 2008), average speed (Newman and Kenworthy 1999: 91, Kenworthy 2008: 22-23, Hass-Klau et al. 2003) as well as image and reputation of particular transport modes and vehicles (Schiefelbusch 2009).
Regarding the tramway it has to be added, that it is a lot more cost-efficient compared to underground systems, which cause enormous construction costs combined with the possibility of decreased accessibility as a consequence of a longer average inter-stop distance. The extent of this effect is influenced by density. Meanwhile, tramway services are – at least in cities with less than 1. mio. inhabitants – considered as the most adequate public transit system. Well-known examples of 'tramway cities' such as Zürich, Amsterdam and Freiburg (Breisgau) with a complex network offering various travel options, are referred to as best practice (see e.g. Apel et al. 1997, Bratzel 1999, Deffner et al. 2006, Haefeli 2008). This can be compared to the rather fragmentary underground and light rail systems in the Ruhr area or in Ludwigshafen, a German city, where in 2008 for the first time in Germany an underground tunnel, built in the 1970ies, has been closed as a consequence of an lack of demand (see Naumann 2008). The impressive example of the 'tramway renaissance' in several French cities such as Strasbourg, Grenoble or Nantes (see Groneck 2003 and 2009)

illustrates that tram systems are perceived not only as a technical and infrastructural improvement but also as an upgrading of public space in terms of design and sojourn quality. These developments show that mobility culture doesn't only refer to simply material and technical characteristics but also to symbolic and discoursive dimensions of transport and movement. In other words, infrastructure for transport embodies a clear human dimension, which in turn influences mobility culture. In sum, the presented public transit indicators are related to many different elements of mobility cultures, which cover infrastructure and transport policy as well as discourses and images of city-development and mobility.
Methodologically the chosen indicators are not unproblematic since their binary structure tends to dominate the clustering of German cities regarding their mobility culture. Therefore in future work we aim to replace them by metric indicators such as the extent of the public transit network or the vehicle-kilometres of service supplied in each city.

car and bicycle related businesses

We argue that the number of services and shops related to particular means of transport work as a reliable indication for the major orientation of people towards a specific mode of transport. To identify the number of bicycle and car-oriented services such as dealers, garages and rental firms, we counted the related entries in the yellow pages of each city. We confirmed through correlation analysis the expected link between number of services and travel behaviour indicated by modal share of cycling (r=0,76) as well as motorization and car ownership (r=0,54).
In a long-term perspective it is aimed, to extend the indicator set related to transport supply by adding the level of provided public infrastructure not only for transit but also for transport based on cycling, walking and private car use. Possible indicators could be e.g. the extent of local road and cycleway networks, especially for private cars, the level of freeway provision.

Price of transit season ticket

A further interesting attribute which either enables or restricts access to transport supply is the price of a season ticket for public transport. We took data from a study, which refers to a ticket which covers the area of approx. 20km around the central railway station of a city.

Spatial indicators

With this group of indicators we focus on spatial characteristics of each city at an aggregate level. Referring to the discussion in the previous section, we consider city size as a relevant indicator, for example because of the assumed positive relation between city size and public transport use. Therefore city size in terms of population and geographical extent is an important and in-fluential condition of transport supply as well as individual travel behaviour.

Nonetheless the pure population size is still an insufficient indicator regarding the relative demand for space and mobility. To close this conceptual gap we have added density-related characteristics to our model of urban mobility culture. We chose three indicators to

characterize urban density as one realm of mobility culture which is in several ways linked to travel behaviour of people as well as to transport policies of city governments: settlement density, share of one- and two-family houses and average distance of work trips.

Settlement density

Settlement density is a widely applied and well-accepted indicator to define urban density (see for many Newman and Kenworthy 1999 and Siedentop et al. 2006). In order to explain travel behavior and urban mobility it is much more adequate than density characteristics based on total land area of administrative units and neglecting the proportion of urbanized land and open space. Consequently in our sample of German cities settlement density explains parts of modal choice, especially regarding public transit use and walking trips. Both are positively correlating with settlement density to a moderate level (public transit: r=0,55 / walking: r=0,33). Somewhat surprisingly the modal share of cycling trips is negatively related to this density indicator, which suggests that people cycle slightly more in low-density cities (r= -0,42). Although this finding contradicts other studies (e.g. Newman and Kenworthy 1999: 103, Ryley 2006) and therefore needs further investigation, it can perhaps be understood as a sign, that cycling is less density-constrained and possibly more related to socio-cultural factors. This finding might be seen in the context of an argument, put forward repeatedly by academic cycle activists: They perceive cycling as a mode of transport which is relatively independent of spatial and infrastructural framings and much more as a consequence of personal attitudes and lifestyle (see e.g. Monheim et al. 2006: 46). However, share of cycling could also be related to settlement size. Smaller German settlements tend to be less dense (correlation city size / settlement density r=0,37), but they also involve shorter distances for cycling, simply because they are small.

share of one- and two-family-houses

The indicator ‘share of one- and two-family-houses’ is helpful in a double sense. First it is linked to the socio-cultural preference towards a specific type of housing expressed by the population of any particular city. On the other hand it can be interpreted as a sign for the extension of the urban fabric of each city. A high share of one- and two-family houses is often related to a rather wide-spread spatial structure including long distances to the city centre as well as to peripheral subcenters. Consequently it can be assumed, that such low-density settlement patterns lead to a relative unattractiveness of public transit and non-motorized modes of transport. Within our sample of German cities the described relation between the share of low density housing types and modal choice could be confirmed for walking trips (r=-0,40) and public transit use (r=-0,58), whereas cycling seems again to be less density-sensitive. Moreover it is plausible in this line of arguing, that motorization (number of cars per 1.000 persons) is positively correlated with the share of one- and two-family-houses (r=0,44). Several studies have documented that the *average distance of work trips* is an indicator of urban density and as a consequence has implications towards the modal choice (see Pucher and Buehler 2006: 269-270, Newman and Kenworthy 1999: 104-107). John Pucher and Ralph Buehler furthermore identify in their comparison of U.S. and

Canadian Metropolitan Areas the average length of journey-to-work trips as the most influential factor regarding bicycle use for work trips (r=-0,54) within a set of six characteristics potentially influencing the decision to cycle or not to cycle[4].

Testing the described relation between work trip distance and modal choice within the city sample of our analysis we find no significant correlation regarding public transit, cycling and car use and just a slight negative correlation with the share of walking trips (r=-0,34). One explanation is decreasing importance of work trips as proportion of all trips, so that the distance of leisure trips might influence the modal choice considerably more. Furthermore work trips have many limits for cyclists such as aspects of bike storage and required dress-codes.

Socio-economic characteristics

Besides spatial and density-related characteristics the social-economic structure of a city is relevant for concept of urban mobility culture we introduced at the beginning of this article. As argued before we assume that socioeconomic characteristics are closely linked to the lifestyle concept and therefore to attitude and behaviour patterns. Consequently we use typical socioeconomic data as contral variables to our analysis, which is mainly focusing on spatial and lifestyle characteristics.

household income and share of single households

Income and wealth affect ownership and access to specific modes of transport. In our sample we could confirm this relation examining the share of high engine-capacity and presumably rather expensive vehicles relative to all registered cars. We found a significant high positive correlation (r=0,72) with the average net household income within our sample of 44 German cities (see fig. 9).
The share of single households is another indicator for urban mobility cultures. It correlates highly with city size (r=0,59), which can possibly be explained by the attractive job market and the cultural and leisure-related offer of big metropolises, features which are especially appreciated by the mentioned groups.

share of elderly people

The influence of age on the intensity and quality of travelling is well-known and documented by a lot of studies, including comprehensive national travel surveys like ‘Mobilität in Deutschland’, at the moment available with data for 2002 (see infas and DIW 2004). Some selected results are, that people, aged 65 years and older, make less trips per year (approx. 1.000 compared to approx. 1.500 by mid-aged people) and are less mobile, both in terms of distance and duration. Furthermore, the elderly require particular qualities of a transport system, e.g. regarding accessibility and user-friendliness. Therefore we included the share of

[4] Besides the length of work trips they included gas price, cars per person, precipitation, cycling fatality rate and temperature in their multivariate regression model.

people aged 65 years and more to our set of indicators. Since other age groups, besides the elderly, are characterized by particular travel patterns, as well, we will consider including additional demographic items such as the share of children and adolescents in follow-up versions of this analysis.

unemployment rate

As another indicator in our analysis we refer to the unemployment rate. It is argued, that a high share of unemployed people has necessarily consequences for urban mobility patterns since work-seeking people might presumably prefer affordable and rather cheap modes of transport, so that we could expect similar consequences to travel behaviour as discussed above, considering the relation between income and urban mobility. Surprisingly, this finding is only partly verified by the characteristics of our city sample. Whereas the assumed concurrence between high levels of unemployment and low shares of rather expensive private car use can be found in Eastern german cities like Leipzig (unemployment – 19% (1 out of 44), modal share of car trips – 41% (35 out of 44)), we observe – despite high unemployment rates - a strong tendency towards car-use among old industrial centres in Western Germany like the cities of the Ruhr (e.g. Duisburg: unemployment – 15.5% (5 out of 44), modal share of car trips – 56% (8 out of 44)). Topp argues that the continuously strong car-orientation in the Ruhr is mainly due to specific priorities of transport, city-planning and infrastructure policies (see Topp 2007: 256), a point we discussed above when looking to indicators related to local transport supply.
In sum we believe that unemployment data and related labour market attributes are linked to mobility-related practices and attitudes in a complex way, so that it is worth adding the urban unemployment rate as provided by BBSR to our analysis. Altogether we applied 25 variables, which a summarized in table 2.

Tab. 2: applied indicators - overview

indicator	description	source	date
1. work trip distances	distance per day and person related to purpose 'job / education'	National survey 'Mobilität in Deutschland'	2002
2. car speed	average speed per car trip	dito	2002
3.-6. modal split	proportion of walking, cycling, transit and private car trips	dito	2002
7. motorization rate	registered cars per 1.000 people	Federal Motor Transport Authority	2009
8. big cars	share of high engine-capacity cars (> 2.000 cc)	dito	2009
9. ADFC members	Number of ADFC members per city	ADFC	2010
10. cycling climate I	Is cycling fun?, average response	ADFC survey	2003, 2005
11. cycling climate II	Do all population groups cycle?	ADFC survey	2003, 2005
12. satisfaction transit	How big is the demand for improving transit?	'Perspektive Deutschland' survey, Mc Kinsey Germany, data categorized into five classes	2005
13. satisfaction roads	How big is the demand for	dito	2005

	improving road network?		
14. tramway	existence of a tramway system (binary variable) (criteria: surface-based, no light-rail or train-tram system)	own research	2010
15. only bus	existence of a public transport system additional to bus services	own research	2010
16. bike businesses	number of entries for cycle - related businesses in local yellow pages	own research	2009
17. car businesses	Number of entries for car-related businesses in local yellow pages	own research	2009
18. pt season ticket	price for a season ticket for public transport	political interest group 'INSM' / Institut der deutschen Wirtschaft	2008
19. city size	no. of inhabitants	Federal Statistical Office	2008
20. settlement density	no. of people living per sq.km. urbanized land (settlement and transport-related land uses)	BBSR (Federal Institute for Research on Building, Urban Affairs and Spatial Development, division 'spatial monitoring') / Federal Statistical Office	2000
21. one- and two-family houses	share of one- and two- family houses in the building stock of a city	BBSR, 'spatial monitoring'	2007
22. household income	average net income per household and month	BBSR, 'spatial monitoring'	2006
23. share of single-households	percentage of single households	BBSR, 'spatial monitoring'	2006
24. share of elderly	percentage of people, aged 65 years and older	BBSR, 'spatial monitoring'	2007
25. unemployment rate	percentage of unemployed people ('Erwerbspersonen')	BBSR, 'spatial monitoring'	2007

FACTOR ANALYSIS

With the 25 indicators just presented we applied a principal component analysis including a varimax rotation in order to group highly related variables and to identify hidden 'background factors' which determine the distribution of the data. Following the Kaiser-criterion we received six clusters. The model explains 75.4% of the variance of all variables, the particular communalities are shown in figure 3.

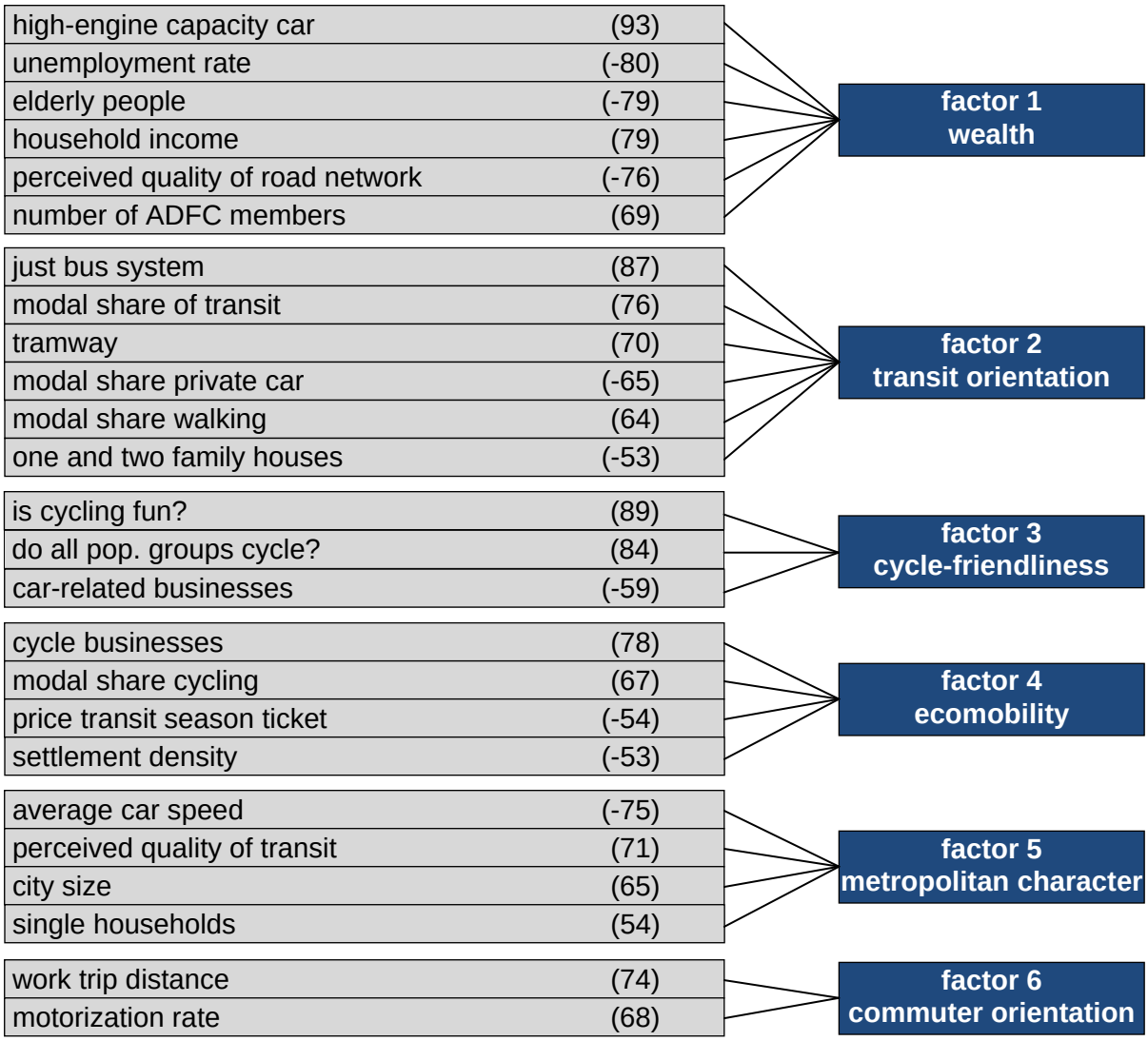

Fig. 3 Factor Overview

Factor 1 – economic wealth

At an aggregate level, unemployment and share of elderly people correlate negatively and the average household income positively with this factor. Furthermore, the share of high-engine capacity cars as well as ADFC membership and a positively evaluated quality of road network, show high loadings on this factor.

In sum, this factor indicates a high standard of transport infrastructure and a high share of young and active citizens demanding high quality modes of transport such as powerful cars.

Factor 2 – transit orientation

Both indicators related to the quality and supply of transit systems, namely the existence of a tramway system and the availability of a system other than bus services, correlate positively with this factor, as well as the modal shares of transit and walking trips. Highly negative

loadings exist for modal share of private car use and the proportion of one and two family houses, which suggests that high-quality transit systems often develop in rather dense cities.

Cities with a high value for this factor are characterized by high shares of walking and transit trips and low shares of private car use as well as a high-performance transit system, mostly expressed by a tramway or other rail-based systems. Furthermore, those cities are rather compact and dense.

Factor 3 – cycling climate

Both variables drawn from the ADFC cycle climate tests correlate highly positively with this factor, which means, that cities with high values are perceived as particularly cycle-friendly since respondents said it is fun to cycle there and all population groups ride bicycles. Consequently, the number of car-oriented businesses and services is loading negatively on this factor.

In conclusion, factor 3 indicates cities perceived and evaluated as explicitly cycling-friendly in terms of a strong appreciation of cycling among the population. Moreover, people living in these cities seem to have a rather low interest in car-oriented services as the related businesses are underrepresented.

Factor 4 – ecomobility

This factor is characterized by high positive loadings on modal share of cycling as well as on cycling-related businesses. On the other hand, the price of a season ticket for public transit and – somewhat surprinsingly – settlement density correlate negatively to the main components which means that cycling is particular popular in rather low-densed cities.

This finding contradicts to several studies, which revealed a positive relation between urban density and propensity to cycle (see e.g. Newman and Kenworthy 1999: 103, Næss 2003a: 169) and therefore makes necessary further research. It might also be interpreted as sign that cycling is less density-sensitive than other modes of transport and possibly rather determined by social characteristics and individual preferences.

The character of cities, indicated by high values on factor 4 can be summarized as cycling-oriented, both in terms of supply and demand combined with an attractive and cost-efficient offer of public transit in rather low-densed cities. Of course, it also relates to the previous discussion that smaller cities more suited to cycling in Germany, are also lower in density.

Factor 5 – metropolitan character

The fifth factor is marked by positive correlations with city size and other metropolitan features such as a high share of single households and a transit system which is perceived as high-standard. Negative loadings can be found for the car speed indicator.

In conclusion, this factor appears to stand for metropolises with a high share of young and unmarried citizens, a high-performance transit system and rather congested road traffic.

Factor 6 - commuter-orientation

High positive correlations of motorization rate and work trip distances, which are attributed to this factor, suggest a particular orientation towards car use and longer trips. This is presumably related to a high share of commuters, who prefer the automobile to bridge longer distances, for example, to reach a workplace in another town of a polycentric urban agglomeration.

CLUSTER ANALYSIS

Based on the extracted factors we discussed above, we applied a hierarchical cluster analysis using Ward's method. We generated six clusters including four up to fourteen cities each. Titles and shares of the clusters are summarized in table 4. Six clusters have been selected to achieve both a sufficient amount of city-groups as well as a limitation of intra-cluster heterogeneity. In the following section we discuss the generated cluster solution. Figure 4 is showing the divergence between the mean of the cluster elements and the mean of all cities for each variable.

Tab. 3: cluster-set: names and shares

Cluster	no. of cities	% of all cities
1. cycling cities	6	13.6
2. transit metropolises	6	13.6
3. auto cities with cycling potential	8	18.2
4. auto cities with transit potential	6	13.2
5. multimodal commuter cities	14	31.8
6. transit cities	4	9.1

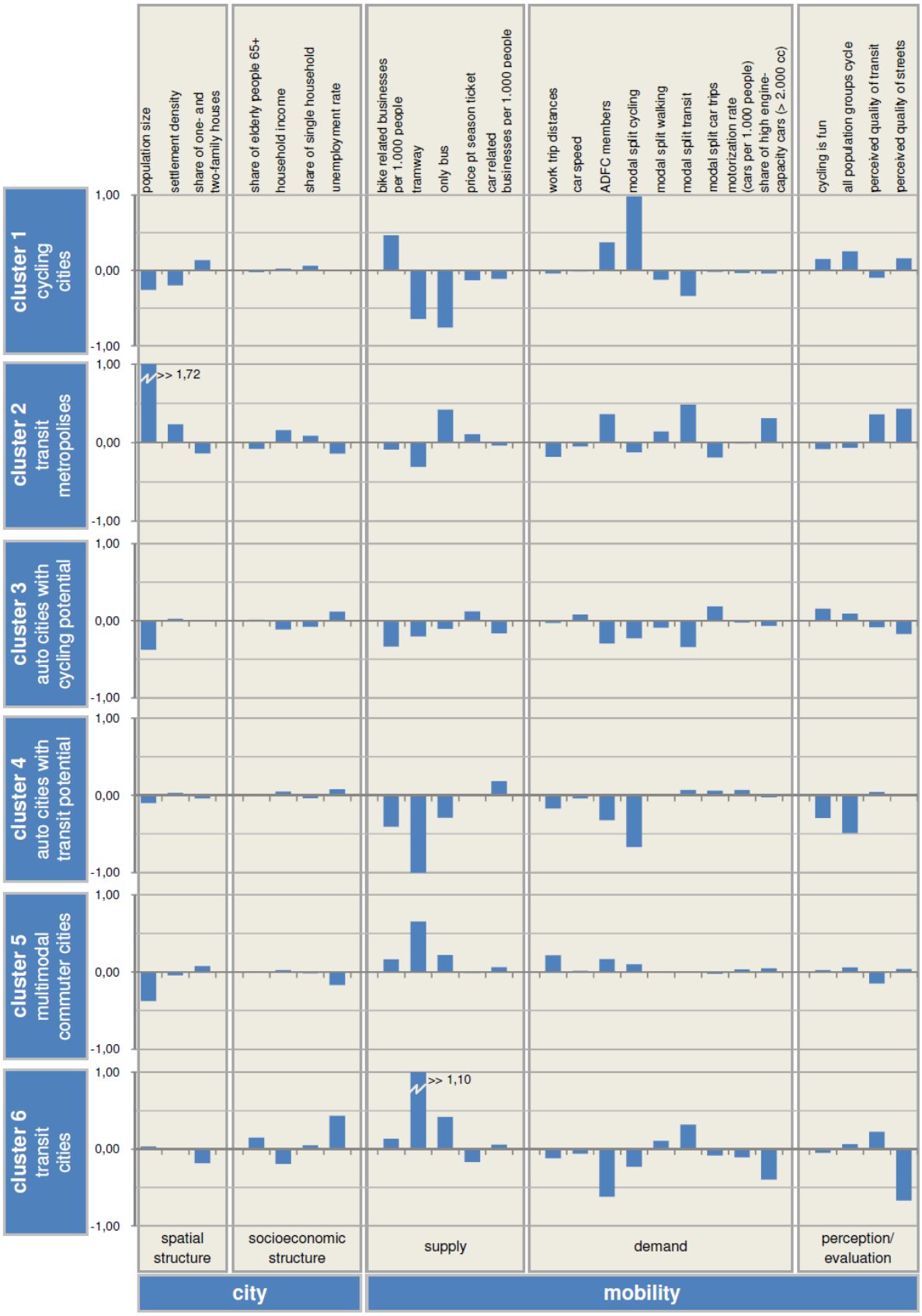

Fig. 4 mean divergence by cluster and variable

Cluster 1 – cycling cities

Aachen, Bremen, Lübeck, Münster, Oldenburg, Osnabrück

This group of cities is characterized by a clearly above-average cycling-orientation in terms of supply, usage and perception. This is indicated for example by high modal shares of cycling trips as well as a 'cycling climate', which is considered as fun-oriented and covering all population groups by the respondents of ADFC surveys in 2003 and 2005. Moreover, transit has a rather low importance since Bremen is the only city offering a rail-based transit system and modal shares of transit trips are below the average of all analyzed cities. Further attributes of these cities are a rather low population size and settlement density as well as a household income and shares of single households, which lie slightly above average. The combination of high cycling shares and low settlement densities is – as discussed above – somewhat surprising, but may be due in part to the link between small settlements and low density. Certainly further research is required on this point.

Taking in account features which aren't included in our set of indicators, it is eye-catching that except Lübeck all cities are traditional university towns with a high proportion of students, which might be one reason for the high share of single-households. An assumed relation between a student-like lifestyle and a strong cycling-orientation is an aspect, which is worth examining further, for example by including the share of students as an additional indicator to future versions of our cluster analysis. Another feature, which all cities of this group have in common, is a rather monocentric spatial structure within a relatively rural environment. This characteristic might explain the below-average distances of journey-to-work trips as well as to some extent the strong cycle-orientation since urban form tends towards - although not being necessarily dense in terms of population density - rather compact and radial. The fact that all cities lie in northern parts of Germany, characterized by a rather flat topography, to our mind should not be emphasised too much, since southern cities like Erlangen or Freiburg (Breisgau) possibly belong to this cluster but are not included in our sample of cities. It is noteworthy however that these northern German cities suffer more climatically from a cycling, viewpoint and yet are cycling-oriented.

Regarding quality and homogeneity this cluster is – compared to the other ones – relatively heterogeneous since the F-values for nine out of the 25 indicators are slightly higher than 1, which is a sign that the variance of values within the cluster exceeds the overall variance of these attributes.

Cluster 2 – transit metropolises

Cologne, Düsseldorf, Frankfurt am Main, Hamburg, Munich, Stuttgart

This group of cities is characterized by high-standard transit systems, based on rapid-transit rail networks, called 'S-Bahn', in addition to either a metro system (Berlin, Hamburg, Munich) or a light rail system, operating below surface at least in inner city areas (Frankfurt, Cologne, Stuttgart). Consequently, modal shares of transit are relatively high, and private car use

rather low. Not surprisingly, this high transit standard occurs in big and relatively dense metropolitan-like cities, since a sufficient demand for these systems is existing there.
Further attributes of this group are above-average household income and share of single households, whereas unemployment is relatively low. Other wealth indicators like share of high engine-capacity cars and number of ADFC members show also comparable high values in these cities.

Further characteristics of these metropolises not included in our analysis are an attractive job market, multifaceted socio-cultural offerings combined with a generally open-minded atmosphere as well as a high share of car-free households, up to 40% in some cases (see Lötscher et al. 2001: 62). These features lead us to the somewhat simplified conclusion, that these cities and their populations can be described as 'affluent, trendy and car-free'.

This cluster can be regarded as relatively homogeneous as only two out of 25 variables show F-values higher than 1.

Cluster 3 – auto cities with cycling potential

Duisburg, Hamm, Herne, Leverkusen, Ludwigshafen, Mannheim, Oberhausen, Offenbach am Main

The cities of the third cluster are identified as relatively poor (low household income, high unemployment) and rather car-oriented (high modal share of private car use). These results suggest socio-economic weaknesses, caused by structural transformation as well as a rather car-oriented city planning and transport policy.

These assumptions are confirmed when we take a closer look at these urban agglomerations. All of them are traditional centres of heavy industries such as coal, steel or chemicals, often linked to one or two big enterprises such as BASF in Ludwigshafen, Bayer in Leverkusen or Thyssen-Krupp in Duisburg. Some of these cities have to deal with enormous economic challenges, since the mentioned industries are declining continuously. Moreover, some of the included cities are known for rather car-oriented city-planning based on motorways, even crossing the city centre as in Duisburg or Ludwigshafen.

Somewhat astonishing is that conditions for cycling are perceived as reasonably good, although cycling plays just a minor role in local modal splits. This paradoxical finding supports the assumption that within these cities a potential for more cycling trips exists which just hasn't been realized yet.

The quality of this cluster can be described as relatively high since only three variables are related to F-values higher than 1.

Cluster 4 – auto cities with transit potential

Bochum, Essen, Fürth, Mönchengladbach, Wiesbaden, Wuppertal

Within the cities of the fourth cluster travel behaviour and modal choice are characterized by a clear orientation towards transit and car use, whereas the level of cycling and related businesses is rather negligible. Besides the common car-orientation, the sample of cities is of a rather heterogeneous nature, including traditional industrial towns like Bochum and Fürth but also rather affluent cities like Wiesbaden, which is the capital of the federal state Hessen. Therefore the reasons and motives for the existing car-orientation are not clear, so that further research on this topic is advisable.

Another interesting point is that although comparatively high shares of transit trips occur in the majority of cities, only bus services are available, which indicates that high-standard and well accepted transit systems do not always have to be based on rail systems. Nonetheless, the introduction of light rail systems as for example discussed in Wiesbaden might strengthen the transit-orientation even more.

The fourth cluster can be regarded as relatively homogeneous since just three variables are indicated by F-values of more than 1.

Cluster 5 – multimodal commuter cities

Augsburg, Bielefeld, Bonn, Darmstadt, Heidelberg, Karlsruhe, Krefeld, Mainz, Mülheim an der Ruhr, Neuss, Nürnberg, Potsdam, Reutlingen, Saarbrücken

This cluster encompasses most cities (14) and is rather heterogeneous, regarding the variance of the indicators – five out of 25 variables show F-values higher than 1 – as well as the history and socio-economic structure of the cities. Traditional industrial centers such as Saarbrücken and Krefeld are included, as well as typical University towns like Heidelberg and Bonn. Cities embedded in polycentric metropolitan areas like Darmstadt and Mülheim an der Ruhr are incorporated, as well as monocentric cities with a rural hinterland such us Reutlingen and Augsburg.

Nonetheless, these cities have many features in common since they are all medium-sized and rather well equipped in terms of transit infrastructure and cycling-related businesses. Somewhat surprinsingly modal share of transit and its perceived quality don't correspond as clearly as expected to the high standard of transport supply. To our mind this might be regarded as complaining on a high level, since most of these cities are well-known for efficient and high-standard systems. Since several cities in this cluster, for example Heidelberg, Augsburg, Saarbrücken and Karlsruhe, extended their tramway or light rail networks in the last years, it would be interesting to know if the corresponding transit shares have risen since 2002, the year the applied data have been collected. We can conclude that generally these cities have a high transit standard and ongoing potential. In combination with above-average values on all cycling-related indicators (supply, usage and perception) and car-related variables which are slightly higher than average, we describe these cities as characterized by a rather multimodal mobility pattern.

A further eye-catching variable is the average distance of work trips, which is much higher than the average of the whole city-sample. Together with the slightly above-average motorization rate, this could be interpreted as a sign for a strong commuter-orientation which is plausible, since quite a few cities of this cluster are located near bigger cities and metropolises (e.g. Mainz / Darmstadt near to Frankfurt, Augsburg near to Munich and Bonn near to Cologne), which suggests a rather high share of out-commuters. Nonetheless, further research on this topic is advisable.

Cluster 6 – transit cities

Chemnitz, Dresden, Leipzig, Halle (Saale)

The cities within this group are characterized by rather strong variations from the mean values of the entire sample, which partly can be explaind by the small sample size. Variables with high loadings on the wealth factor (household income, high engine-capacity cars, perceived quality of road network) show values far below the average. On the other hand all transit-related features (supply, usage, perception) lie far above average. Comparably transit characteristics can only be found in the big metropolises of the second cluster. On the contrary, cycling seems to have no tradition in these cities, since all related variables show rather low values.

Because all four cities are located in Eastern parts of Germany the described results have to be understood in the context of the socio-economic and political transformation process following German reunification. The low wealth indicators point to the economic weakness compared to Western German cities. Furthermore, the strong transit orientation in all four cities could be understood as a persisting consequence of high priority public transport systems enjoyed in the former GDR, and other Eastern European nations. Another detail which could be related to the socialist past is the fact that many social groups cycle (ADFC surveys), although overall cycling orientation is rather low. This could possibly be interpreted as a sign that social differences and milieu-specific routines and practices are developed to relatively low level.

The quality of this cluster is regarded as medium-level since four out of 25 F-values are higher than 1.

DISCUSSION AND CONCLUSION

The aim of this paper was to operationalize the theoretical concept of urban mobility cultures, which are described as a combination of subjective and objective characteristics such as mobility-related preferences and practices on the one hand, and spatial, socio-economic and political structures on the other hand. Furthermore, the concept has been related to Giddens' structuration theory which defines social structures as a framework, which in turn allows an

efficient organization of daily social life by enabling and restricting the range of accepted practices.

In order to quantify and operationalize the described concept we choose a set of 25 indicators which we applied to a sample of 44 German cities with more than 100.000 inhabitants. Drawing from elements of the mobility cultures concept such as lifestyles, travel behaviour, transport policy and infrastructure, we collected data from a wide range of sources. The applied indicators can roughly be divided into spatial and social patterns at a city-level, transport supply and transport behaviour, as well as mobility-related perceptions and evaluations.

Conducting a factor and cluster analysis, we obtained six clusters ranging in size from four up to 14 cities. By interpreting the average value of any variable within every cluster, we named the six groups regarding their main characteristics as follows: cycling cities, transit metropolises, auto cities with cycle potential, auto cities with transit potential, multimodal commuter cities and transit cities.

The particular value of these findings is that they describe how and to what extent urban mobility patterns vary within the same political and socio-cultural context. A further result is that cities having the same historical and socio-economic starting position such as the traditional industrial centres of the Ruhr area, nonetheless vary so much that they are included in different clusters. This finding confirms the initial assumption of the mobility cultures concept, which says that these social structures aren't fixed and homogeneous entities but dynamic and clearly changeable social fabrics. This argument leads to the further research question of what determines the significantly different priorities found in the mobility culture of a wide range of cities.

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