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Mobility

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Spatial mobility refers to both migration-related mobility and daily, regular or occasional changes of location, triggered by the desire or need to carry out an activity at the destination. In this way, people explore the given options for action in space.

1 Clarification of the term

Mobility refers to the movement of individuals. The term *Mobility* is used in the sciences concerned with physical ▷ *Space* as well as in scientific fields that deal with humans and society. In the spatial sciences, spatial mobility is the subject of research and planning, while the social sciences focus on social mobility and psychology and medicine/pharmaceuticals focus on mental and intellectual mobility.

Spatial mobility describes a change of location that is triggered by 'the necessity, ability and need of living beings to change location' (Gleich 1998: 11). This change of location can take a permanent form. In this case it is a matter of migration, combined with a change of residence. This contrasts with spatial mobility as an everyday movement that usually begins and ends at the place of residence over the course of a day. For this reason, day-to-day mobility is sometimes also referred to as 'circular mobility' (cf. Bähr/Jentsch/Kuls 1992). Everyday mobility can be regular or frequent, such as driving to work, or only occasional or rare, such as an appointment at an administrative office or a weekend trip. *Mobility* includes any movement that traverses space and serves a specific purpose. In the vast majority of cases, the purpose is an activity at the destination, e.g. working or shopping; in addition, mobility as such can also be pursued as a purpose in and of itself (cf. Mokhtarian/Salomon/Redmond 2001).

A constantly neglected aspect of mobility is long-distance mobility (or travel), i.e. mobility over longer distances and over a longer period of time. As a rule, travel is defined based on the fact that one spends at least one night at the location, as defined in the national mobility survey 'Mobility in Germany'. The fine distinction between different types of travel (e.g. short trip, holiday trip, business trip) is made based on the number of overnight stays and the purpose of the trip.

A special case of spatial mobility is virtual mobility, which is a means of overcoming distances without any (directly perceptible) physical movement using ▷ *Information and Communication Technology* (ICT). Virtual mobility is today used in numerous fields, such as electronic commerce, remote working or telehealth. In every case, virtual mobility fundamentally substitutes for physical mobility. However, it can be assumed that when virtual mobility is integrated into daily activities, substituting, complementary and inducing elements will overlap; at the same time, the way in which activities are carried out changes. For this reason it is unclear whether the use of ICT reduces traffic, as is often assumed (cf. Lenz 2011).

The term *mobility* focuses on the actions of the individual. The term *traffic* denotes the aggregate result of individual spatial mobility. This aggregate is characterised by the mode of mobility on the basis of the available options through individual traffic behaviour (▷ *Road traffic*; ▷ *Railway transport*). Occasionally the term *mobility of goods* is used, which mostly focuses on the fact that the production and distribution of goods is connected with spatial movement (trade), but from an economic perspective it also serves to distinguish it from factor mobility, that is the mobility of the production factors land, labour and capital (cf. Weerth 2016) (▷ *Commerce*). This article relates exclusively to personal mobility.

2 Reasons for mobility

According to Zelinsky (1971), one of the most significant characteristics of highly industrial societies is that they are highly mobile. The need for everyday mobility is related to the differentiation between society and the economy; the further this differentiation extends, the greater the need for mobility. A major trigger is the division of labour in the economy, but also in administration and other state institutions, which leads to a differentiation and division of space as well as a subdivision of time. This determines where and when people can undertake activities outside their home – work, education, shopping and free time activities. Mobility is shaped and influenced by the individualisation and pluralisation of ▷ *Lifestyles*, which are primarily attributed to an increase in prosperity, a reduction in working hours and an increase in the level of education (cf. Schimank 2012).

The emergence of day-to-day mobility is closely linked to industrialisation and the social developments associated with it. With regard to travelling between the home and the work place, the mobility of labour can be understood as the beginning of regular and functional mobility, at least in industrialised countries. At the same time, a need for mobility in training was prompted by the newly emerging economic and social structures. In Prussia, which was a pioneer in the educational sector, general compulsory elementary school education was implemented in 1845, and from 1869 attending a vocational school was mandatory for apprenticeships. However, because educational opportunities depended on social class, schools were often established close to pupils' homes, such that journeys to school were essentially on foot until well into the 20th century.

The ▷ *Social change* triggered by industrialisation and the simultaneous functional differentiation within cities and the connections between cities had a significant influence on the development of new mobility needs. At first, shopping became increasingly important due to the gradual improvement in the economic livelihoods of ever greater parts of the population and the associated change in consumer behaviour of private households. While the vast majority of household income had to be spent on food up to the middle of the 19th century, this proportion is now only 14%. Since then, the number of consumer goods owned by households and individuals has grown enormously (cf. Destatis 2016).

In addition to this, for decades there has been an increase in mobility for leisure purposes. At the beginning of the 1960s, the non-working weekend became the rule in West Germany, which at first gave rise to mainly local recreational traffic; as mass motorisation gradually increased, this also opened up the wider area surrounding the residential areas. The weekend trip became a leisure activity that has since become an integral part of modern consumer behaviour, both in Western and Eastern Germany (cf. Irmscher 2000; Dienel 1997; Schuster 1994). Today, recreational traffic makes up the largest share of traffic volume with around a third of the journeys. The most important leisure purpose is visiting or meeting friends, relatives and acquaintances (16% of leisure journeys), followed by walks or rides (8% of the leisure journeys). In third place is active sport exercise which accounts for 6% (cf. *Mobilität in Deutschland, MiD* [Mobility in Germany] 2008, author's own analysis).

3 Mobility and travel behaviour

Mobility needs and their realisation are equally influenced by economic, social and individual factors. The economy and society provide the framework in which mobility can and must take place. This includes physical elements such as settlement structures (▷ *Settlement/settlement structure*) and the infrastructure that develops and connects them (▷ *Infrastructure*), but also social standards and values that relate to individual mobility. The essential individual factors include an individual's socio-demographic and socio-economic characteristics, such as their age, gender, level of education and income, but also factors pertaining to their household situation. To illustrate this with a simple example: people of different ages develop different needs with regard to the places they want or need to go to – e.g. the playground, the workplace or the supermarket. In addition, mobility needs and how they are fulfilled are influenced by personal preferences, such as those expressed in the diversity of leisure activities outside the home.

The specific way in which individuals realise their mobility needs is what is known as travel behaviour or traffic behaviour. This term is not clearly defined, but rather serves as an umbrella term which encompasses the numerous different means and characteristics of active mobility, such as car and bicycle ownership or the frequency of activities outside of the home. The central major factor in travel behaviour is the choice of the means of transport. It reflects the needs, options and preferences of road users and determines the composition of the existing traffic. For this reason, the choice of the means of transport is also seen as the key to behavioural changes, which can help to reduce the undesirable effects of traffic. However, time and again it has been noted that travel behaviour is difficult to change in view of habits and routines – that are tried and tested from an individual point of view – or that voluntary changes can only be achieved over longer periods of time (cf. Wilde 2014).

Changes in traffic behaviour that have become apparent in recent times primarily relate to young adults and senior citizens. Among young adults, the fact that fewer have a car they can use and the decline in the proportion of ▷ *Motorised individual transportation* is particularly noticeable in the modal split (cf. *ifmo* [Institute for Mobility Research] 2011) . The day-to-day mobility of this group is barely increasing, and this applies not only to the young population in big cities, but also outside the metropolises. The falling average car availability and use of motorised individual transport among young adults has led to much speculation about the reasons for this. On the one hand, a change in the importance of having a car can be assumed, in particular due to the increasing importance of other consumer products such as mobile phones and smartphones; on the other hand, a general change in behaviour towards 'using instead of owning' has been suggested. There is currently no conclusive empirical evidence for either assumption (cf. Lenz 2014). Instead, there is clearly verifiable evidence that the behavioural changes in young adults are largely due to changed social and economic living conditions. A relevant influencing factor is the increase in the proportion of young people who aspire to a university education and therefore live in cities with a well-developed public ▷ *Transport infrastructure*, who often have a semester ticket. In addition, the household incomes of young adults have fallen in recent years – this applies not only to Germany, but also to a whole series of other industrialised countries (cf. Kuhnimhof/Buehler/Wirtz et al. 2012).

A considerable proportion of the increase in mobility among the elderly is due to the increased use of cars. Older women and men not only drive more often, they also cover longer distances over the course of the year (cf. *infas/DLR* [Institute for Applied Social Sciences / German Aerospace Centre] 2010; Buehler/Nobis 2010). In a comparison of 2002 and 2008 by Mobility in Germany, the general observation was that (1) the proportion of older people who leave the house every day has increased, (2) the elderly cover longer distances on average and (3) above all, the proportion of journeys made for free time and shopping has increased. This increased mobility is largely attributed to their increasing physical fitness (cf. Kasper 2007). However, in view of the increase in both shopping and leisure journeys during the transition to retirement age, it seems reasonable to assume that the consumption patterns of older people are also changing. The influence of lifestyle or mobility style on the travel behaviour of older people and the changes associated with this has thus far received scant attention in the research (cf. Lüdtke 2000). There are still considerable gaps in knowledge here. This contributes to the fact that senior citizens are often not perceived to be the distinctly heterogeneous population group they really are, having considerable differences in terms of social relationships, economic resources, cultural preferences and health requirements (cf. Spellerberg 2014).

4 Measuring mobility

The measurement of mobility is almost always a measurement of the mobility that has actually taken place. National mobility surveys that are carried out in numerous countries around the world and essentially pursue very similar objectives are of particular importance in the measurement of mobility. While they tend to collect similar data, a direct comparison can still only be made within certain restrictions due to methodological differences.

The first national mobility survey in Germany was the Continuous Survey on Traffic Behaviour *(Kontinuierliche Erhebung zum Verkehrsverhalten, KONTIV)* in 1976. A further series of surveys followed in 1982 and 1989 and then, under the new name Mobility in Germany (MiD) in 2002, 2008 and 2016. Both the Continuous Survey on Traffic Behaviour and the Mobility in Germany surveys were commissioned by the Federal Ministry of Transport (*Bundesverkehrsministerium*). The Technical University of Dresden *(TU Dresden)* has been conducting the System of Representative Traffic Surveys mobility survey *(System repräsentativer Verkehrsbefragungen, SrV)* in German cities since 1972, using an increasingly uniform survey design (cf. *TU Dresden* 2016). Mobility in Germany and SrV are cross-sectional surveys which can also make changes in mobility visible by comparing different survey years (cf. infas/DLR 2010).

In contrast to this, the Mobility Panel *(Mobilitätspanel, MOP)*, which is also commissioned by the Federal Ministry of Transport and is representative of all German-speaking households in Germany, surveys the stability and changes in intrapersonal travel behaviour; it therefore looks at travel behaviour in a longitudinal profile. *Panel* is a term from empirical social research that denotes surveys that 'repeatedly record information on the same facts at different points in time for the same survey units', so that it is possible to map intrapersonal changes over time (cf. *KIT* [Karlsruhe Institute of Technology] 2016). Due to the similarity in the recording strategy based on a travel diary, the Mobility Panel and Mobility in Germany are largely compatible.

Half of the households that have access to a car also keep a logbook in which the mileage and fuel consumption are noted.

Table 1: Mobility indices for Germany in 2017

Population	82,200,000				
Traffic volume (journeys)	260 million per day (approx.)				
Transport performance (passenger kilometres)	3,200 billion per day (approx.)				
Modal split	Car driver (motorised individual transportation)	Car passenger (motorised individual transportation)	Public transport	Bicycle	On foot
Traffic volume (journeys) (in percent)	43	14	10	11	22
Transport performance (passenger km) (in percent)	55	20	19	3	3
Proportion of mobile people	85%				
Average number of journeys per person per day	3.1				
Average number of kilometres per person per day	39 km				
Average time spent travelling per person per day	79 min				

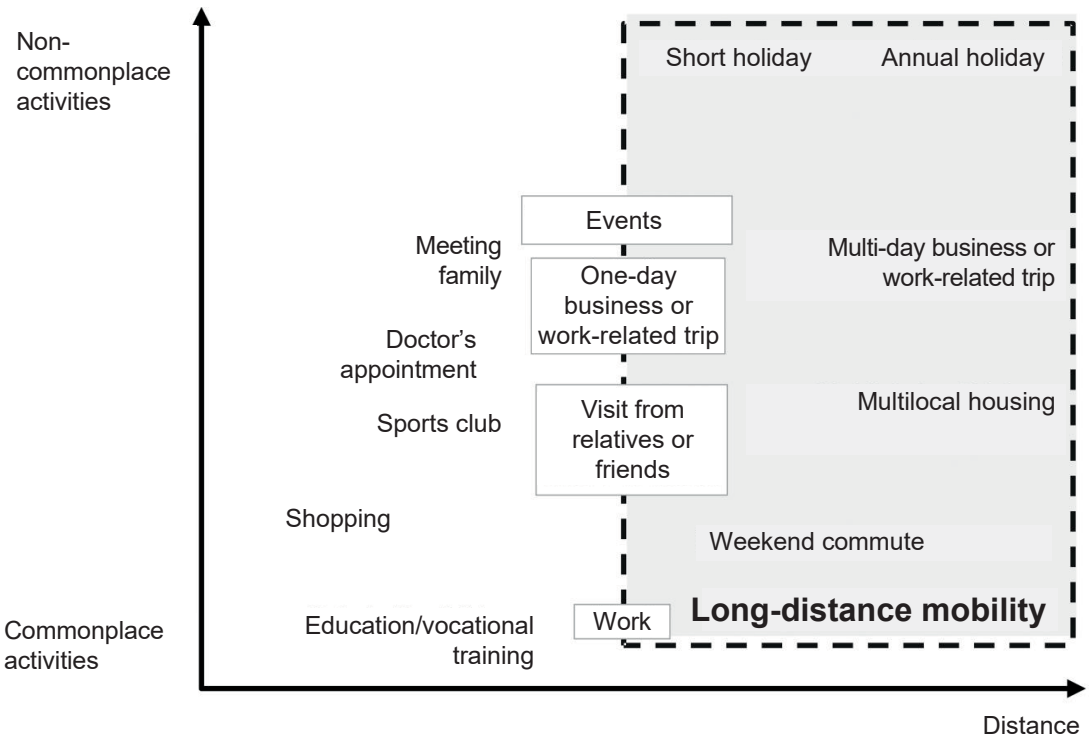
Source: BMVI (Ed.) 2018

The main results of the mobility surveys are firstly parameters on the extent of day-to-day mobility, expressed in terms of traffic volume (number of journeys) and transport performance (kilometres driven by mobile people). On the other hand, the modal split is determined, i.e. the share of the distance/kilometres driven (or covered on foot) using a particular type of transportation. Other fundamental values for assessing mobility trends are the mobility rate (proportion of respondents who made a journey on the day of the survey), the number of journeys,

the daily distance and the time that the average population spent on mobility. Table 1 shows the corresponding values for Germany.

The mobility parameters collected at the national level form an important input for the benchmark 'Traffic in Numbers', which has been published annually by the Federal Ministry of Transport since 1971 and serves as a statistical compendium for mobility and traffic in Germany. The figures on the volume and development of traffic are supplemented by information about key parameters relating to the framework conditions and also the effects of traffic, such as the number of vehicles, the number of people holding a driving licence, traffic expenses or traffic accidents (cf. *BMVI* [Federal Ministry of Transport and Digital Infrastructure] 2016).

Figure 1: Long distance mobility as part of individual mobility



Source: Kuhnimhof 2014: Sheet 6

There has been a lack of surveys on long distance mobility over the past years, and the few individual surveys that have been conducted, such as INVERMO (Zumkeller/Manz/Last et al. 2005), are isolated studies; there has been no continuous observation. This is all the more unfortunate as long distance mobility makes up around half of the total passenger transport performance in Germany (cf. Fig. 1).

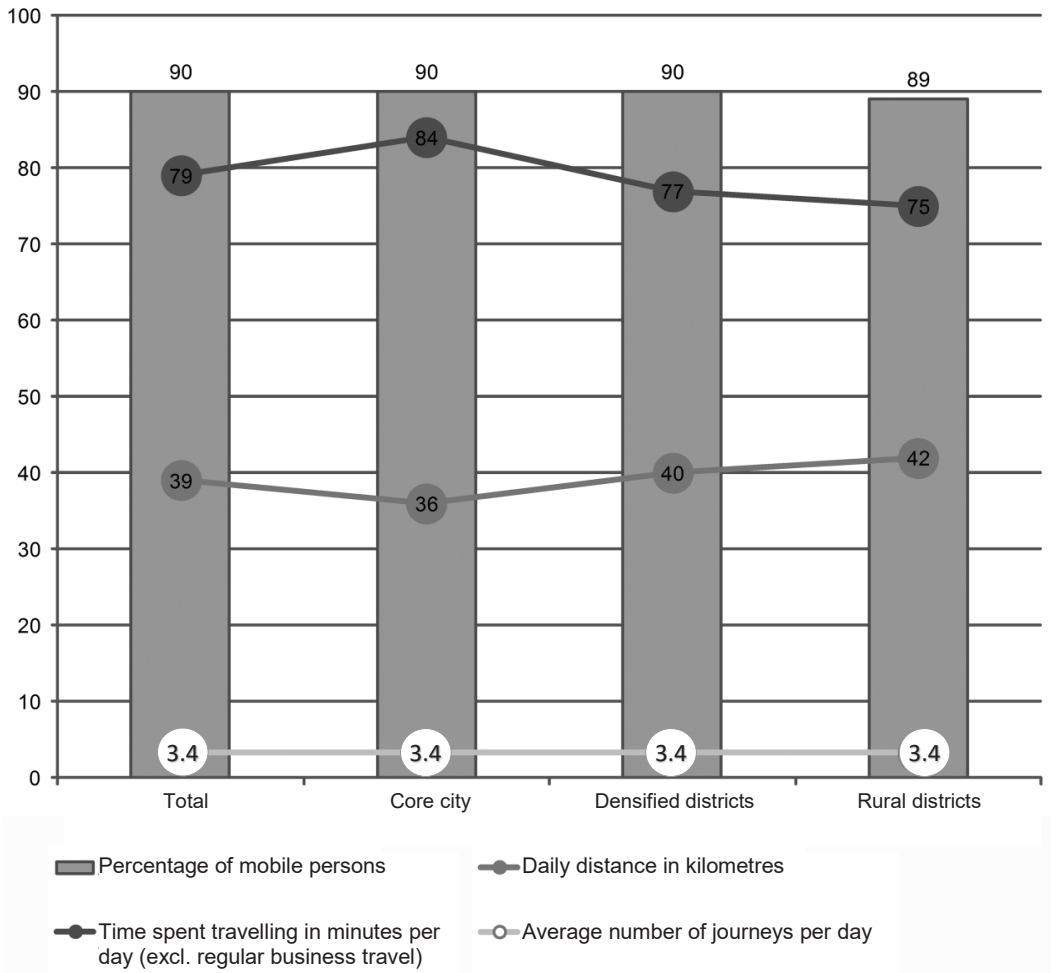
5 Mobility and space

The connection between mobility and space has been comprehensively discussed in numerous empirical studies. The results from the Mobility in Germany surveys suggest that – at least in Germany – mobility needs are independent of space, but that the specific realisation of these needs varies according to the spatial categories in which the mobile people live (cf. Fig. 2). Mobility rates (the proportion of people who made a journey on the day of the survey) and the average number of journeys per day are almost identical in the *core cities*, *densely populated districts* and *rural districts*; the mix of activities that triggers mobility also varies little between these spatial categories. However, the travel distances and durations differ considerably: in the core cities, the daily distance is the shortest with 36 km, but requires the longest travel time with 86 minutes per day (0.41 km per minute). In contrast, in rural districts 42 km per day are covered in 75 minutes (0.56 km per minute) (cf. *infas/DLR* 2010: 42). The main reason for this is the difference in the modal split, since in the core cities a significantly higher proportion of journeys are made on foot and by public transport (▷ *Public transport*; ▷ *Urban traffic*; ▷ *Transport in rural areas*).

The connection revealed by the national traffic survey has also been analysed in numerous individual studies on day-to-day mobility in Germany (▷ *Transport planning*). The settlement features used in these studies were (and are) in particular the size of the place, the proportion of the area covered by the settlement and the population and settlement density. These studies have shown that dense building structures and a high level of centrality go hand in hand with comparatively low traffic needs for work, training and shopping, and at the same time, the potential accessibility of destinations for such activities increases. From this, the following assumptions on the relationship between settlement structures and travel behaviour were derived, which also contributed considerably to the development of guiding principles for the compact city (▷ *Guiding principles for urban development*) (cf. Siedentop/Kausch/Guth et al. 2005: 37):

- The proportion of non-motorised mobility is comparatively high in compact settlement structures.
- The distance travelled by mobile people is comparatively short.
- The use of local public transport is comparatively high, while the use of private cars is comparatively low.

Figure 2: Central mobility parameters according to type of district



Source: infas/DLR 2008: 42

Nonetheless, the expectations regarding the impact of dense settlement structures on traffic and transport were themselves highly contradictory. This was especially true where these expectations relied on the (implicit) assumption that the observed relationship was of a causal nature. The main points of criticism in the discussion which ensued were (cf. Siedentop/Kausch/Guth et al. 2005):

- The studies were limited to static, mono-causal interpretations of differences that are based solely on settlement density and that are seen in the travel behaviour of residents in different settlement structures, while they neglected at the same time essential socio-demographic and socio-economic influencing factors such as level of education, household size or income (cf. Holz-Rau 1995)

- The studies neglected the effects of self-selection, which are based on the choice of residential location and thus on a process that precedes day-to-day mobility (cf. Holz-Rau 1995; Crane/Crepeau 1998)
- Above all, with regard to cities and urban agglomerations, the studies did not sufficiently take into account destination traffic from the surrounding area (cf. Holz-Rau 1995)
- The studies primarily considered commuter traffic, neglecting leisure traffic in particular (cf. Gordon/Richardson 1997)
- There was insufficient critical reflection on the meaningfulness of the information yielded by the analyses with regard to the spatial scale on which the respective study was based (cf. Ewing/Cervero 2001)
- The studies incorrectly deduced recommended actions for policymaking and planning on the basis of the proven correlation between settlement structure and mobility (cf. Handy 1996)

The result of the intense discussions that have taken place since the 1990s is that differences in travel behaviour in different types of settlement structures are no longer classified in terms of a causal relationship between settlement structure and mobility; rather, spatial structures enable specific forms of mobility behaviour, but do not determine them.

6 New mobility strategies

In contrast to transport strategies which deal with the interaction of different means of transport in an overall system, mobility strategies (following on from the understanding of the concept of mobility) refer to the provision of options for fulfilling mobility needs. Particular attention is paid to the so-called new mobility strategies, which mainly involve sharing options for bicycles or cars, occasionally even in connection with public transport. At the core of these strategies is the provision of a single means of transport on a temporary basis.

Classic car sharing as a variant of such mobility strategies has existed in Germany since 1988 (cf. Loose 2014). In 2015, almost 8,000 vehicles were available for around 800,000 registered users in more than 490 cities and municipalities as part of station-based offers. Several classic car sharing providers have mixed systems with station-based vehicles and non station-based vehicles (cf. *bcs* 2015).

The new mobility strategies are considered new due to the specific usage options, which are extremely flexible in terms of both time and distance, but only within the area that the respective provider covers. This coverage is currently limited to sub-areas within large cities that are already equipped with a variety of mobility options. The user does not have to specify the rental period in advance; the vehicles can be parked anywhere or at one of the many stations in the area. In contrast to classic car sharing, this flexible form of car sharing is characterised by comparatively short rental times and the use of vehicles on routes that are mostly between 5 and 25 km long (cf. bcs 2015).

The principles of supply and hire are very similar for bicycles. The flexible form of bike sharing was introduced by Deutsche Bahn in 2000 as 'Call-a-Bike'. In the meantime, comparable hire systems, such as NextBike or MetropolRadRuhr, have been set up in several cities. In all of these systems, bicycles are made available in public spaces for short-term hire (▷ *Public space*).

The emergence of the new mobility strategies is largely due to the technological possibilities that have arisen due to digitisation. The main elements of the provision of the service and communication with the user are based on digital technologies and networking, e.g. the location of the vehicle, reserving a vehicle, granting access authorisation to the vehicle or billing for the vehicle use. An important breakthrough came when Apple launched its first app store, which made mobile apps (application software for mobile devices) – and thus comparatively easy-to-use software – available to smartphones.

7 Outlook

The discussion over the past few years has centred on the question of whether and to what extent the development of mobility and thus the demand for transport have peaked. Indeed, the expectations for industrialised countries assume that this peak has occurred due to market saturation (cf. Millard-Ball/Schipper 2011). However, this by no means applies to emerging and developing countries, which have been catching up for years (cf. Kuhnimhof/Lenz 2016). The cap on the demand for transport has been explained by the fact that technological advances within the existing spatial and settlement structures mean that further significant improvement in travel times are not expected and the population is not willing and does not need to spend any more time on day-to-day mobility. Against the backdrop of the likely future automation of driving, including in individual transportation, this assumption is currently under examination. It cannot be ruled out that people in an individual vehicle or in an individualised public vehicle will accept longer journey times, since the journey time is no longer filled with the task of driving. This could have massive effects on the settlement structure (cf. Heinrichs 2015). In order to draw more concrete conclusions, developments over the next 10 to 15 years will have to be followed carefully.

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