NEW LOCATION, NEW MOBILITY?

THE INTERACTION BETWEEN DAILY MOBILITY AND RESIDENTIAL RELOCATION IN BERLIN'S RUMMELSBURGER BUCHT

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Erwischt!

Preface

The completion of this research entails the final stage of my master program in Urban Geography. Over the last five years, I have been studying the bachelor program in Human Geography and Planning and the master program in Urban Geography at Utrecht University. I believe that my studies have been a very valuable contribution to my knowledge about how people shape their lives and environment on our planet and have helped me to achieve what I wanted to be since I was a kid: a geographer. With a lot of enthusiasm, I am looking forward to continue working in the dynamic and interesting world of (urban) geography.

The research presented in this thesis is the result of the study I conducted in Berlin and Utrecht between March and August 2012. This study was part of my internship at the Deutsches Zentrum für Luft- und Raumfahrt (DLR) Berlin and covers the interest of both the faculty of Geosciences of Utrecht University, DLR and my personal interest in mobility and urban geography. The research is the result of six months of intense theoretical and empirical analyses and could not have been completed in its current form without the help of several people. First of all I would like to thank everyone at the DLR for their helpfulness, friendliness and for giving me the unique chance to live and work in one of the best cities in the world. I especially want to thank Dirk Heinrichs and Julia Jarass, for their willingness to always help with my research, the comments and suggestions on all my work and their guidance in helping to put the focus on the right aspects. I would also like to thank my supervisors in Utrecht, Jan Prillwitz and Pieter Hooimeijer. Jan brought me in contact with the DLR and thereby provided me the opportunity to fulfill my desire to combine my master thesis with an internship abroad. Besides, I want to thank him for his comments on the early drafts of parts of the thesis. The help of Pieter has been of great value for the finalization of the thesis, by helping me to get *to the point* in order to achieve a more structured and comprehensive thesis.

Furthermore, this research could not have been completed without the help of the following persons which I would like to thank: the people living in my research area Stralau-Stadt in the Rummelsburger Bucht in Berlin, for their cooperation with my empirical research; my sweet friend Taleatha for her comments on spelling and grammar and the times we spend together in Utrecht and Berlin; and my friends and everyone in Utrecht and Berlin, for their support, inspiration and the sometimes needed distractions. Last but not least, I want to thank my family and especially my parents for their trust in me and for giving me the comfortable feeling of having the best home I can imagine.

Berlin/Utrecht, 2012

Diese Stadt hatte mal einen Schlaganfall erlitten, und die Folgen waren noch immer sichtbar. Wer von der einen Seite in die andere ging, durchquerte einen merkwürdigen Riktus, eine Narbe, die noch lange zu sehen sein würde. Hier war das trennende Element nicht das Wasser, sondern jene unvollständige Form der Geschichte, die Politik genannt wird, wenn die Farbe noch nicht ganz trocken ist."

– Cees Nooteboom, Allerseelen

Content

English summary

A residential relocation can lead to a variety of changes in someone's life such as a new house, a new school, a new living environment and new neighbours. The question is however: can a residential relocation also result in a change in daily mobility? This research focuses on the possible change in daily mobility by looking at the mutual interactions between daily and residential mobility. Thereby the questions addressed are: Which role does daily mobility play in the decision for a residential relocation; and to what extent does this residential relocation lead to a change in daily mobility? This question is answered by an analysis of the available literature and a quantitative empirical research in the Rummelsburger Bucht area in Berlin. This newly built residential inner city area was expected to be associated from an environmental point of view of more sustainable mobility patterns. This research hopes to contribute to this association by showing if a neighbourhood like the Rummelsburger can indeed lead to more sustainable mobility patterns and then perhaps the construction of such areas can become attractive from a mobility perspective.

As a framework for the mobility component, the emphasis has been on a theoretical analysis of approaches to daily mobility, habitual mobility and on a life-course perspective on residential mobility. The relations between urban form, mobility and other determinants of mobility have also been examined and the case-study area of the Rummelsburger Bucht has been put into a wider context of inner city projects and also within its city, Berlin.

The findings of the research indicate that mobility does not play a role in the decision to relocate. On the other hand, mobility aspects did play a role in the relocating process as it affected the location decision. Still, the influence that mobility had in the location decision was on most aspects found to be lower than aspects of the built environment and accessibility. Although correlations were found between the preference to relocate to an area that facilitated the travel needs and the actual transport mode usage, these 'residential self-selection effects' on mobility are expected to be low as they seem to be only limitedly supported by the motives for relocation. The location motives indicated that aspects that are normally associated with a residential location more outside of the city centre (e.g. an own garden, a quiet area and the availability of green spaces and terraced-housing) were important motives to move to the Rummelsburger Bucht. Together with the finding that most households previously lived in (central) Berlin, this means that the area can offer opportunities for people in Berlin who otherwise might have left the city to satisfy their preferences and at the same can attract people from outside the central areas to Berlin's centre. Areas like the Rummelsburger Bucht can therefore contribute to the re-urbanisation process of the city. This is particularly of importance in the case of Berlin, as the city is struggling with financial problems and needs to attract and retain wealthy residents and businesses.

Whereas only a minor role for daily mobility on residential mobility was found, more effects were found for residential mobility on daily mobility. The descriptive analysis showed that the households in the Rummelsburger Bucht had characteristics and mobility tools that are associated

with higher travel distances and car-use. A comparison on city-level however showed hardly any differences in transport mode choice. Overall, no major changes in travel times and travel distances to various destinations were found between previous and the current location, but a closer look showed that there was an increase in travel time and travel distance for daily shopping trips (a consequence of a lack of shops in the area) and a decrease to green spaces, bus/tram stops and regional train-/bus stations. Changes in mobility were also found for the usage of transport modes for commuting-, shopping- and leisure trips. Generally, a relocation to the Rummelsburger Bucht led to an increase in cycling for all three trip purposes and to an increase in walking for leisure trips. This means that it seems that independent of (low) self-selection effects and socio-demographic characteristics a change in the urban form can lead to changes in mobility. Differences in a change in transport mode usage were also found between people that previously lived in central Berlin and in other areas, as the latter group showed an increase in the use of fast local public transport and a decline in car-use for all trips whereas no changes were found for the first group. Furthermore a habit for car-use was found and car-use also decreased for some groups. Although these findings suggest a car-habit breaking effect, no certainty about the relation can be given due to the research method used.

Despite the minor role that daily mobility played in the relocation process, changes in daily mobility occurred after relocation. The results indicate that it makes sense to develop newly built inner city areas like the Rummelsburger Bucht in light of more sustainable mobility patterns and confirm that urban form can have an effect on mobility. It should however be kept in mind that these mobility patterns are dependent on the transport opportunities that are available in the area and that the findings of this research do not automatically apply to other spatial contexts. Moreover, because of the small data set used it is advised to be cautious in generalizing the findings of this research. Further research is recommended to look at the effects for mobility between different projects within the same and between different spatial contexts and to concentrate on daily mobility before and after relocation by using a longitudinal design and travel diaries. Another interesting addition can be to include other forms of mobility such as virtual mobility and to focus on qualitative methods that can also pay attention to the role of attitudes towards mobility.

Keywords: daily mobility, residential mobility, urban form, newly built inner city areas, Berlin

Dutch summary

Een residentiële verhuizing kan leiden tot een aantal veranderingen in iemands leven zoals een nieuw huis, een nieuwe school, een nieuwe woonomgeving en nieuwe buren. De vraag is echter: kan een residentiële verhuizing ook leiden tot een verandering in de dagelijkse mobiliteit? Dit onderzoek focust op de veranderingen in dagelijks mobiliteit door zich te concentreren op de wederzijdse interacties tussen dagelijkse en residentiële mobiliteit. De vragen die daarbij ten sprake komen zijn: welke rol speelt de dagelijkse mobiliteit in de keuze voor een residentiële verhuizing; en tot op welke hoogte kan een residentiële verhuizing leiden tot veranderingen in de dagelijkse mobiliteit? Deze vragen zijn beantwoord met behulp van een analyse van de beschikbare literatuur en een kwantitatief empirisch onderzoek dat is uitgevoerd in de wijk de Rummelsburger Bucht in Berlijn. De verwachting is dat binnenstedelijke nieuwbouwwijken zoals deze wijk geassocieerd kunnen worden met vanuit het milieu gezien meer duurzame mobiliteitspatronen. Dit onderzoek hoopt bij te dragen aan deze associatie door te laten zien of een wijk zoals de Rummelsburger Bucht inderdaad kan leiden tot meer duurzame mobiliteitspatronen en daarmee aan te tonen dat de ontwikkeling van zulke buurten aantrekkelijk kan zijn ten aanzien van het milieu en de mobiliteit.

Allereerst geeft het onderzoek een theoretische analyse van mobiliteit waarbij de nadruk ligt op verschillende benaderingen van dagelijkse mobiliteit, gewoontegedrag en op een *life-course* benadering van residentiële mobiliteit. Daarnaast is in de theoretische analyse aandacht geschonken aan de relaties tussen stedelijke locatietypen (*urban form)* en mobiliteit en is de casus van het onderzoek, de Rummelsburger Bucht, in een bredere context van binnenstedelijke nieuwbouwwijken en haar stad Berlijn geplaatst.

De bevindingen van het onderzoek wijzen er op dat mobiliteit geen rol speelde in de beslissing om te verhuizen. Aan de andere kant speelde mobiliteit wel een rol in het verhuizingproces bij de locatiekeuze. Desondanks was de belang dat gegeven was aan mobiliteit bij de motieven voor de locatiekeuze van minder belang dan factoren met de betrekking tot de nieuwe woonomgeving en de bereikbaarheid. Ondanks dat een correlatie was gevonden tussen de voorkeur om te verhuizen naar een gebied dat voldeed aan de reisbehoefte en het corresponderende vervoermiddelgebruik, zijn de effecten die verwacht worden van deze 'residentiële zelfselectie' beperkt omdat ze deze niet ondersteund worden vanuit de verhuismotieven. Verder toonden de locatiemotieven aan dat motieven die normaal geassocieerd worden met een residentiële verhuizing naar gebieden buiten de stad (bijvoorbeeld een eigen tuin, natuur/groen in de omgeving, een rustige buurt, de aanwezigheid van eengezinswoningen) belangrijke motieven waren om naar de Rummelsburger Bucht te verhuizen. Dit betekent dat, samen met de bevinding dat de meeste huishoudens voor hun verhuizing in centraal Berlijn woonden, de wijk woonmogelijkheden biedt voor mensen uit Berlijn die anders misschien verhuist waren naar buiten de stad om hun behoeften te bevredigen. Tegelijkertijd kan de wijk ook dienen voor het aantrekken van mensen uit de buitengebieden van de stad. Dit wijst er op dat wijken zoals de Rummelsburger Bucht kunnen bijdragen aan het re-urbanisatie proces van de stad. Dit is vooral in het geval van Berlijn van belang, aangezien de stad worstelt met financiële problemen en behoefte heeft aan het aantrekken en behouden van welvarende inwoners en bedrijven.

Ondanks dat slechts een beperkte rol voor dagelijkse mobiliteit op residentiële mobiliteit is gevonden, zijn daarentegen meer effecten gevonden voor de invloed van residentiële mobiliteit op de dagelijkse mobiliteit. In de beschrijvende analyse wordt aangetoond dat de huishoudens in de Rummelsburger Bucht karakteristieken en mobiliteitsmiddelen tot hun beschikking hadden die wijzen op een hoog aantal dagelijks afgelegde kilometers en een hoog autogebruik. Een vergelijking tussen de vervoerswijze keuze van de wijk en de stad laat echter bijna grote geen verschillen zien.

Globaal gezien zijn geen grote verschillen gevonden tussen de reistijden en reisafstanden naar verschillende bestemmingen voor en na de verhuizing. Een meer gedetailleerde kijk laat echter zien dat er sprake is van een toename in de reistijd en reisafstand naar dagelijkse inkoopgelegenheden (als resultaat van een gebrek aan winkels in de wijk) en een afname naar groengebieden, bus- en tram haltes en haltes/stations van regionale treinen en bussen. Veranderingen in mobiliteit zijn ook gevonden in de vervoerswijze keuze voor woon-werkverkeer, de dagelijkse inkoop en recreatieve verplaatsingen. In het algemeen heeft een verhuizing naar de Rummelsburger Bucht geleid tot een toename van het fietsgebruik voor alle drie verplaatsingdoeleinden en een toenemend aantal verplaatsingen per voet voor recreatieve doeleinden. Dit betekent dat onafhankelijk van (beperkte) zelf selectie effecten en sociaaldemografische kenmerken een verandering van de *urban form* kan leiden tot veranderingen in de mobiliteit. Verschillen in de veranderingen van de vervoerswijze keuze zijn ook gevonden tussen mensen die voorheen in centraal Berlijn woonden en mensen die daarbuiten woonden, waarbij laatstgenoemde een toename laat zien in het gebruik van snel lokaal openbaar vervoer en een afname van het autogebruik. Voor mensen die voorheen in centraal Berlijn woonden zijn geen grote verschillen gevonden. Naast deze bevindingen is er ook bewijs gevonden voor het bestaan van gewoontegedrag voor autogebruik en een afnemend gebruik van dit vervoersmiddel voor sommige groepen. Alhoewel deze bevindingen lijken te suggereer dat deze afname gepaard met een breuk in het gewoontegedrag, is deze relatie niet geheel duidelijk gezien de gebruikte onderzoeksmethoden.

Ondanks de geringe rol die dagelijkse mobiliteit speelde in het verhuizingproces hebben veranderingen plaatsgevonden in de dagelijkse mobiliteit na de verhuizing. Deze veranderingen geven aan dat het nut heeft om binnenstedelijke nieuwbouwwijken zoals de Rummelsburger Bucht te ontwikkelen in het kader van het bereiken van een meer duurzame mobiliteit. Men moet hierbij echter wel in acht nemen dat de veranderingen in mobiliteit afhankelijk zijn van het transportaanbod in deze wijken en dat bevindingen van dit onderzoek niet automatisch vertaalt kunnen worden naar een andere ruimtelijke context. Bovendien luidt het advies om voorzicht om te gaan met de generalisering van de bevindingen in dit onderzoek gezien de kleine data-set die gebruikt is. Verder onderzoek wordt aangeraden om te kijken naar de effecten voor mobiliteit in en tussen andere ruimtelijke contexten en zich te concentreren op het gebruik van data van zowel voor als na de verhuizing. Dit kan door gebruik te maken van langdurig onderzoek op verschillende tijdspunten en reisdagboeken. Daarnaast kan het ook interessant zijn om aandacht te geven aan de rol van andere soorten van mobiliteit zoals virtuele mobiliteit en aan kwalitatieve methoden waarbij ook de rol van attitudes ten opzichte van mobiliteit kunnen worden meegenomen.

Introduction

There has been considerable debate on the influence that urban form can have on mobility (Maat, 2010). In this debate it is often questioned if urban form has an influence on mobility patterns and to what extent urban form might contribute to more sustainable forms of mobility. These sustainable forms are necessary as the consequences of the growth of mobility raises the question of how to deal with the environmental limits to mobility and the liveability of the city. It is argued that urban form can have an influence on the reduction of less sustainable transport modes and mobility patterns and can stimulate the use of more sustainable alternatives. Within different spatial typologies, it seems especially that inner city areas can have an influence on mobility as high concentrations of activities in the city, high densities and a mixed land-use seem to reduce the amount of kilometres travelled and support the use of public transport and slow modes of transport (Snellen, Hilberts & Hendriks, 2005). However, this possible influence on mobility is not clear as a study by Konings, Krutyhoff & Maat (1996) concluded that no significant changes in mobility can be expected from a relocation to a new inner city area. Besides, it is uncertain if a relation between urban form and mobility still holds true when applied to other spatial contexts and after controlling for other factors such as socio-demographic characteristics and residential self-selection effects (Cao, Mokhtarian & Handy, 2009). This research contributes to the debate by concentrating on the change in mobility in a newly built residential inner-city project. It will be questioned if and for whom this project has a positive reducing effect on mobility patterns and thus if it makes sense to develop these projects in order to promote more sustainable mobility patterns. In order to see if the particular urban form has an impact on mobility, the focus of this research will be on a change in urban form by concentrating on residential relocations. It will thereby provide more insights into the extent and for whom a residential relocation has led to a change in daily mobility and in what sense the daily mobility has changed. The role of daily mobility in the location decision will also be questioned. Stanbridge, Lyons & Farthing (2004) found that a residential relocation can prompt a reconsideration of daily mobility and that people are consciously considering their transport mode choice at one or more points during the course of the moving progress. Conversely, other researchers as for example Lee & Wadell (2010) and Molin & Timmermans, found only a limited role for daily mobility in relocation. This research will attend to this discussion by addressing which role daily mobility plays in the location decision when relocating. Here the focus will be on both the motives for the decision to relocate and the motives for the location decision.

In short, the research will thus attempt to determine to what degree mutual interactions between daily and residential mobility exist. Hereby residential mobility will be approached from a life-course perspective and the emphasis will be on a change in daily mobility. This daily mobility is constituted by movements that are associated with daily performed activities and that together result in a someone's daily travel behaviour. Largely this daily travel behaviour is a result of reasoned decisions or planned behaviour. However when travel behaviour is performed repeatedly, mobility decisions can become less deliberate and take on a more habitual form (Verplanken et al, 1997; Gärling & Axhausen, 2003; Dijst et al, 2002). It is argued that habitual travel behaviour can possibly be broken when a change in the circumstances for decision-making

is made. In that light, a relocation might provide a new decision context that can lead to a reconsideration of daily mobility and a possible change in (habitual) travel behaviour (Bamberg, Rölle & Weber, 2003; Fuijii & Kitamura, 2003). This research will test if these findings also remain true for people that have relocated to a newly built residential inner city area by addressing the question 'to what extent and for whom can a residential relocation break habitual mobility?'

As a case-study of a newly built residential inner city area, the Rummelsburger Bucht in Berlin has been chosen. Over the last fifteen years, the city of Berlin has developed five urban mixed land-use, high density areas as part of a plan to develop deprived (industrial) areas and urban wastelands into new attractive neighbourhoods with a mainly residential function. These inner city development projects seem to be part of a re-urbanisation movement that has taken place in several European cities over the last twenty years (Buzar et al, 2007). In this research the Rummelsburger Bucht will be placed into the wider context of these new urban development projects and attention will be paid to its position within the city of Berlin. It is thereby questioned if the Rummelsburger Bucht can contribute to the re-urbanisation of the city by concentrating on the characteristics and the previous residential location of the households that relocated.

The information that is derived from these topics and questions will be used to answer the main question of this research, '*which role does daily mobility play in the decision for a residential relocation to the Rummelsburger Bucht and to what extent can this residential relocation lead to a change in daily mobility?* In order to answer this question, quantitative empirical research has been conducted in the Rummelsburger Bucht area. Subsequently, the findings of the empirical research have been statistically analysed and compared and contrasted with other data-sets and the findings that derived from the theoretical framework.

All mentioned aspects will be further addressed in the remainder of the thesis, which is organized as follows. *Chapter 2* gives an introduction to mobility and focuses on daily and residential mobility and their mutual interactions. It provides an overview of the literature on daily mobility by on one hand by concentrating on approaches to daily mobility and on the other hand by focusing on the habitual nature of mobility behaviour. Thereafter residential mobility will be discussed and the effect that residential mobility can have on daily mobility and vice versa. Finally, the conceptual model and the research questions will be addressed. A residential relocation leads to a new situational context and urban form. The effects of urban form on daily mobility will be shown in the *chapter 3*. Here attention will also be paid to the effects of socio-demographic variables, residential self-selection effects, the effects for different spatial typologies and the transferability of the results to other spatial contexts. The case study of this research, the Rummelsburger Bucht area in Berlin will be introduced in *chapter 4* which elucidates its context, characteristics and mobility aspects. *Chapter 5* introduces the research design chosen for the empirical research and presents the research methods and the operationalization of the research. In *Chapter 6* the results of the empirical research are shown, which are structured by the research questions and consist of the descriptive and statistical analysis of the empirical data. The results will be discussed in *chapter 7* by comparing the results with previous findings and paying attention to the shortcomings of this research. Furthermore, suggestions for further research are made. Finally, the appendix contains the questionnaires that were used in the empirical research.


Allianz


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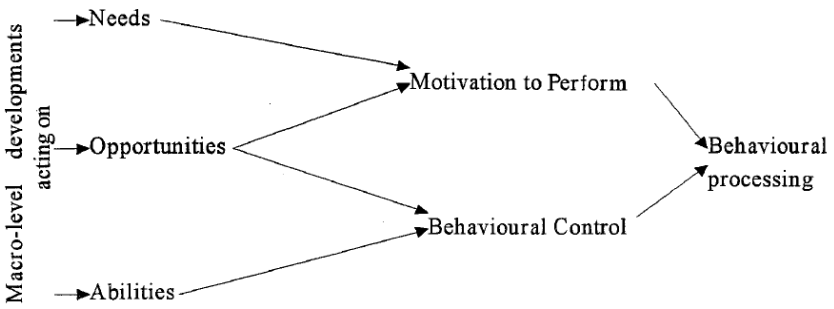
2 Daily and residential mobility

2.1 Daily mobility

In order to go to work, meet friends or to go shopping people have to cover distance. In covering this distance, people have to choose what kind of transport best fulfils their needs. The way people make this choice has been a subject that has been studied extensively. Up until the 1960s travel behaviour was often studied from a trip-based perspective, a perspective in which movement was considered as an activity in itself, separated and independent from other movements, activities and behavioural processes of individuals and collectives. Central in the trip-based approach is that movement is a result of a choice that individuals and groups make. In the 1970s a new approach was developed in which the focus shifted towards activities. In this activity-based approach the focus was more on the demand side for transport and individual travel behaviour, whereas previously trip-based approaches focussed on mobility as resulting from the supply of transport opportunities. The activity-based approach sees movement as a derivative of the preference and need to participate in activities that are separated within time and space. These preferences and needs cannot always be fulfilled, as they are influenced by constraints. Instead of a focus on a single move, attention shifted to a focus on chains of movements and activities and more attention was paid to the temporal dimension (Dijst, Rietveld & Steg, 2002).

The activity-based approach has been used by multiple disciplines, including (micro)-economy, geography and psychology. The economic view concentrates on the utility of the transport mode to reach destinations. This utility is dependent on alternatives (price, travel time), personal characteristics (income, car ownership etc.) and situational characteristics such as time during the day and the motive for movement. A combination of a geographical and a psychological approach can be found when focussing on the needs, opportunities and abilities that together determine the travel behaviour. The relation between these aspects that together can explain behavioural processing is shown abstractly in **figure 2.1**, which forms the NOA (Needs, Opportunities & Abilities) model.

Figure 2.1: The NOA Model



Source: Vlek, 2000

On an individual level, the behavioural processing (the participation in activities) is depended on what a person wants and what he or she is capable of. The wanted action is in the model described by the motivation to perform and consists of needs and opportunities. The needs can for instance mean that people need to participate in activities and therefore need to cover a distance within a particular timeframe. Besides, they can have the need to cover this distance in a comfortable, reliable and comfortable way. The needs can be influenced by social norms, which can result in that individuals will show behaviour that is similar to persons around them or they might get the feeling that they are expected to behave in a certain kind of way. The motivation to perform is also dependent on the opportunities that are available. This means for instance that if you have the need for a cheap way of travel, cheap transport modes have to be available. At the same time, the opportunities also influence the behaviourial control, which means that the people are also capable of performing a certain action. It is important to note that the behavioural control is influenced by opportunities that derive from the situational context and abilities at the individual level. Here the opportunities that derive from the situational context could be the availability of transport facilities. The abilities can for example refer to the physical condition of an individual or his or her skills. This means for instance that in order to use a car, someone should have the resources, skills and the physical condition that enables him or her to drive the car. Combined, the needs, opportunities and abilities give an individual a choice set that determines travel behaviour. This choice set is influenced by the macro-context which among others things consists of economic, demographic, cultural, technical and spatial factors and developments (Dijst, Rietveld & Steg, 2002). The choice set of an individual results in activity patterns which can be performed in his or her action space. The size of this action space (and hence, the activities that can be performed) is hindered by constraints. These constraints have been described in Hägerstrand's (1970) time-geography, who divided these constraints in capability constraints, coupling constraints and authority constraints. The capability constraints can refer to the fact that people have to eat, sleep and drink at a certain time, which puts constraints in time and space on the participation in activities. Coupling constraints are focussed on the necessary interactions that people need. For instance, someone needs a bus driver that arrives at the desired time in order to reach his or her destination on time. The third kind of constraints are authority constraints. They deal with laws and regulations that constrain people in their behaviour. An example for mobility can be that people need to stop for a traffic light once the light is red. The constraints show that the activities of an individual are constrained by fixations in time and space. Together with the choice set these constraints determine an individual's travel behaviour.

The sociological- and geographical views form an addition to the economical approaches, that often assume that people are a 'homo economicus', in that their choices are based on rational thinking (Prillwitz, 2008). This approach has for example been used in Rational Choice Theory. In newer theories, the attractiveness of a means of transport was not only defined by travel time, travel costs and quality or other rational choices that were stated in approaches such as Rational Choice theory, but also by non-rational behaviour and habitual behaviour. An often used approach is the theory of Planned Behaviour by Ajzen (1991). This theory broadens Rational Choice theory by adding social norms and rules, as well as subjective perception (Prillwitz, 2008, p.3). In this theory, behaviour is the result of the intention to behave. Thereby the intention to behave in a certain way is dependent on the attitude (the favourability of a possible action and the

beliefs about the likely consequences of the behaviour), the way an individual interprets or perceives the social norm and the perceived feasibility of the behaviour (Dijst, Rietveld & Steg, 2002). These behavioural, normative and control beliefs guide the human action, whereby in general the rule is that 'the more favourable the attitude and subjective norm, and the greater the perceived control, the more likely the persons intention to perform the behaviour in question' (Bamberg, Ajzen & Smidt, 2003, p.176). According to Bamberg, Ajzen & Smidt, the choice of a transport mode is largely a reasoned decision, whereby this decision can be affected by interventions that produce changes in attitudes, subjective norms and perceptions of behaviour control. Reasoned behaviour implies that choices are made based on a careful consideration of the advantages and disadvantages of alternatives. However, is it questionable if all behaviour is reasoned as behaviour can also be executed automatically. When over a longer period people do not consider their behaviour anymore, this can lead to habitual behaviour.

2.2 Habitual mobility

A habit could be defined as 'the repeated performance of behaviour sequences' (Gärling & Axhausen, 2003, p.2). According to Verplanken, Aarts & van Knippenberg (1997) these behavioural sequences are 'learned acts that become automatic responses to specific situations, which may be functional in obtaining certain goals or end states and it is this goal-directedness that distinguishes habits from other forms of repeated automatic behaviour' (p.3). Habits are efficient because they require little mental effort to execute, can occur without awareness, are controllable and are goal-directed and therefore to some degree intentional (Møller, 2002, p.3). Habits are very functional for the individual user in that they give the user time to focus on other things at the same time. The actions that need to be performed are repeated events and this will lead to less complicated and stressful situations, as the positive outcomes of alternatives are uncertain and the costs of alternatives might be high. This may especially be the case when people are constrained by time, budget or social commitments (Gärling & Axhausen, 2003). Another aspect is that habits make behaviour predictable so that people can adapt more easily to each other's behaviour. However, other persons do not necessarily benefit from an individual's habit and people might be too focused on their habitual way of travelling. This can reduce the information on alternatives and give a biased estimation of other means of transport. In this way, people might develop a more negative perception of alternatives and have a mismatch between their behaviour and transport mode choice, as circumstances might have changed and better alternatives have become available. This behaviour is called suboptimal behaviour (Prillwitz, 2008, p.3, 4 – Verplanken, Aarts & van Knippenberg, 1997, Dijst, Rietveld & Steg, 2002).

The relevance of looking at habitual travel for this research is that past behaviour can be a predictor of future acts, as frequency of past behaviour can reflect habit strength and has a direct effect on future performance (Ouelette & Wood, 1998). However, the role of habit might not be as straightforward and is debated in the literature. This is exemplified by Ouelette & Wood (p.54) who say that 'when behaviors are not well learned, or when they are performed in unstable or difficult contexts, conscious decision making is likely to be necessary to initiate and carry out the behavior'. In these situations, behaviour is controlled by deliberate reasoning, and the effects of past behaviour on future behaviour are mediated by intentions. As mentioned before, these intentions reflect attitude toward the behaviour and are, together with the past behaviour and the

situational context of opportunities and constraints, the potential determinants of behaviour (Gärling & Axhausen, 2003). This means that the more behaviour is mediated by intentions (reasoned, deliberate behaviour), the weaker the habit and vice versa. This also explains that repeated choices are not per se habitual choices, as the intention to perform the behaviour is not automatically performed repeatedly. Additionally Bamberg, Ajzen & Smidt (2003) found that past behaviour is not always a good predictor of future behaviour. This is because human behaviour is cognitively regulated and it appears to be subject to at least some degree of monitoring. As a result, 'relatively minor events of relevance can be noticed; they can disrupt automatic execution of the behavior and initiate reasoned action. New information, when relevant and persuasive, can change behavioural, normative and control beliefs, which can affect intentions and perceptions of behavioural control. This can influence later behaviour' (p.185-186). They conclude therefore that choice of travel mode is largely a reasoned decision and that past travel choice is only an influence on future behaviour if the circumstances remain stable.

Habitual behaviour does not necessarily imply that once a choice is made the behaviour is not rational any more, as the behaviour could be the optimal behaviour in a specific context. However if the circumstances change, the habitual behaviour might continue and the behaviour can become suboptimal. To optimize the behaviour, the habit should be broken and a new deliberate choice should be made. It is important look at how these habits can be broken, so that people can gain new information on alternatives and possibly change their (travel) behaviour and attitudes towards more optimal transport modes. This is especially interesting in light of a shift to more sustainable transport modes such as the bicycle and public transport. Several researchers found that habits are hard to break because of the advantages that they provide (Verplanken & Aarts, 1999). However, as Bamberg, Ajzen & Smidt (2003) mentioned, habitual behaviour mostly occurs when the circumstances remain relatively stable. One of these changing circumstances could be an intervention. A study by Fuijii & Kitamura (2003) suggests that a temporal structural change might be an important tool to convert car travel to the use of public transport, as their evidence showed that people who were offered a (temporary) free bus ticket developed a more positive attitude and a more the frequent bus-use. Car-use on the other hand was shown to become less habitual over time. Another example is provided by Ouelette & Wood (1997), who argue that 'that shifts in the supporting environment can derail automatic cueing and execution of old habits and increase the importance of conscious intentions' (p.70). A residential relocation might provide such a change in the supporting environments and might thus lead to more a conscious, (re) consideration on behaviour and a possible change in travel behaviour.

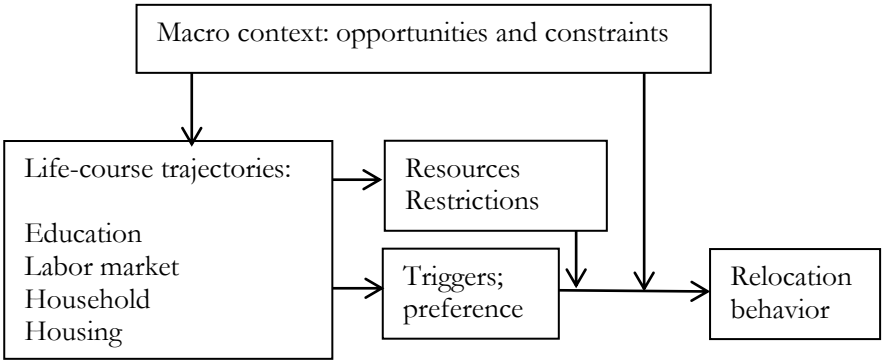
2.3 Residential mobility

As previously mentioned, daily mobility and residential mobility have mutual interactions and complementary functions. This complementarity is what Mulder & Hooimeijer (1999) define as something that can be used to distinguish between residential mobility and migration, as residential relocation can 'trigger complementary action with respect to travel only and not to forms of daily activities (such as the workplace)' (p.162). Migration differs here, in that it relates to multiple relocations as more forms of daily activities (housing, work, friends etc.) get relocated. Residential mobility is a form of non-daily mobility that is triggered by different factors than daily mobility. Instead of a daily scope, residential mobility is often looked at from a life-course perspective (Mulder & Hooimeijer, 1999). These life-courses consist of trajectories, stages in life

which are called careers. These can for example be work, the birth of a child or retirement. The life-course perspective stresses the interdependency between the various careers, as events in one career are often related to changes in other careers. It is thereby argued that it is the goals that arise from a specific career that can trigger relocation. For example, a new study might lead to a reconsideration of the residential location. Furthermore, even when the relocation is not triggered by one of the (changes in) careers, they are still important for the moving decisions, as they can condition the decision to move by providing the resources for the move and by imposing restrictions on physical mobility. But while a goal of a career of one person can be fulfilled by a residential relocation, the relocation can at the same time have a negative effect on other careers or on the careers of household members. This means that a residential relocation is not for every person a deliberate choice.

A residential relocation is not without costs and is influenced by the micro-context of resources and restrictions (e.g. financial resources, home ownership) on one side and the macro context of opportunities and constraints (e.g. availability of housing) on the other side (see **figure 2.2**).

Figure 2.2: Diagram of theoretical framework for residential mobility



Source: Mulder & Hooimeijer (1999)

Because of this, 'people will not relocate unless there is something of a trigger causing the benefits of moving to outweigh its costs' (Mulder & Hooimeijer, p.162). This is however not the case when people have to move involuntary, as their forced relocation is necessitated by events that are beyond the control of the household (Beige, 2008). The location of the relocation depends on the career goal that is pursued. Household careers triggers are for example shown to be of greater importance in short-distance moves than in long-distances moves, whereas the educational career is of greater explanatory value for long distances moves.

2.4 The interaction between daily- and residential mobility

Residential relocations are part of what are termed key events (Stanbrigde, Lyons & Farthing, 2004; Prillwitz, Harmes & Lanzendorf, 2007). According to the life-course perspective, the careers can be characterized by behavioural stability over time as long as the behavioural context stays unchanged. Key events as residential relocation however mean a change of context and can have the potential to change travel behaviour (Prillwitz, Harmes & Lanzendorf, 2007). A

residential relocation will have an impact on the daily mobility as according to Beige (2008) 'after relocation, people show a travel behaviour that is different from the travel behaviour before relocation, as a move usually implies changes in the spatial distribution of activities and, hence, the activity space (p.11). The place of residence is normally the centre of an individual's activity space and a change in this centre usually implies a change in daily mobility as the distance to other activities changes. On the other hand, daily mobility also influences the residential mobility, as daily mobility aspects (e.g. the availability of a car or public transport) can influence an individual's action space. People are therefore looking for a (new) residential location in which activities, and most important activities related to life course careers, can be performed. This shows that there are always mutual interactions existing between the two forms of mobility, as a change in one form of mobility also requires a complementary decision by the other form of mobility.

In **figure 2.2** it was shown that a residential relocation is a result of triggers and preferences that are influenced by personal restrictions and resources and opportunities and constraints that derive from the macro-context. The triggers to relocate result in the decision to relocate, whereas a consideration of the preferences, restrictions, resources and opportunities and constraints will lead to the choice for a specific location. The triggers for a particular relocation most often result from a change(s) in the life-course perspective. The role that mobility plays as a trigger for a particular relocation is thus expected to be low. However a consideration of daily mobility when choosing a new residential location is expected as a change in residential location will automatically mean a change in daily mobility. Evidence from the literature on motives for residential relocation is reluctant towards to role that mobility can play in the relocation process. An analysis of motives for residential relocation in the Ruhr-area in Germany by Blotevogel & Jescke (2003) (who unfortunately do not separate between the decision to relocate and the choice for a specific location) shows for example a change in household size, a lack of residential space, a different tenure choice, a lack of green space and a wish for a more social environment as main motives for a relocation. Mobility, in their study indicated by a wish for a better connection to the road and/or public transport, was only considered by 15% of the questioned people. Similar importance of motives were found by Lee & Wadell (2010), who used a nested logit model to find motives for relocation. Another study by Molin & Timmermans (2002) on accessibility indicates that although accessibility has some influence on the choice for a residential location, the importance of housing characteristics and characteristics of the environment were found to be of greater significance. Furthermore, they note that it seems that when people have the opportunity to afford flexible means of transport, it is more likely that the impact of accessibility on their residential relocation is relatively limited. They conclude therefore that land use and transportation policy cannot be expected to have a substantial impact on residential relocation in terms of reducing mobility patterns, but that the impact of the policies might get stronger when attempts are made to better match residential locations with lifestyles, socio-demographic characteristics and physical characteristics of neighbourhoods with their (new) residents. Similar findings by Beige (2008) and Zondag & Pieters (2005) on the role that daily mobility plays in the decision making process for a residential location confirm its minor role. In the study of Zondag and Pieters, it was found that the role of accessibility was significant but small compared to the effects of demographic factors, neighbourhood amenities and dwelling attributes in explaining residential location choices. Beige found that personal and familial reasons were the most

important reasons to move, followed by accommodation related reasons. It is however in many cases that a combination of motives finally leads to the decision to relocate. The minor role that daily mobility plays in the choice for a new location can possibly be a consequence of trade-off effects, as in the consideration of the preferences for certain aspects of the new residential location higher importance is attached to other aspects than daily mobility. This does not automatically mean that mobility is not considered at all, but that other aspects played a more important role. For a family with children this can for example mean that the availability of a garden at the new location was considered to be more important than the commuting distance to work.

Previously it has been indicated that intention forms together with past behaviour and the situation to provide a potential determinant of behaviour (Gärling & Axhausen, 2003). This means that if the intention to change behaviour is considered before residential relocation, this can potentially lead to a change in travel behaviour after the move. Stanbridge, Lyons & Farthing (2004) argue that a residential relocation does prompt reconsiderations of transport mode choice and people are consciously considering their transport mode choice at one or more points during the course of the moving progress. According to them residential mobility can result in a change in intention that eventually might result in a change of behaviour. This intention to change behaviour can mean that as the situational context changes, a change in travel behaviour might be considered. Old transport mode choices and especially habits could be broken during the residential relocation. This does however not mean that this intention to change travel behaviour is always translated in an actual change in travel behaviour after the move. It thus seems that residential relocation can be a situational context in which people reconsider their transport mode choice. Bamberg, Rölle & Weber (2003) call this moment in the residential relocation a 'sensible phase', in which people are more open and motivated to receive new information. This is especially the case if people receive information that is personally relevant and which contains persuasive information. In their study they showed that in a new decision context, people that frequently used the car at their previous residential location showed a strong behavioural reaction to an intervention during their residential relocating. This intervention was that they received information on public transport in their new living environment and a free ticket for public transport in the area for one day. The results were that the usage of public transport changed from 19% before the intervention to 47% after the intervention. This proved that the intervention might have provided the last push in the sensible phase in which people were. Furthermore, the study did not find a direct effect on future transport mode choice as a consequence of past habitual behaviour, leading Bamberg, Rölle & Weber to conclude that a 'new decision context and an intervention can change the cognitive foundation of intention which changes the intention that determines subsequent behaviour' (p.106).

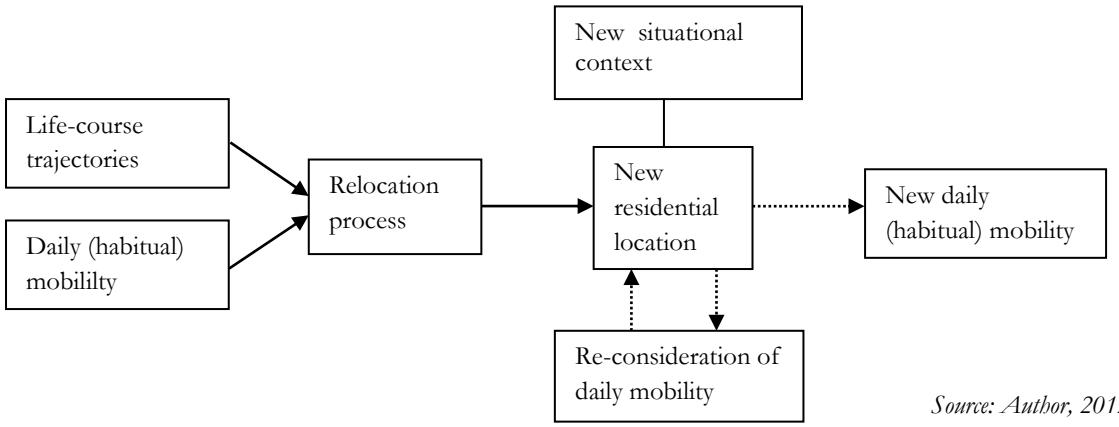
Besides changes in transport mode choice, a residential relocation is also found to be of influence on other mobility patterns. Van Ommeren, Rietveld & Nijkamp (2000) and Prillwitz, Harms & Lanzendorf (2007) for example found that workers are more willing to relocate when commuting distances increase and that relocations have a strong impact on commute distances. This appears to be especially the case when residential relocations and job relocation are performed at the same time. The latter study furthermore found that higher incomes and the number of cars that an individual owns tend to reinforce job and location decisions that result in longer commute

distances. Another study by Konings, Krutyhoff & Maat (1996) has looked at differences in travel distances and modal split before and after the residential relocation. They concluded that a residential relocation to a newly built (inner-city) area is not expected to lead to any significant changes in mobility behaviour as no major reduction in the amount of kilometres for commuting and no contribution to more a more sustainable modal split were found.

2.5 Conceptual model & research questions

The previous sections showed the relations between daily and residential mobility. These relations have been used to develop a conceptual model to guide the research (**figure 2.3**).

Figure 2.3: Conceptual model of the interaction between daily and residential mobility



Source: Author, 2012

The conceptual model shows daily mobility before relocation and after relocation. Here daily mobility entails the average daily travels that people make and thus excludes non-daily travel activities that are only performed occasionally. As was shown in *section 2.2*, this daily mobility can either be a reasoned or deliberate decision or can take a more habitual form. *Section 2.3* showed that triggers (often resulting from changes in the life-course) can lead to the decision to relocate. The choice for a new residential location depends on choice set that people have. This choice set consists of the preferences that people have and is influenced by personal resources and restrictions and the macro context of opportunities and constraints. In this research, it is questioned if besides these triggers, daily mobility can also play a role in the relocation process. *Section 2.4* demonstrated that a residential relocation can result in a change in daily mobility as a consequence of a new situational context. This can for example mean that a change occurred in urban form or in the mobility opportunities. It was also shown that a residential relocation can introduce a sensible phase in which people are more open to receive new information and try new things. The phase of the residential relocation or the phase just after the move might thus trigger a different (re)consideration of people of their travel behaviour. This can eventually result in a change in travel behaviour and a possible break with past (habitual) travel behaviour.

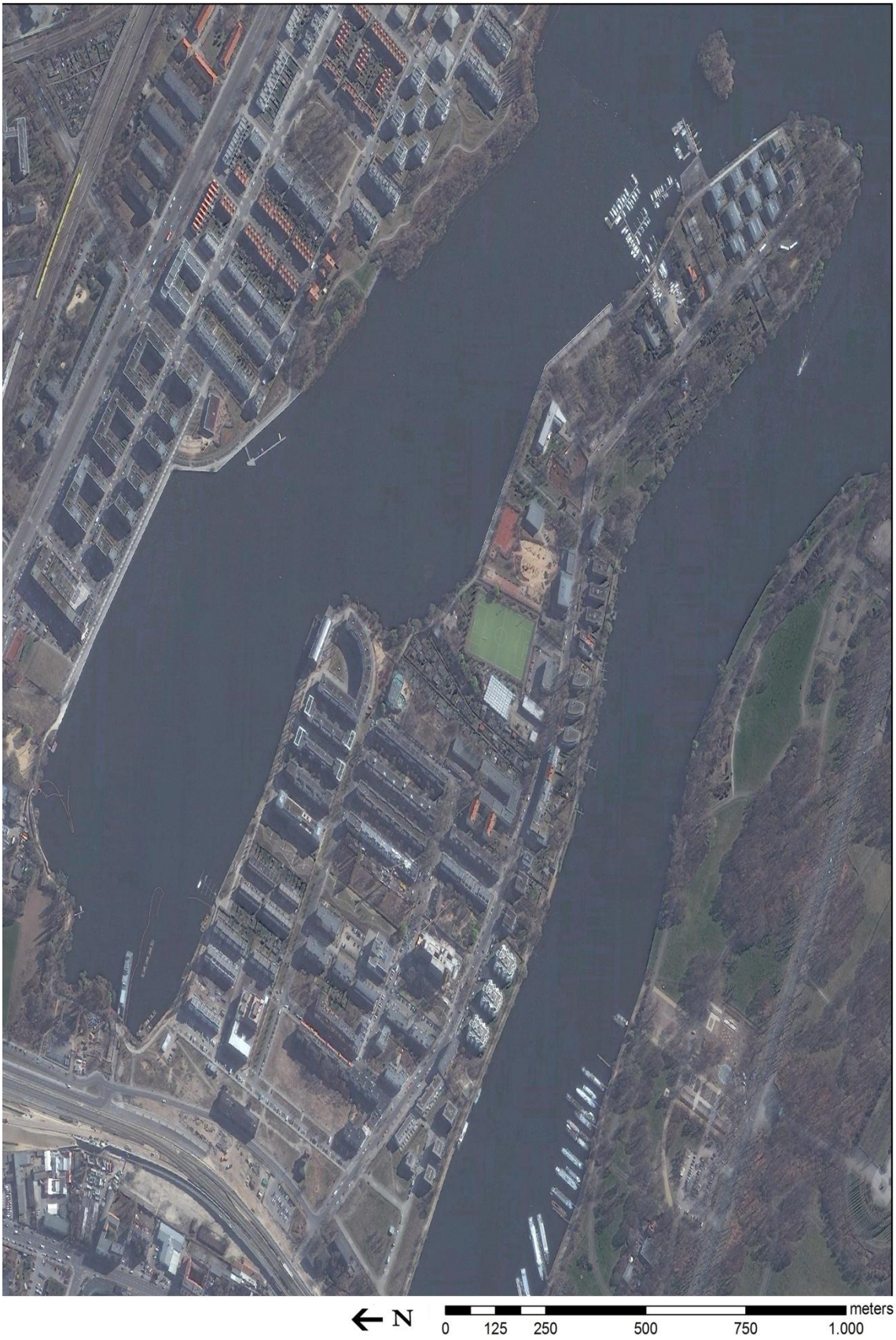
The relations between the mentioned concepts are presented abstractly in the conceptual model, which helps to provide more insight into the aims of the research and the relations between the different concepts. These relations and associated questions that stem from the model have resulted in the following research question:

Which role does daily mobility play in the decision for a residential relocation to the Rummelsburger Bucht and to what extent can this residential relocation lead to a change in daily mobility?

In order to answer this question it has been split into the sub-questions:

- *Which role does daily mobility play in the decision to relocate to the Rummelsburger Bucht?*
- *To what extent and for whom has a residential relocation to the Rummelsburger Bucht led to a change in daily mobility and in what sense has the daily mobility changed?*
- *To what extent and for whom can a residential relocation to the Rummelsburger Bucht break habitual mobility behaviour?*

The emphasis on for whom changes occur results from the expectation that the answers to these research questions are likely to be highly dependent on socio-demographic characteristics. Besides, the influence of residential mobility on daily mobility might also be influenced by other factors. This means that the causality of the relations between the different concepts is not always clear and that the relationship might be intervened by other concepts such as residential self-selection. The next chapter will pay attention to these aspects and examines if an autonomous effect of urban form on mobility can be found.



The Rummelsburger Bucht, June 2012 *Source: Digital Globe, 2012*

3 Urban form and mobility

3.1 Does a relation exist? An overview of findings

The debate over the existence of a relation between urban form and mobility has led to a considerable amount of literature on the subject over the last decades. In recent years, several surveys of the literature on this relation have been published that have reviewed and discussed a large amount of articles in order to come to more general conclusions. In one of these articles Ewing & Cervero (2010) conclude from their overview of over 50 articles that the influence of urban form on mobility among several studies strongly differs, ranging from no significant relation to very strong relations between urban form and travel outcomes. The effects thereby differ strongly between various aspects of urban form, which Ewing & Cervero grouped in what they call the 'six D's' of density, diversity, design, destination accessibility, distance to transit and demand management. Besides, they mention that it is important to look at a seventh none-spatial factor, demography. The results of their meta-analyses can be found in **table 3.1**.

Table 3.1: Weighted average elasticities (*e*) of vehicle miles travelled, walking and transit use with respect to urban-form variables.

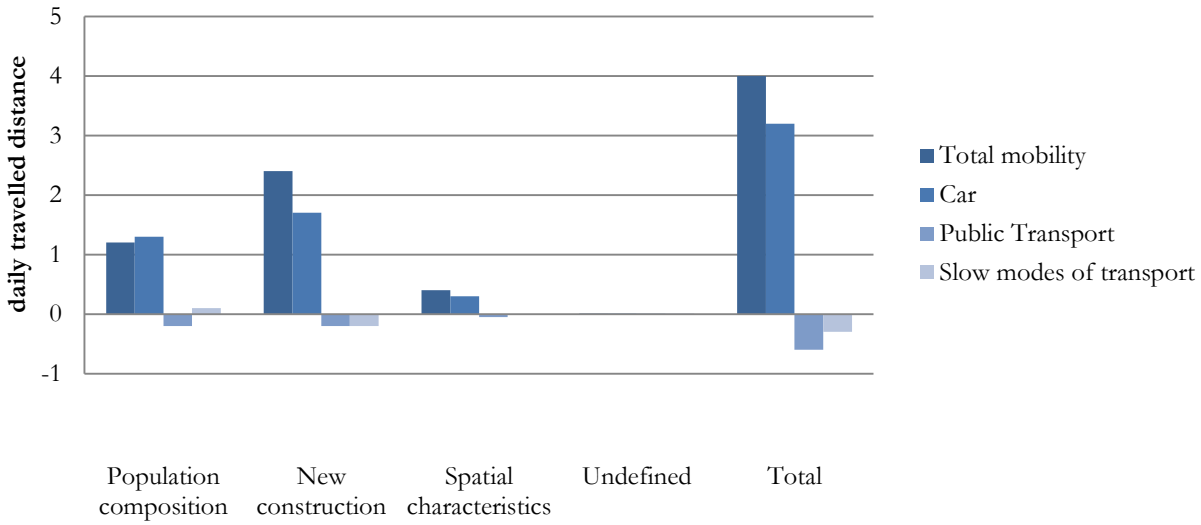
		Vehicle miles travelled	Walking	Transit use
Density	Household/population density	-0.04	0.07	0.07
	Job density	0.00	0.04	0.01
	Commercial floor area ratio	-	0.07	-
Diversity	Land use mix (entropy index)	-0.09	0.15	0.12
	Jobs-housing balance	-0.02	0.19	-
	Distance to a store	-	0.25	-
Design	Intersection/street density	-0.12	0.39	0.23
	% 4-way intersections	-0.12	-0.06	0.29
Destination accessibility	Job accessibility by auto	-0.20	-	-
	Job accessibility by transit	-0.05	-	-
	Job within one mile	-	0.15	-
Distance to transit	Distance to downtown	-0.22	-	-
	Distance to nearest transit stop	-0.55	0.15	0.15

Source: Ewing & Cervero, 2010. Adjusted by author, 2012

The measure which they used to see if there is a relationship is elasticity, 'the ratio of the percentage change in one variable associated with the percentage change in another variable' (p.272). For example, a positive elasticity for transit with respect to design measures means that transit use increases when the design is improved. For the distance to transit, the percentage of change that has been used is based on a reduction of distance, meaning for instance that when the distance to the downtown is reduced, this leads to a decrease in vehicle miles travelled. The elasticity numbers can be used as an indication of whether a factor is of influence or not. Although the magnitude of most elasticaties is not very high, Ewing & Cervero argue that the combined effect of several spatial variables on mobility could be quite large. A relation between urban form and mobility was also found in a selection of empirical European articles (*Appendix A)*. Depending on which variables were included, relationships were found for all the six D's that were mentioned earlier. Some studies even found relations on almost all factors, such as Snellen (2002) who found an influence of urban form, transportation network types at different levels, available services and land use mix in the neighbourhood, degree of urbanisation of the

neighbourhood, population density of the neighbourhood and distance to the city centre or inter-city train station on mobility. Others, like Meurs & Haaijer (2001) found that certain aspects of the planned environment do have a clear impact on mobility, particularly on shopping and social/recreational trips. Despite that relations are found, numerous author argue that the strength of the relationship is weak. Meurs & Haaijer (2001) demonstrated that the impact of the overall residential environment on the number of commuter trips appears to be negligible and that the impact of street characteristics is small. Snellen, Hilberts & Hendriks (2005) come with more specific numbers and note that the place of residence only has a slight influence on mobility in that it in total can explain 0.5 kilometres difference per day. However, they note that role of the spatial structure has a higher explanatory character when looking at differences between neighbourhoods (*see section 3.6)*. The slight influence of the spatial characteristics compared to other factors on the difference in daily travelled distance for different modes of transport are illustrated in **figure 3.1**.

Figure 3.1: Contribution of different causes to difference in daily travelled distance (in kilometres) per mode of transport between residents of newly built area and total population



Source: Snellen, Hilberts & Hendriks, 2005

This graph shows the different contribution of several aspects to the difference in daily travelled distance between the total population and people living in large scale newly built areas in the Netherlands (the so-called VINEX-areas). The total of causes shows that people in newly built areas travel on average four kilometres more than the total population. Residents of newly built areas were found to cover lower distances by public transport and slow modes of transport and higher distances by car. This is however mainly caused by population composition and the effect of moving to a newly built construction[1] and hardly by spatial characteristics (Snellen, Hilberts & Hendriks, 2005). These results are in line with the findings of Maat (2010) and Van Wee & Maat (2004) who argue that the influence of the urban form is often only minor compared to the influence of socio-demographic variables. The effects of spatial structure on mobility are in most cases likely and significant, but in total have just a slight impact. Similar conclusions on the minor

[1] *The phenomenon that people who live in newly built housing are systematically more mobile than the total population*

influence of the urban form have been made by Stead & Marshall (2001). They furthermore conclude from their overview of studies that urban form characteristics have an influence on travel patterns, but the extent to which these characteristics have an influence might be lower when controlled for factors such as residential self-selection (*see section 3.3).* These interfering variables are also mentioned by Ewing & Cervero (2010) who stated that the combined effect of spatial variables can explain mobility to quite a larger extent, but note that because of their small sample size and lack of control for residential preferences and attitudes, planners should be careful in generalizing their findings. They say that an association between urban form and travel behaviour may therefore not automatically mean a causal relation, as 'their empirical results will be biased in the sense that features of the built environment may appear to influence activity more than they in fact do' (p.266). Another explanation for the larger effects that they found might be derived from the spatial contexts that they considered in their overview of studies. In the next sections, attention will be paid to these different spatial contexts and their the transferability of findings between different spatial contexts will be discussed. Besides, the influence of self-selection effects and the role that socio-demographic characteristics can play in differences in mobility patterns will be examined.

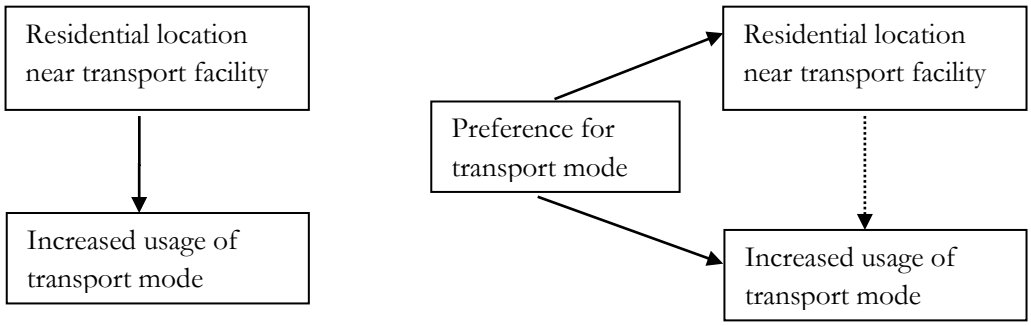
3.2 Transferability of the findings

As said, there is a decent amount of literature available on the relation between spatial form and mobility. However, most research on this topic has been conducted in North-America and it is questionable if the results from these studies can also be translated to an European context. Studies by Maat, (2010) and Buehler (2011) for example indicate that when comparing mobility figures, car-ownership, the amount of trips per car, car-kilometres and car-related emissions are higher in the USA in comparison with Germany. Besides socio-economic-, demographic- and cultural factors, these differences can also be explained by differences in transport policies, spatial structure, access to public transport and the fact that European settlements tend to be smaller, older and have different histories that lead to a different spatial organisation and an often car-free historic core with mixed land-uses and high densities (Schwanen, 2001). As a result of these differences in transport mode use, the impact that urban form can have on car-kilometres travelled is expected to be higher in North-America. Yet, one should also be careful when comparing research within Europe. Schwanen (2001) for example notes that there is a wide variety in the commuting distances and times as wells as in the modal split for commuting between different European cities. This is mainly a result of different spatial policies and structures of European countries. This shows that is important to be careful when interpreting and applying the findings of studies on the urban form to other spatial contexts. Still and despite all these differences that were found between and within Europe and North-America, Maat (2010) suggest that much of the effects of spatial structure on mobility behaviour are found in both North-American and European studies. Evidence shows for example that for both North-America and Europe, a compact city has a significant influence on travel patterns and reduces the amount of kilometres travelled by car and car-ownership. Furthermore, Maat noted that the work-location played a major role in both regions and that residential self-selection effects were present. A comparison of the transferability of the results thus shows that the sign of the relationship between urban form and daily mobility will most likely be the same in most countries and spatial contexts, but that the strength of the effect differs.

3.3 Residential self-selection

A factor which might intervene the relation between urban form and mobility is residential self-selection. This self-selection implies that people have a preference to relocate to a location that can facilitate their travel needs, which results in a higher use of this transport mode at the new residential location. Van Wee, Holwerda & Van Baren (2002) found in their study that preferences for transport modes have an impact on people's residential location choice. This was found to be particularly true for people with a preference for public transport. Additionally, they also found that preferences for transport modes can have a significant impact on the number of trips and distance travelled by that transport mode. It therefore seems that besides a relation between urban form and daily mobility, these findings point to the fact that there are other factors at play as well. The association between urban form and travel behaviour does for that reason not automatically mean causality **(figure 3.2)**. For example, it is not clear if in a neighbourhood were more people walk, this is caused by the way the urban form facilitates walking or that it is the case that people that tend to walk more, choose for a urban form that can facilitate their needs. This process is called residential self-selection, the preference that people have to relocate to an area that facilitates their travel needs (Cao, Mokhtarian & Handy, 2009.

Figure 3.2: The problem of causality and the interference of residential self-selection effects



Direct association (no self-selection) False association (self-selection)

Source: Cao, Mokhtarian & Handy, 2009

It is important to look at these self-selection effects in order to see if building in a certain way can (independently of self-selection effects) promote desired modes of transport and to better match the preferences of people for transport modes so that they are also able to self-select (Cao, Mokhtarian & Handy, 2009). From an overview of articles that control for the relation between urban form and daily mobility, Cao, Mokhtarian & Handy conclude that after reviewing 38 empirical studies (including European studies) 'virtually all of the studies reviewed found a statistically significant influence of the built environment remaining after self-selection was accounted for (p.359)'. This means that when a car-oriented person moves to a neighbourhood that is prioritizing walking, he or she is also more likely to walk. Still, although a relationship is found, it is important to keep in mind that the influence of the urban form diminished substantially after residential self-selection is taken into account. For that reason, self-selection

effects should also be considered in this research when looking at the effects of a change in urban form on mobility that results from a residential relocation.

3.4 Socio-demographic variables

Several authors have remarked that a much larger influence on mobility is caused by socio-demographic variables than by aspects of the urban form. Meurs & Haaijer (2001) for instance argue that it is mainly personal characteristics that largely or almost entirely determine commuter traffic and car-use. Additionally, Schwanen, Dijst & Dieleman (2002) note that socio-demographics are generally more important than residential context characteristics in the explanation of travel time.

Almost all of the studies considered in this chapter have corrected their results of the influence of urban form on mobility for socio-demographic variables. Variations in the socio-demographic variables proved to explain much variation in travel behaviour, on all kinds of travel outcomes such as travelled distances, transport mode choice, activity patterns, trip purposes and travel time. Although these variables strongly differ among countries and regions, Guiliano & Narayan (2003) argue in their comparative study on the USA and Great Britain that there are few differences in the way that socio-demographic and urban forms characteristics are associated with travel patterns; gender, age, household type, income and employment status were found to have similar effects. First of all, they found that personal characteristics as gender and age are of influence. This finding is confirmed by Buehler (2011), who in his study on mobility patterns in Germany concluded that men (65%) are more likely to conduct trips by car than women (57%). This percentage is the highest for men between 18-65 years old and is largely explained by work-related activities and income. Like Guiliano & Narayan and many others, he found that in nearly all cases higher household incomes are related to more car travel and fewer trips by public transport, foot and bicycle. Individuals in households with more cars per household member at driving age or a more frequent car-access choose the car for a higher share of trips than individuals in other households, and the probability to use public transport, to cycle or to walk decreases with car ownership levels. According to Limtanakool, Dijst & Schwanen (2006) this holds true for all kinds of trip purposes. The earlier mentioned study by Schwanen, Dijst & Dieleman (2002) found that their findings also hold true for travel time, as gender, number of workers in the household, age and education all proved to have a significant increasing effect on travel time; car ownership and household income were found to have an indirect effect.

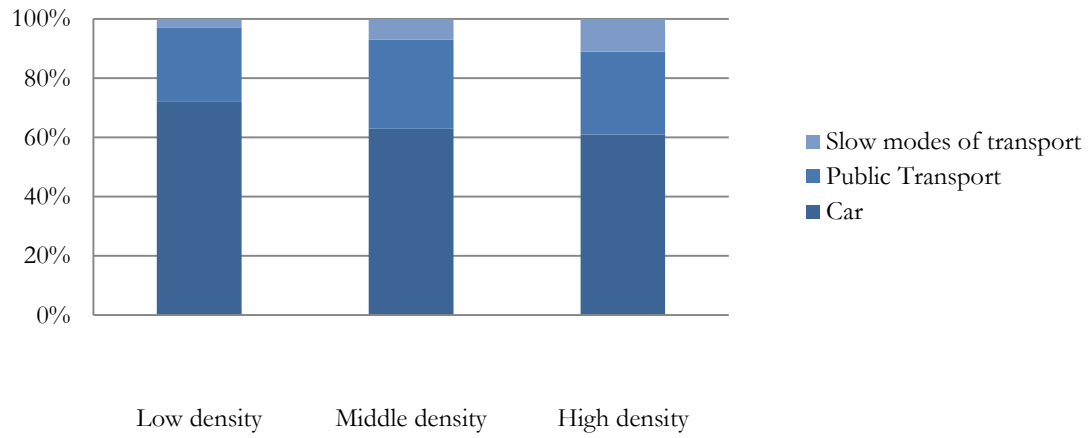
3.5 Spatial determinants

The previous sections showed that despite residential self-selection effects and variations in spatial context, still an effect of urban form on daily mobility patterns can be found. The next sections take a more specific look at which aspects or determinants of the urban form were found to be of influence on daily mobility. This is done by comparing the findings of several empirical European studies (*Appendix A*), as their findings are better transferable to the case-study area of this research than other (North-American) studies.

Density

Density was in most studies found to be a significant determinant of variations in travel behaviour. A higher density was especially found to reduce (commuting) distances, result in less car-use, reduce the amount of car journeys and promote walking and public transport use (Schwanen, 2001 – Buehler, 2011- Meurs & Haaijer, 2001). In an ideal situation, this can result in a strong decrease of car-use as is indicated by Meurs and Haaijer who state that when an area has a high density and configuration and when the accessibility inside and from outside the neighbourhood is not easy by car, people make more than 40% fewer car trips. Although the total amount of total trips increases, there is a marked shift from car-use to more sustainable modes of transport. In their study on Athens, Milakis, Vlastos & Barbopoulos (2008) also found a relation between density and transport mode choice. Their findings show that residential density is a key factor influencing mainly modal split, a finding which is supported by Konings, Krutyhoff & Maat (1996) and which is graphically shown in **figure 3.3**. This figure shows that higher densities lead to a considerable increase in the usage of both slow modes of transport and public transport in contrast to car-use. An explanation for this influence can be that higher densities are associated with a higher availability of (transport) facilities that can encourage the use of other modes of transport than the car.

Figure 3.3: Transport mode usage in low, middle and high density areas.



Source: Konings, Kruythof & Maat, 1996

Furthermore, a study by Schwanen, Dijst & Dieleman (2002) on the Netherlands found that travel times for car drivers tend to rise with the degree of urbanisation of the residential environment. If people want to cut car-travel time, this can more likely be achieved in lower density environments. Although density was found to be of influence on the transport mode choice, both Guiliano & Narayan (2003) and Konings, Krutyhoff & Maat (1996) found no relation with travel- and commuting distance. Despite this it could be concluded that building in higher densities contributes to a more desirable modal split and that if more compact urban structures are adopted, more sustainable mobility patterns will emerge (Limtanakool, Dijst & Schwanen, 2006 - Milakis, Vlastos & Barbopoulos, 2008).

Diversity & design

The selected studies do not show unanimous results when the impact of land-use is concerned. Milakis, Vlastos & Barbopoulos (2008) for example argue that the land use mix in their study did not appear to have effects on travel behaviour. Contrary, Buehler (2011) found that a greater mix of land uses was associated with less car travel (8%) and more walking (4%), cycling (3%) and public transport use (0.2%). Limtanakool, Dijst & Schwanen (2006) also found a relation for medium and longer distance trips, as the impact of the spatial configuration of land use and transport infrastructure showed to have a significant impact on mode choice processes. On a smaller scale, the diversity of different housing types showed that there are differences in travel outcomes between people living in different types of houses. Meurs & Haaijer (2001) conclude that the type of home appears to create differences in mobility and choice of mode of transport; semi-detached houses create more trips than terraced houses, which in turn create more trips than people living in a flat, even after controlling for personal characteristics and location. The influence of street design was earlier mentioned (**table 3.1)** as a factor that can be of influence on mobility patterns. Unfortunately this factor has been less considered by the authors of the European articles. This aspect is only mentioned by Schwanen (2001), who found that a distinction in mobility patterns can be made between neighbourhoods that prioritises public transport and neighbourhoods that priorities walking, such as pedestrian areas or low-speed zones.

Destination access & distance to transit

Two studies that paid attention to the destination accessibility found a significant relation with travel behaviour (Næss, 2011 - Hilbers, Snellen & Hendriks, 2006). They both found that when the distance to the centre of the city region or metropolitan region increases, this caused an increase in travel distances and an intensification of car usage. This seems logical, as the travel distance to various locations and activities increases and public transport modes are less available when people live further away from the city centre. The earlier findings by Ewing & Cervero (2009) are confirmed by these studies. Related to this is that also an effect was found for the distance to transit. Living in a more urban area normally implies that more public transport is available. Buehler (2011) and Maat & Timmermans (2009) found that when households live closer to public transport, they are less likely to make trips by car and more likely to make trips by public transport and foot. The positioning of the residence and the distant to important functions as work and transit options proved to be a significant determinants of travel behaviour. This distant is largely dependent on in what kind of spatial configuration someone lives. The next section looks at these spatial configurations and distinguishes the effects for different spatial scales.

3.6 Variations between spatial typologies

Several authors have found different travel outcomes for various spatial configurations. On a large scale, the size of the metropolitan area and the urbanization rate proved to be of influence. Guiliano & Narayan (2003) found that metropolitan size has a small but significant effect on trips, but not on travel distance. Travel distances do not seem to increase when the metropolitan

size increase. They argue that this can possibly be explained by a higher amount of trips and that shorter trips take place in smaller, more self-contained areas, but are not sure of this explanation. As a consequence of a better provision of public transport, Hilbers, Snellen & Hendriks (2006) found that car-usage is lower in the metropolitan area and especially within cities, compared to more peripheral areas. When different metropolitan areas are compared, more differences can be found. Schwanen (2001) found that in monocentric cities with a concentration of both population and employment in the urban core, commuting distances tend to be shorter. Besides, lower travel times were found in monocentric regions by Schwanen, Dijst & Dieleman (2002). Differences between spatial typologies were also found on a lower scale. According to Snellen (2002) more effects can be found from characteristics of the neighbourhood than from characteristics of the city. This implies that neighbourhood design is more influential than characteristics of the city or town as a whole. This is however in contrast with the findings of Næss (2011), who found that metropolitan-scale urban form variables generally exert stronger influences on the distance travelled by car than urban form variables on a neighbourhood-scale.

In the Netherlands research has been done on the effects of different types of newly built residential areas, which often have been compared to other projects and general mobility figures. It was found that even though the residents of inner-city intensification were highly mobile, they travelled relatively few and made more use of more sustainable modes of transport. The findings demonstrated a low amount of kilometres and car-kilometres travelled and a high usage of public transport compared to other newly built areas. On the contrary, the mobility patterns of residents of newly built city expansion areas proved to be relatively very high. This is mainly a consequence of the demographic situation in the area, as education, age, the presence of children and employment were all found to be important determinants (Snellen, Hilberts & Hendriks, 2005). This high mobility does not automatically mean that all the residents of these areas frequently use the car, but the general picture gets often influenced by the high amount of kilometres of people who do use their car frequently (Konings, Krutyhoff & Maat, 1996). Furthermore, residents of city-intensification areas also have a lower pressure on intensely used roads than people in both city-expansion areas and other locations. Car-usage during rush hours in city-expansion areas was found to be high (in the Randstad and the East and South regions of the Netherlands) and was also higher than car usage in non-expansion areas (Hilbers, Snellen & Hendriks, 2006). It thus seems that of the newly built residential areas, people living in inner-city intensification areas have most sustainable travel behaviour. This argument also holds true when inner-city (intensification) areas are compared with a suburban location. Næss' (2011) study on the metropolitan region of Copenhagen found that people living in inner city areas make more short trips and had a higher proportion of trips by bicycle or foot. This, and the generally better provision of public transport in the inner-city can help to reduce car-use and to increase the usage of more sustainable transport modes.

3.7 Lessons learned

Most studies found an effect of urban form on mobility but their total effect, especially in comparison to other factors, differs strongly between the studies and the scale of analyses. Consequently, caution should be taken in interpreting the results and in translating them to different spatial contexts as it seems that the sign of the relationship is mostly the same, but the

strength differs. In all of the articles considered a relation was found, but the effect of the urban form on mobility was often weak as for example becomes clear from studies by Maat (2010) and Van Wee & Maat (2004) who conclude from there overview on the literature that the effects of spatial structure on mobility are in most cases likely and significant, but in total have just a slight impact. This slight impact is a consequence of the role that other factors such as residential self-selection and socio-demographic factors play in the explanation of daily mobility patterns. For that reasons, the empirical part of this research will also concentrate on these aspects.

When looking more specific at spatial variables, several variables were found to have an influence on mobility including density, diversity, design, destination accessibility and distance to transit. In most of the studies, only a few of these spatial variables were considered, which makes it difficult to compare the studies and to estimate the effect of the individual variables. In general, it can be said that for Europe higher densities, compact cities, mono-centric cities, a shorter distance to the city centre, an inner-city residential location and a good availability of transport facilities lead to a reduction of travel patterns such as travel distance and a more sustainable modal split. Besides, diversity and land-use were found to be of influence but their role is debatable. Interesting for the case-study of this research are the findings on the variations between spatial typologies. It was shown that people living in newly built areas are expected to travel longer distances and make more use of the car compared to the total population. However, when a distinction was made between city intensification and city-expansion areas, it was demonstrated that the residents of city-intensification areas made less (car) kilometres and made more use of public transport. Depending on the previous location of the residents, a residential relocation to a city-intensification area such as this research's case-study is thus expected to result in a reduction of car-use and travel distances and an increased use of public transport.

The Rummelsburger Bucht before redevelopment and in its current form. *Source: ERB, 1994 – IERB, 2010*

4 The Rummelsburger Bucht

4.1 European inner city development projects

As a part of a new urban regeneration scheme, several European cities have over the last decades developed large scale inner city projects that renewed the existing spatial structure so that the economical and functional potential of the area could be utilized (Buzar et al, 2007). They form prestigious land and property projects that can play a catalytic role in urban regeneration and are mostly located on former industrial areas or brownfields and near the centre of the city (Spaans, 2004 - BBSR, 2012; see Lecroart & Palisse, 2007 and Foletta & Field, 2011 for an overview of projects). Often, these projects can be found at the waterfront and consist of a mix of residential, business and touristic functions. The central location of these projects can lead to a reduction of travel distances and travel times as various (daily) activities are within close range. Besides, in nearly all projects good transport facilities are present that can increase the connectivity and the transport opportunities for the users of the area. Despite that there is a wide variety in projects, what they often have in common is that they are aimed at an affluent clientele, such as yuppies, middle- and high-income families and affluent seniors. Cities hope to attract these groups from outside their area and to prevent that affluent inhabitants leave the city (Doucet, 2010). The case-study of this research, the Rummelsburger Bucht in Berlin, shows a great deal of similarities with these projects. This chapter will show these by introducing the area, its context within Berlin and its mobility characteristics.

4.2 A new change for Berlin

Over the last half of the 20th century Berlin lost its dominant economic position as the construction of the wall divided the city and caused an isolation from international development (Gorning & Häusermann, 2002). After the fall of the wall in 1989 and the relocation of the West-German government back to Berlin in 1990, the expectations were that the city would flourish again and attract new residents and businesses. Some were even expecting a growth to over six million inhabitants by 2010 (Kulke, 2003). Massive investments in urban development and infrastructure were made and Berlin grew towards becoming a cultural capital as the spread of alternative lifestyles and the cultural- and artistic scene gave the city a new image. However, the large business investments that were hoped for largely remained absent, as companies kept their headquarters in Germany's highly specialized cities such as Hamburg, Frankfurt and Munich (Gornig & Häusermann, 2002). Nowadays, Berlin has about 3.5 million inhabitants with a metropolitan area consisting of 5.9 million people, making it one of the major cities within Europe. However, the city does not (yet) have the central position that was hoped for and is hardly cited by any scientists as being a global city (Kulke, 2003). In the future, the city has the potential to climb up the hierarchy of global cities, especially in light of the developments in the cultural and creative sector and because of its role as a social melting pot. Yet, future developments in these sectors are uncertain and the financial situation of the city is worrying, with a debt of over 63 billion Euros. Moreover, there is an unemployment rate of 13.6%, almost double of the national average (AfSBB, 2010). One solution for the city to regain its position as a metropolis and global city was to focus on urban (re)development. New urban projects, often

developed on the former locations of the Berlin wall, were started to attract businesses and visitors. Famous examples here are the redevelopment of the Postdammerplatz, the government quarter and the Mediaspree project. Besides these projects, the city also needed to retain and attract new (middle- and upper-class) residents to improve its tax base. This is why in the middle of the nineties, they started to developed five large residential urban development projects of which the Rummelsburger Bucht is one.

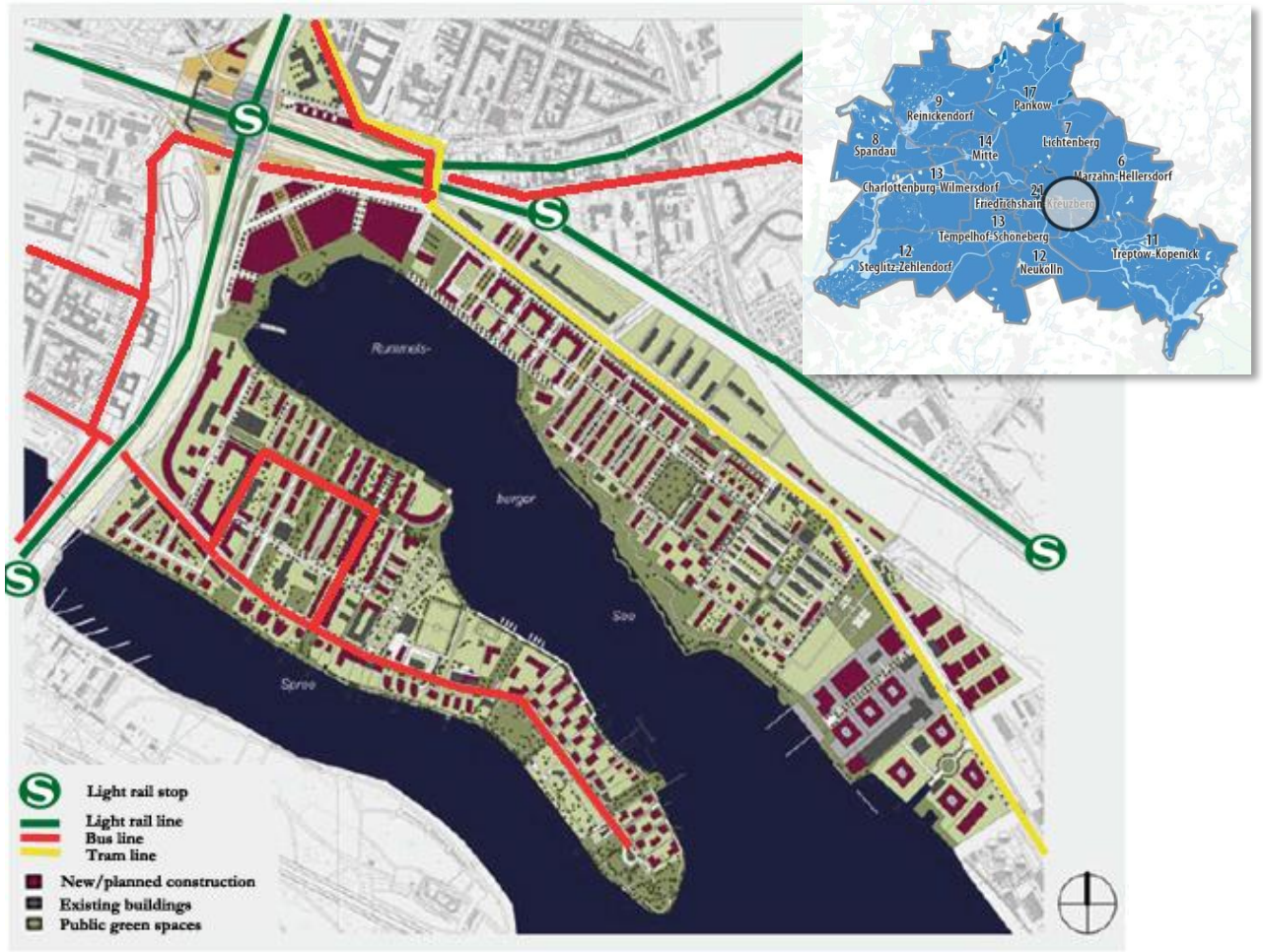
4.2 The Rummelsburger Bucht

As mentioned the expectations for Berlin after the reunification were high and the city was expected to grow both in population and economy. The twenty years following the reunification were expected to attract 100.000 to 300.000 new residents to the city. However, like the high economic expectations, these expectations could not be met. This was not just a result of the disappointing economic progress, but also of the decline of the population in the Eastern districts of the city, the sprawl of the city's population to the suburbs and neighbouring cities and a decline of the euphoria after the reunification. In the beginning of the nineties the projections were however high and the city developed plans to create accommodation for the new expected residents and businesses in five urban development areas. These five projects in total consisted of 950 hectares of land and were supposed to provide 31.300 housing units and 4.2 million square metres for business. Each had a different character, but what they had in common was that they were developed in under and unused areas. The initiator of the projects was the City of Berlin which provided land to private parties to be developed. The City of Berlin was also responsible for providing resources and a comprehensive planning. To do this, it established development agencies to guide the processes and to, together with the private developers and Berlin's residents, come with a plan for the projected areas (SenStadt, 2007a).

One of the five development areas is the Rummelsburger Bucht. This area of 131 hectares is located along the river Spree and on the edges of the neighbourhoods Friedrichshain and Lichtenberg in the East of Berlin (**figure 4.1**). Roughly, the area can be divided into the Rummelsburger Ufer which is located at the North side of the Rummelsburger See and part of the district of Berlin Lichtenberg and Halbinsel Stralau, the peninsula between the Rummelsburger See and the river Spree which belongs to the district of Friedrichshain-Kreuzberg. It was at this peninsula that the first human settlements in the area were established during the Middle Ages. Later on, the area developed from a fishermen-town to an industrial site by the middle in the 19th century. This was also the time that new housing blocks were built that nowadays are still present in the neighbourhood. In the middle of the 20th century, the industry stagnated and Berlin got divided in an allied zone and a Soviet zone. The Rummelsburger Bucht was located on the edge of this division as the river Spree formed the border between the two zones. As a consequence the area became a place for border patrol activities of the DDR, leaving its original function as an industrial and residential neighbourhood in despair. At the time of the fall of the Berlin wall in 1989, the area hardly contained any residents and was a source of decay and pollution. With the making of the new development plans for the city, the area had the potential to be prosperous again due to its central location. Another advantage was that the area did not need new infrastructures to be constructed as the area was already in the proximity of important transport nodes like the light-rail stop (S-Bahn) Ostkreuz (SenStadt, 2007b). In 1994,

the city senate of Berlin officially declared the Rummelsburger Bucht as an urban development area and started the development agency Entwicklungsträgergesellshaft Rummelsburger Bucht mbH (ERB), a corporation between the state of Berlin and the Berliner Landesbank. Later, the additional Wasserstadt GmbH was founded, which coordinated both the Rummelsburger Bucht development area as well as one of the other projects, Wassserstadt Berlin-Oberhavel. They coordinated the plans between the different actors and land-owners involved with the neighbourhood. The government was the major player as 33% of the land belonged to the municipality of Berlin, 15% to the federal state and another 10% to the Treuhandanstalt, the development agency that guided the privatisation of land that was previously publicly owned by the DDR state. The other land-owners were the German railway company (Deutsche Bahn) that owned the land near Ostkreuz and private owners, which accounted for respectively 13% and 27% of the land (ERB, 1994). The development plans made it possible that all these actors had to participate, in order to clearly direct the development of the area.

Figure 4.1.: The urban development area Rummelsburger Bucht and its location within Berlin.



Source: SenStadt, 2007b, 2010. Adjusted by author, 2012

The plan was to develop the neighbourhood in four phases, with the final phase ending in 2006. The area had to be developed in an area with 'urban density' but with the openness of a rural landscape, which in total consisted of 5.400 housing units and 596.000 m^2 for business-space. However, as the expected growth of the city remained absent, these expectations were lowered to 4.200 housing units and 300.000 m^2 of business space. One third of the original plans were dropped and the focus shifted to the development of 'living at the waterfront in the proximity of the city centre'. Densities figures thereby dropped from 44 persons per hectare to 32 persons (Carl, 2008). At the same time, the senate opened the option for privately-financed residential construction to increase the quota of privately owned buildings and to reduce its financial investments in the area. Even though these measures reduced the amount of constructions to be completed, the project is even at the time of this research still under construction and the estimated population figures have not yet been reached. Despite these deviations from the original plans the area has succeeded to attract young, high-income groups and families to its differentiated housing stock, and it is claimed that its value nowadays is much higher than the investments made (SenStadt, 2007b). Its central location, position at the waterfront, proximity to Treptower Park and other green spaces have together with the good transport provisions created an attractive area to live and recreate. However, a disadvantage of the area is its access to shopping facilities, as hardly any daily shops are available in the area. With the construction of the Ostkreuz area, this problem will largely be solved as the 'an der Mole' area (in the North-West of **figure 4.1**) will provide opportunities for the development of shopping facilities. Until then it is expected that the lack of shops will have an influence on the mobility for daily shopping behaviour.

Although still under construction, the neighbourhood already shows a wide variety of housing types and styles, with apartments and family housing as the most dominant types. For a high share of residents the possibility to own a family house with a garden proved to be the prime reason to move to the neighbourhood as was indicated by previous research (Carl, 2008). This attractiveness for families was in the same research also found to highly influence the average age of the residents of the neighbourhood and the household size, as most people were found to be young parents. The average income was in 80% of the cases higher than the average income in Berlin and an even greater contrast in income was found in comparison to its district. Another interesting finding was that 90% of the questioned residents lived in Berlin before they moved to the Rummelsburger Bucht and more than half of them relocated from an adjacent neighbourhood to the area. The neighbourhood can therefore be regarded as successful in the plans of the city to retain its inhabitants and to prevent young, high-potential people and families to relocate to an area outside the city.

4.3 Mobility in the Rummelsburger Bucht

Initially one of the reasons to develop the Rummelburger Bucht area was that the infrastructure was already available and the area was well connected to several transport facilities. Important here is its proximity to four S-Bahn stops namely, Treptower Park, Rummelsburg, Betriebsbahnhof Rummelburg and Ostkreuz (**figure 4.1**). Especially the last mentioned is of importance as it forms Berlin's busiest S-Bahn station and will in the future also contain a train station for regional trains. From Ostkreuz, it only takes a couple of minutes to reach the centre of

Berlin and Friedrichshain's shopping and leisure areas. Other parts of Berlin can also easily be reached as the 'ring-bahn' that encircles the city centre stops here, given the area a high connectivity by public transport. Additionally, a tramline connects the North of the area with its surroundings and two bus lines connect the peninsula with other parts of the city. Furthermore, the car and bicycle roads have been integrated into the city-wide road network. Lastly, plans have been developed to improve the main road on the north side and to extend the A100 highway from the south towards Ostkreuz, to improve car-access and to counter congestion (ERB, 1994). This means that the residents of the Rummelsburger Bucht could be on Germany's main road network within minutes. However, although the plans for this highway extension have already been developed since the beginning of the nineties, its development is highly unsure due to heavy protests by residents of the surrounding areas (BISS, 2012). It is important to keep in mind that the possible execution of these plans can result in changes in (car) mobility as they can reduce contemporary congestion and improve the car-connectivity of the area which can make car-use more attractive.

An advantage for the neighbourhood is that both the Rummelsburger Ufer as well as the Stralau-peninsula are protected from through-traffic by their natural boundaries, resulting in roads with a low car-intensity. Furthermore, some roads in the area have been designated as pedestrian areas. Next to these aspects and the good accessibility to public transport, no specific measures to reduce private motorized transport have been found. Private and public parking spaces are fully available and without charge and the area is located just outside Berlin's 'umweltzone', a city-centre zone with environmental taxes for those who want to use privately motorized transport. Still, the quality of the accessibility of the public transport was hoped to directly translate to an improved usage, with the expectations of a modal split for workers that consists for 80% of public transport, cycling and walking and for 20% of individual motorized transport in the direct proximity of Ostkreuz. For the rest of the area, a modal split of 60-40% was projected (ERB, 1994).

5 Research design & methods

5.1 Research strategy, design & methods

The assumptions from the theoretical framework and the research questions will be tested and analysed in the empirical part of this research. For this empirical part a quantitative research strategy has been chosen. This strategy has as an advantage that the expectations that derived from the theoretical framework can be tested. This deductive way of research provides numerical data that can be compared to other data sets (such as data sets on a higher geographical scale) and is a way of measuring social variables. This makes it easier to compare figures, to test relations for significance and to generalize results. In light of the focus of this research on travel behaviour before and after residential relocation, a quantitative approach can help to compare these results. A quantitative approach entails that a more positivistic view on society and an objectivist conception of social reality is taken. According to Bryman (2008), with a quantitative approach 'we can measure concepts that can explain certain aspects of the social world, or they stand for things we want to explain. These measurements of concepts allow us to delineate fine differences between people, provide a basis for more precise estimates of the degree of relationship between concepts and they give a consistent device for making distinctions between people and groups' (p.144). However, a quantitative approach entails that there is less space for interpretation, meaning and the context as when a qualitative approach was taken.

As mentioned before, the Rummelsburger Bucht has been chosen as a case-study. By choosing this research design, a detailed and intensive analysis of the area can be given. To put the case-study in a wider perspective, the previous chapter has provided information on its context within a wider process of re-urbanisation and on the locational- and situational context of the area. The external validity of this research is increased by a comparison with secondary data-sets on a more macro level. While the case-study provided data on a more micro-scale, secondary data-sets gave the opportunity to compare this data on a city and national level. Preferably this case-study would have been combined with a longitudinal and a comparative study on other cases. This would have made it possible to more precisely compare travel behaviour before and after a residential relocation over a longer period and to compare the results of different cases to increase external validity. However, due to time-restrictions this was not possible. Further research is encouraged to incorporate these research designs.

Within the case-study area of the Rummelsburger Bucht, the area of Stralau-Stadt has been selected (**figure 5.1**). This area has been chosen because of the wide range of transport opportunities that are available in the area and its surroundings, and the short length of residence of its inhabitants. In this part of the Stralau peninsula, most buildings have been recently developed or were still under construction. This gave the opportunity to look at both current- and past travel behaviour, as past travel behaviour might still be fresh in their memories. Although this retrospective is not optimal and a travel dairy before and after relocation would be preferred, it is believed that while people only recently moved to the Rummelsburger Bucht, they should still be able to remember their previous travel behaviour.

Figure 5.1: Selected area for empirical research

Source: Author, 2012

The execution of the research took place in June 2012. According to the most recent population figures, 2 997 people were living on the Stralau peninsula by the end of 2011 of which 2 373 were older than 18 years. Most of them were living in the research area of Stralau-stadt (AfSBB, 2012). The sample of the total population that has been used in this research contains the information of 73 households that completed the questionnaire. This sample was part of a target population of 237 households. The target population were household-members above eighteen years old that that were either the head of the household (the person responsible for the main income of the household) or the partner of the head of the household that were living in the newly built residential blocks in Stralau-Stadt. Furthermore, as the focus of the research was on mobility, elderly residents that were not living independently were excluded as they were considered as less mobile.

The results of the sample have been compared to the figures of the research population which consisted of all households in the Rummelsburger Bucht. Using Pearson's Chi-squared Goodness of Fit tests, the sample has been compared on income, gender distribution, education level and age. The comparison has been based on the data by AfSBB (2012) and Carl (2008). The tests showed that no differences between the distribution of the households in the sample and the households in the Rummelsburger Bucht were found. This means that the results of the sample can also be used to represent all households in the Rummelsburger Bucht. It should however by noted that the distribution of terraced-houses and apartments in the sample is not equal to the distribution of the Rummelsburger Bucht. Because of the relatively low amount of cases and the specific aim the research to see the differences between these two types of housing, it was been decided to not weight these results, but to describe the interesting differences that were found. Furthermore, the distances to activities such as daily shopping and public transport facilities can vary to some extent between different areas in the Rummelsburger Bucht which can (slightly) influence the results for these parts.

The questionnaire has been handed out door-to-door to all households in the selected residential blocks that contained both apartments and family houses (**figure 5.1, 5.2)**. Residential blocks that were not selected were either not recently built or not yet completed. Besides, one residential block has been left out of the selection as its residents did not meet the criteria of the target population while they were considered as less mobile. Before the questionnaire was handed out, the target group received an announcement letter to inform them about the questionnaire that would be conducted in the three weeks following. It was hoped that because of this letter, households would be better informed about the research and more willing to participate in the research. In the week after the announcement later, the respondents were given a self-completion questionnaire and were after a short introduction to the subject kindly requested to fill in the survey. Completed questionnaires were collected the same day or at another time during that week. In the cases that the households were willing to participate but could not be reached at the moments of the collection of the questionnaires, an envelope had been delivered. That way, the households were offered the opportunity to submit their questionnaire cost-free by mail. The questionnaires were available in both the English as the German language (*see Appendix B,C*) and contained clear instructions for the respondents to complete the questionnaire individually. This way the researcher's influence was reduced and a higher objective value of results could be achieved. The questionnaires were tested in three stages before the start of the research to make sure that the questionnaire was clear to the respondents. Firstly, the questionnaire has been controlled several times at the DLR; secondly, the questionnaire was handed out to friends of the researcher who did not have a background in geography or a similar subject to make sure that the questions were also understandable for people that do not have an expertise on mobility or geography. Thirdly, the first respondents in Stralau-Stadt were asked about the clarity of the questionnaires. Fortunately, the respondents replied positively to this question so that their results could also be incorporated in the final results. In case that things were still unclear, the researcher was available to explain the questions at the time of the neighbourhood research and could be contacted at the DLR. To get a more representative sample, questionnaires were held after working hours and on Saturdays so that in most cases also the head of the household was available.

Table 5.1 provides more information on the completed surveys and the response rate. Before the start of the empirical research, the response rate was expected to be limited, as smaller households, people that are working and people in bigger cities are more difficult to reach as respondents (de Leeuw, 2001). Unfortunately, this assumption proved to be true as the response rate was low. This was a consequence of a variety of reasons. Most importantly, 46% of the sample population was not at home. People were considered as absent if they were not at home for a minimum of three times, on different times at different days. This absence can partly be explained by the fact that the holiday season just started and that people were still in the process of moving and were not yet living there. Besides, it was especially the case in the apartments that people only made few use of their home in the Rummelsburger Bucht as they were also living in other places. It is important to keep in mind that the absence, especially of the last group, can influence the findings of this research as they might form a group with distinctive mobility patterns (e.g. longer travel distances, more regular international travel). Furthermore, some questionnaires that were handed out were not completed or could not be collected as the respondents were at home or did not send their completed questionnaire to the researcher.

Figure 5.2: Selected residential blocks in the streets Fischzug, Krachtstraße, Bahrfeldstraße, Jollenseglerstraße, Alt-Stralau and Dora-Benjamin Park in Stralau-Stadt, Rummelsburger Bucht.

Source: Author, 2012

Table 5.1: Data gathering and non-response

Completed questionnaires *(n)*	Non-response				
	Absent	Non-target group	No time	No interest	Not retrieved
73 (31%)	110 (46%)	4 (2%)	10 (4%)	27 (11%)	13 (5%)

Source: Author, 2012

5.2 Operationalization

This section explains the important choices that have been made for the questionnaire and explains the terms that have been used and how they have been interpreted. Before going into detail about the operationalization of the empirical research, it important to clarify the use of some mobility terms. In this research the focus will be on what Creswell (2006) and Urry (2007) describe as *physical movement* or *abstracted mobility*. This mobility can result in the act of movement itself, which will be called travel and which is facilitated by what will be termed transport. It is recognized that other forms of mobility can be a valuable contribution, but it is chosen to focus on one type of mobility due to the complexity of the subject and time considerations.

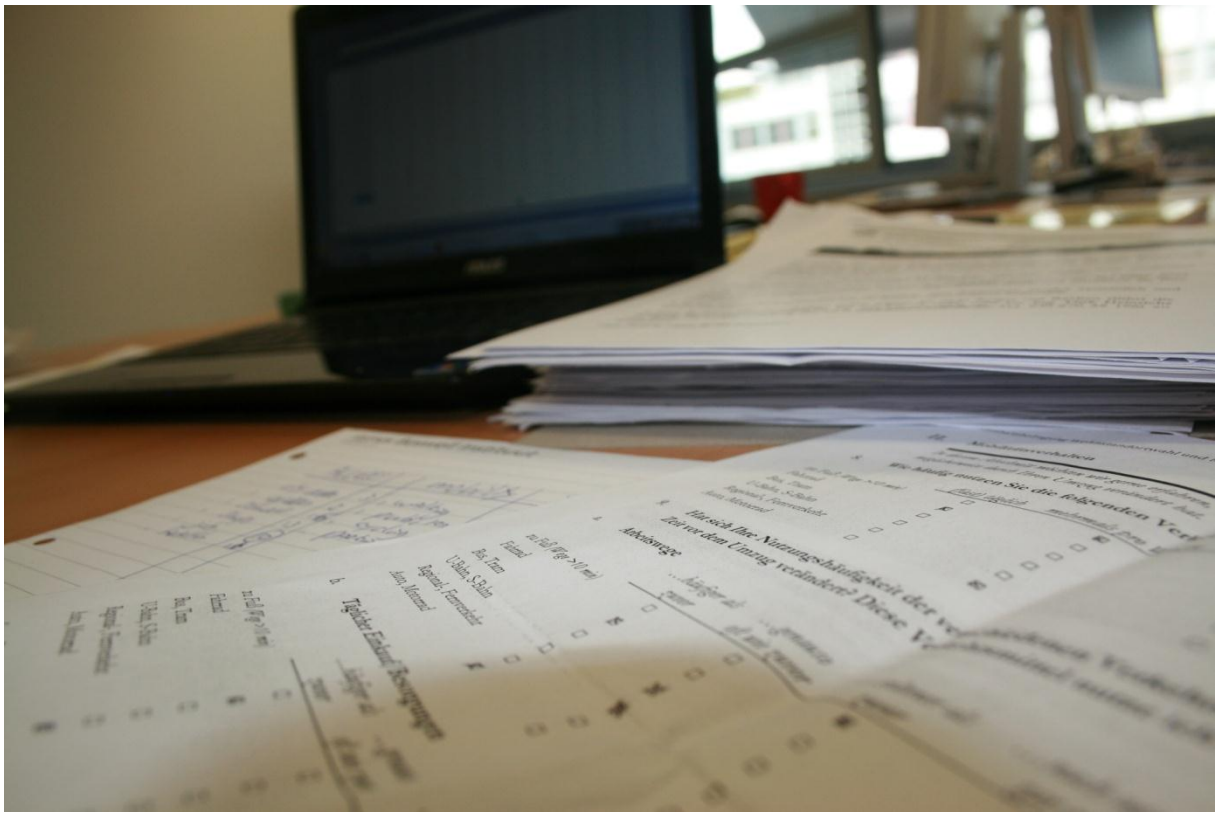
As previously indicated, the empirical research consisted of the conduction of questionnaires in the Rummelsburger Bucht area. In total, a questionnaire consisted of 22 questions and resulted in 102 variables. As this is quite a number of variables, closed questions were chosen to minimize the time to complete the survey, to improve the reliability and replicability and to reduce the researcher's influence on the results. To give the questionnaire a clear structure it was split into three parts. The first part focussed on the characteristics of the previous place of residence and motives for a residential relocation. For the previous location, respondents were asked to indicate where the location of their previous place of residence was and in what building type they used to lived. Furthermore, the respondents were asked how they would characterise the population density at their previous place of residence. As *chapter 3.5* showed, (population) density proved to be an important variable in explaining the relation between urban form and mobility. Although it is recognized that density is not an overarching variable for urban form and that the answers to these questions can be subjective, this variable has been chosen as an indication of the urban form of the previous location. The results of these questions can be compared to the current situation. The two other questions in the first part concentrate on the reasons and motives to move to a new residential location. From the theoretical framework it became clear that it is useful to make a distinction between reasons that trigger a relocation (that often stems from changes in life-course trajectories) and reasons for a relocation to a specific location. The first question is concerned with general and personal reasons to relocate that result from a change in the life-course trajectories, such as family extension or the need for a bigger house. As the target population had to be above eighteen years old and the housing prices and the rent in the area were high (so that people had to have a stable, high income), it was expected that education-related motives would only play a minor role as a motive to relocate. They have therefore been left out of the list of motives. The second question looks at the importance of several characteristics of the Rummelsburger Bucht in choosing this particular location to live. The

importance of the motives were measured on a scale from 1-5 and also included mobility characteristics. This question also looks at the aspect of residential self-selection, as the importance that people give to the characteristics pedestrian-friendly residential environment, reachability of public transport, a cycling-friendly neighbourhood and the availability of parking spaces can give an indication for the preference of a residential environment that can suit their travel needs. The characteristics were mixed in the questionnaire but have later been grouped into transport mode, accessibility and characteristics of the residential environment. Together, with these two questions it is hoped to find to what extent mobility was an important motive for the decision on a new residential location and what the role of mobility as a motive was in comparison to other motives. Finally, this section gave four statements to the respondents in which they have to answer on a 1-5 scale how important the suitability of their new residential environment was for walking, cycling, public transport and car-use. With this question, it can be seen if people have a preference for a location that suits their travel needs and thus if people residentially self-select.

In the second part of questionnaire attention is paid to the daily mobility behaviour of the respondents and to what extent their daily travel behaviour has changes as a consequence of the new residential location. To get an overall impression of their usage of several transport modes, the respondents were asked how often they used these modes of transport on a daily basis. Preferably this usage is measured by a travel dairy, but due to time restrictions this proved too difficult and a direct question was chosen to get an indication. The categories that were available were walking, cycling, slow local public transport (bus, tram), fast local public transport (metro, light-rail), regional trains and busses and the car or motorbike, as these were considered the most used transport modes on a daily basis in the state of Berlin. Furthermore, the respondents were asked to indicate to what degree their mobility patterns have changed since they moved. They could answer this be indicating a decrease, increase or stable situation for the travel distance and travel time to several locations. Besides, the use of several modes of transport for the three most used trip purposes that are performed on a daily basis (commuting to work, daily shopping and making leisure trips) were measured (INFAS-DLR, 2008). Lastly, the respondents were asked to indicate which mode of transport they would use if they spontaneously decided to perform a variety of activities. They were thereby asked to respond quickly and without much deliberation. This technique is called the response-frequency measure of habit and has been used in previous studies (Verplanken et al, 1994 – Bamberg, Rölle & Weber, 2003 – Fuiji & Kitamura, 2003). The assumption is that the more frequently a transport mode gets chosen, the more habitual the response is. The proportion of these responses can serve as a measure of habit strength.

The third part of the questionnaire looks at the personal- and household characteristics of the respondents. With this part, the results of the first and second part can be differentiated among gender, age, income, level of education, household situation and house ownership. Additionally, several mobility tools of the personal/household were asked, namely: the ownership of a drivers' license; if people had frequent access to a car, motorbike or bicycle; the availability of a private parking space; and if they had a monthly- or yearly public transport card. As was shown in *chapter 3.4*, these personal characteristics and mobility tools can explain an important part of the variations in travel behaviour.

To statistically assess the relations that were found, several statistical tests have been executed. The important statistical outputs of these tests are included in the text of the research. A more extensive overview of the output is available upon request by contacting the author. The limited amount of cases that could be used for the empirical analyses has reduced the possibilities to perform tests and analysis that require a higher amount of cases (e.g. regression analysis). Due to the structure of the questions in the questionnaire, the test used have been based on nominal and ordinal data. This means that only the use non-parametric tests was appropriate (with the exception for the test on difference in age between households in the apartments and the terraced-housing, which has been performed with a ANOVA-test). The statistical test that has been used to see if correlations (two-tailed) between two variables existed was Kendall's Tau-B test. The changes in travel time, travel distances and transport mode usage were tested on the assumption that they differed from zero (no change) by using a Sign Test. The remainder of tests that have been performed tested if the score of two groups can be considered as equal by using Mann-Whitney Tests. In the results (*chapter 6)*, only significant relations have been mentioned, unless explicitly indicated differently. The standard significance level used is a probability of 95% (α=0.05). In the next chapter the findings of these tests will be presented together with the descriptive analysis of the data.




DISCOVERING STATISTICS

6 Results

6.1 General characteristics of the residents

This chapter presents and analyses the results of the empirical research in order to answer the research question '*which role does daily mobility play in the decision for a residential relocation to the Rummelsburger Bucht and to what extent can this residential relocation lead to a change in daily mobility*?' In *chapter 3.4* it was demonstrated that the answers to this question are expected to be dependent on the socio-demographic variables of the households as they form influential determinants of mobility patterns. A higher income or the availability of a driver's license might for example give households more resources so that they can choose from a wider variety of transport modes. These resources might also result in a preference for a transport mode that can cover higher distances or to reduce travel times.

In **table 6.1**, the general and household characteristics can be found. The table shows that there is an even distribution between men and women as their share is nearly equal. The average age for the head of the household or his or her partner was found to be 40 years and ranges from 23 to 61 years. The relatively low average age[2] can mostly be explained by the presence of young starters that lived in the apartment blocks and the families living in the terraced-houses. Household members in the apartments were found to be younger than the household members in the terraced-houses, although the difference in age was not significant. As the aim of the research was concerned with a change in mobility, the target population had to be recently relocated to the area. Depending on the completion date of the building block, the time that the respondents were living in their dwelling varied between a few weeks to over four years, whereby 60% of the respondents were living in the area for less than two years.

Table 6.1: Household characteristics

Average age			40 years (σ = 8.5)		
Distribution female-male (%)			51-49%		
Years of residence (median)			2-3 years		
Owner (%)			61%		
Renter (%)			39%		
Terraced housing			63%		
Apartments			37%		
Monthly net income households in Euro (*n=47*)					
<900	900 - <1300	1300 - <1500	1500 - <2000	2000 - < 2600	2600>
0%	0%	2%	13%	9%	77%
Highest finished level of education					
No school completed	Primary school	Junior high-school	Senior high-school	University/ College	Other education
0%	0%	6%	14%	67%	13%
Household situation					
Single	Single with children		In a relationship	In a relationship, with children	
9%	1%		32%	57%	

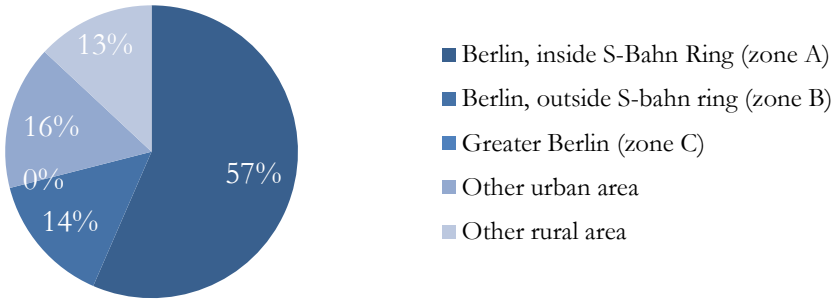
[2] *Note that household members below 18 years are not part of the target population.*

Because of the high housing prices in the Rummelsburger Bucht, living in the bigger apartments and terraced-houses proved to be only possible for those with a stable, high income. Over 77% of the households were found to be in the highest income group[3] and had a net income of over 2 600 euro per month. The lowest income class found was 1 500 - 2 000, meaning that the average monthly net income of households in the Rummelsburger Bucht was in all cases at least the same or higher as the median income in Berlin (1 541 euro in 2009, AfSBB, 2011). Expected was that variations in the household incomes could be explained by ownership status and type of dwelling, but no significant differences were found. The high income can be related to the high educational level, with 67% of all household members having a university or college degree. A clear separation between ownership statuses can be seen between households living in terraced-houses and households living in apartments, whereas nearly all households in the terraced-houses were owners and nearly all households in the apartment were renters. This in total resulted in a 61% share of owned dwellings. Another difference between the two building types is the household situation. In both cases almost all households were in a relationship or married, but the percentage of households with children in the terraced-houses (73%) was more than double the amount of the households living in an apartment. These household characteristics are interesting when compared to the literature presented in *chapter 3.4*, as it showed that the income, household type, ownership status and age-categories that were found in the Rummelsburger would all imply a more mobile population that travels longer distances and that makes more use of motorized transport.

In total 63% of the households were living in a terraced-house and 37% in an apartment. More than 75% of all the households used to live in an apartment before they moved to the Rummelsburger Bucht. Interestingly, the share of the apartment building as the previous dwelling type was higher among those who are now living in terraced-houses compared to the households that are now living in the apartments. This indicates that it is likely that people were looking for a place where terraced-houses were available, of which the Rummelsburger Bucht is one of the few places where these can be found within proximity of central Berlin. The high share of apartments as the previous dwelling type can largely be explained by the previous location of the dwelling. **Figure 6.1** shows that over half of the households used to live in the most central zone of Berlin and that in total over 70% lived in Berlin before relocation. None of the households were living in the outer zone of Berlin before relocation and only a small percentage moved in from a rural region. Similar findings were made in the research on the Rummelsburger Bucht by Carl (2008). Most of the households thus relocated from nearby areas. This seems to be in line with the findings of Beige (2008), who found that most people look for a residential relocation in a limited area and that most residential moves are characterized by short distances. These findings are interesting in the light of re-urbanisation and the attraction of sub-urban households to the city (*see chapter 4.1)*, as they indicate that the Rummelsburger Bucht mainly attracts people from within Berlin and only has a limited contribution to the attraction of households from outside the urban area. It could be the case that a move to the Rummelsburger Bucht provides living option (green spaces, terraced-houses, quiet neighbourhood) that would normally be found outside the city. That way, the area attracts new residents that otherwise would have left the city to satisfy their living requirements and now contribute to the revitalization of the city.

[3] *Income grouping based on income groups in Berlin as used in SenStadt, 2010.*

Figure 6.1: Previous residential location of households of the Rummelsburger Bucht



Related to the previous location, households were also asked to indicate (1-5) the population density at their previous place of residence. On average the household indicated a high density (4.0), a score which can be comparable with the population density in the research area[4]. In *chapter 3.1* it was mentioned that density was an often used indicator of urban form that could influence mobility, as (population) density often indirectly encompasses the access to transport modes and infrastructure. This result shows that there was no major change in population density, meaning that possible changes in mobility are not expected to result from changes in this variable.

The espondents were also asked about their mobility tools (**table 6.2)**. This information was asked, as the access to and the ownership of mobility tools were indicated as important determinants of mobility patterns in *chapter 3.5* Nearly all residents (99%) owned a driver's license for a car or motorbike and also had frequent access to these modes of transport (90%). These are percentages that are higher than what were found in previous studies on car ownership and access in Germany (*see* Beige, 2008). In most cases (86%), they also had a private parking space available. These high percentages are interesting as a high car ownership and car access can serve as a proxy for car-use, and thus lead to the expectation that car usage by the residents of the Rummelsburger Bucht is higher than average. Besides they are, as well as the previously mentioned socio-demographic characteristics, associated with higher travel distances and more frequent car-use (*see chapter 3.5)*. Figures on travel outcomes (*see section 6.3*) are thus expected to reflect these findings. Keeping in mind that the ownership of mobility tools is relatively stable over longer periods of time (Beige, 2008), this can indicate that future travel behaviour will also dependent on this current ownership.

A high percentage of frequent access was also found for the bicycle (94%). A lower percentage was found for the ownership of a monthly/yearly public transport card, as 43% indicated that they owned such a card. This does however not mean that the other respondents do not make use of public transport, but it is expected that the ownership of a public transport card will result in a higher public transport use.

[4] *The density in the Rummelsburger Bucht is higher than average (90 compared to 37 person per hectare), but not as high as other parts of the city (AfSBB, 2012 – SenStadt, 2011)*

Table 6.2: Mobility tools of households of the Rummelsburger Bucht

Mobility tools	Availability
Driver's license car or motorbike	99%
Frequent access to car or motorbike	90%
Frequent access to a bicycle	94%
Private parking space available	86%
Owner monthly/yearly public transport card	43%

The values that were found for the household characteristics are associated with a transport mode choice that is more focussed on motorized transport and more intense travel outcomes as for example distances travelled and travel times are expected to be higher than average. These expectations are further enhanced by the mobility tools that were available to the households. When combining these findings with the transport facilities in an around the area, this means that the residents have a wide range of travel opportunities and that are not very restricted in their travel decision, giving them a wide travel choice set. Another interesting finding was that most of the residents previously lived in Berlin and that nearly all residents moved from an urban area to the Rummelsburger Bucht. These findings are interesting as they show that the area might not only be an area that attracts people from outside Berlin to the city, but also an area that can keep residents of Berlin from moving out of the city by providing them a living environment within the city that could normally not be found there. In the next section, these assumptions about the choices for a new residential location will analysed by looking at the motives for a relocation, the motives to move to the Rummelsburger Bucht and the role that mobility plays as a motive to relocate.

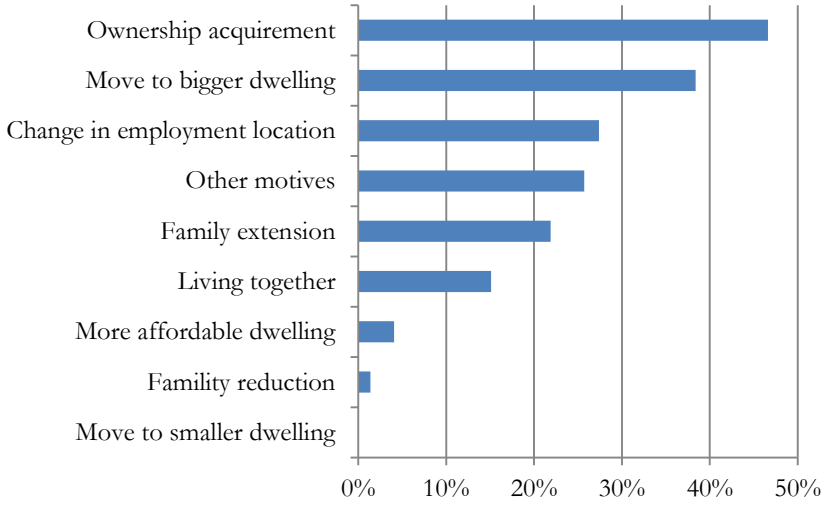
6.2 Motives for relocation and the role of mobility

This section addresses the question '*which role does daily mobility play in the decision to relocate to the Rummelsburger Bucht'?* It is important to look at the role that mobility can play, to see what importance people attach to mobility as a motive to relocate and if people deliberately choose a neighbourhood because of its mobility aspects. Earlier studies by Blotevogel & Jescke (2003), Lee & Wadell (2010) and Molin & Timmermans (2003) (*see section 2.4*) only found a minor influence of daily mobility in the relocation process. It is useful to make a distinction between motives that trigger a relocation and motives to relocate to a specific location. In *section 2.3* it was shown that in most of the cases a relocation gets triggered by change in the life-course (e.g. a change in education, work, or the household situation. The location motives that were found were mostly related to the built environment. In this section, attention will firstly be paid to the life-course motives that triggered a relocation, before paying attention to the location decision motives.

In **figure 6.2** the life-course changes and related aspects are shown that played a role in the decision to relocate. Most frequently, the respondents indicated that housing motives (ownership acquirement - 47%, move to a bigger dwelling - 38%) were a motive that triggered relocation. The frequency of housing-related motives can be explained by the previous residential location of the households, which in most cases was in Berlin, a city that is dominated by the rental-sector and (smaller) apartments. Often, a search for a bigger dwelling was also associated with a family extension. The housing-related motives were followed by a change in employment location

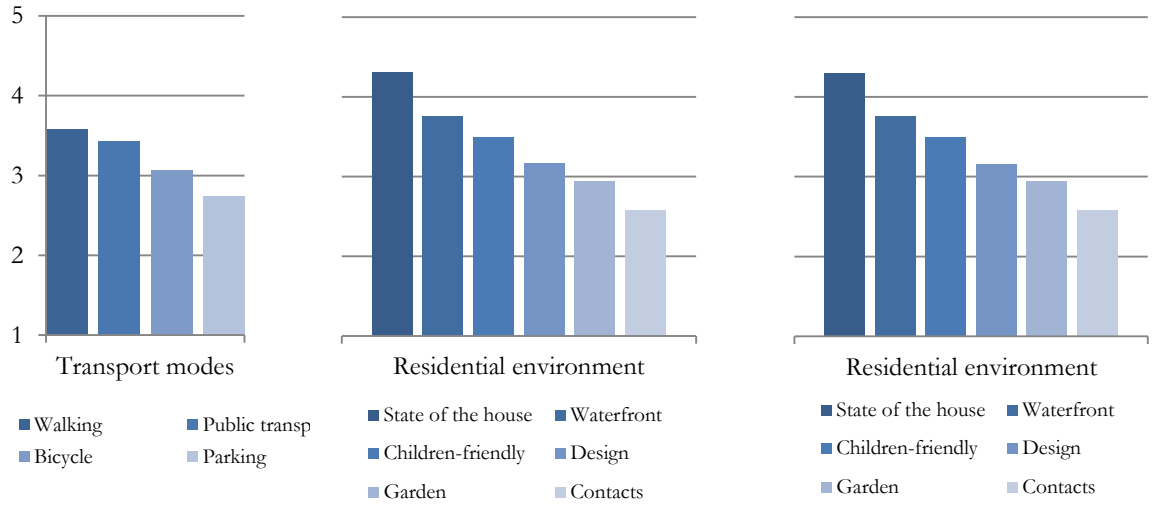
(27%), which could be either a change in the location of the current job as well as a new job. Interesting, of the percentage of households that indicated that they had a change in employment location, 90% previously lived outside Berlin. Furthermore, a change in the household trajectory played a role with as most important motive the extension of the family (22%). Household-related motives were also frequently mentioned as other motives to relocate as respondents indicated that it was important for them that the neighbourhood would be suitable for children. Other motives that were mentioned were related to the characteristics of the neighbourhood itself (quiet neighbourhood, location at the waterfront etc.). Interestingly, none of the respondents indicated a change in lifestyle or mobility as a motive to relocate. Possibly this lack of mobility as a motive is a result of the question that was used or could be explained by the previous residential location as this location already provided the opportunities to satisfy their needs.

Figure 6.2: Life-course motives for relocation



To capture the importance of location decision to relocate to the Rummelsburger Bucht the respondents were asked to indicate how important a selection of sixteen characteristics of the Rummelsburger Bucht were when they relocated to the area (**figure 6.3)**. A first look shows that there is a mix of important variables within and between the three groups. The figure illustrates that the most important characteristic was the state of the house, followed by the accessibility of green spaces and the accessibility of the city centre. Also, the location at the waterfront is valued high. This is interesting as all these characteristics are characteristics that make the Rummelsburger Bucht unique and that distinguish the area from other locations in the city. Other distinctive characteristics of the area are that people can have the opportunity to have their own garden and that it is a quiet and calm area to live, making it suitable for children. Characteristics related to these features were also commonly mentioned in the section where households were able to submit other important characteristics.

Figure 6.3: Importance of characteristics of the Rummelsburger Bucht as a motive to relocate



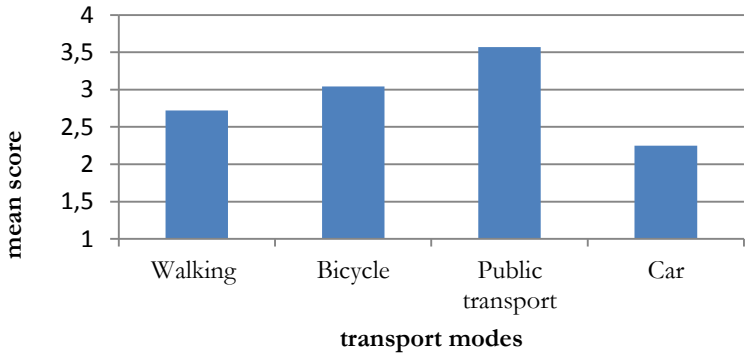
Although at first sight the availability of a garden and a children-friendly neighbourhood appear to be of lesser importance than previously mentioned motives, a higher importance was found when the characteristics were controlled for housing type and household status. Households living in a terraced-house valued a garden more significantly (3.67) than households in apartments (1.62) and households with children attached more importance to the accessibility to schools (3.53) and a children-friendly environment (4.42) than households without children (1.57 and 2.33 respectively). Furthermore, singles also gave a high importance for accessibility to schools and a children-friendly environment, although these findings are based on a low amount of cases. This might be explained by their intention to have children.

When concentrating on the transport mode characteristics, the walking-friendliness of the area is the most highly valued characteristic, followed respectively by public transport access, cycling-friendliness and parking (an indicator for car-friendliness). The high score for walking-friendliness can be explained by the good walking environment in the Rummelsburger Bucht. Its location on the Stralau peninsula means that there is no through-traffic and its location at the waterfront and the footpaths available give attractive opportunities to walk to a destination or to just go for a walk. What is remarkable is that the car-friendliness indicator (parking options) is valued lower than the friendliness of the neighbourhood for other transport options. Possibly this result can be a consequence of the usage of parking options as an indicator for the concept car-friendliness, the overall level of car-friendliness in the city or socially-desirable answers by the respondents.

The role that mobility plays in a relocation gets also reflected in the preference that people have to relocate, that an area that facilitates their travel needs, or in other words, the residential self-selection that people have for transport modes. It is important to look at these residential self-selection effects as *section 3.3* demonstrated that changes in mobility after relocation might be affected by self-selection effects. **Figure 6.4** shows how important it was for households to relocate to a place that facilitates the travel needs. The results show that public transport scores higher than other modes of transport, with a score that is significantly higher than the score for

walking and the car. This means that an environment that has a good support of public transport was more important for the respondents than an environment with a good support for walking, to use the car and to a lesser (non-significant) extent the bicycle. This result is in line with the findings of Van Wee, Holwerda & Van Baren (2002), who found that a preference for particularly public transport can influence the residential location preference. What is further remarkable is the relative low score for car usage. Possibly this can be explained by the wide range of scores for this variable. From *section 6.1* it became clear that almost all households in the Rummelsburger Bucht had frequent access to a car or motorbike. Despite this high car-availability and the expected more frequent use of the vehicle, the respondents did attach more importance to a neighbourhood that supports public transport than a neighbourhood that supports car-use. This might be an indication that people had the intention to relocate to a neighbourhood that also gave them other transport mode options, with a possible reduction of car-use as result. Yet, another explanation for the relatively low car score can be that the respondents gave a socially more desirable answer to this question. These results are interesting compared to the results in **figure 6.3**, where walking was found to be the most important aspect of the Rummelsburger Bucht as a motive to move. A possible explanation for this difference in results can be that overall, good access to public transport and cycling roads can be found in most areas in Berlin. This could mean that a good environment for these modes of transport are not *per se* distinctive qualities of the Rummelsburger Bucht, in contrast to walking.

Figure 6.4: Importance of a suitable environment for transport modes



In light of the residential self-selection process, the preference for a neighbourhood that is suitable for the preferred mode of transport is expected to be reflected in the usage of this mode of transport. This means for example that if households had the preference to relocate to a neighbourhood that is suitable for the bicycle, they are also expected to cycle more than households that did not have this preference. The relation between the preference and the transport mode was tested using correlation and Kendall's Tau B-tests. The tests show that the usage of all transport modes significantly correlated with the preference for a suitable neighbourhood for the same mode of transport. Thereby medium effects were found for walking (τ = .25), cycling (τ = .33) and public transport (τ = .28), whereas the correlation for the car demonstrated a large effect (τ = .50). This difference in effect size can be explained by an overall usage of walking, cycling and public transport by all households, while car usage tends to be more limited to a group of more car-oriented households. Furthermore, the large effect found for car usage can be an indication of car-habit. A significant effect (τ = .21) was also found for the

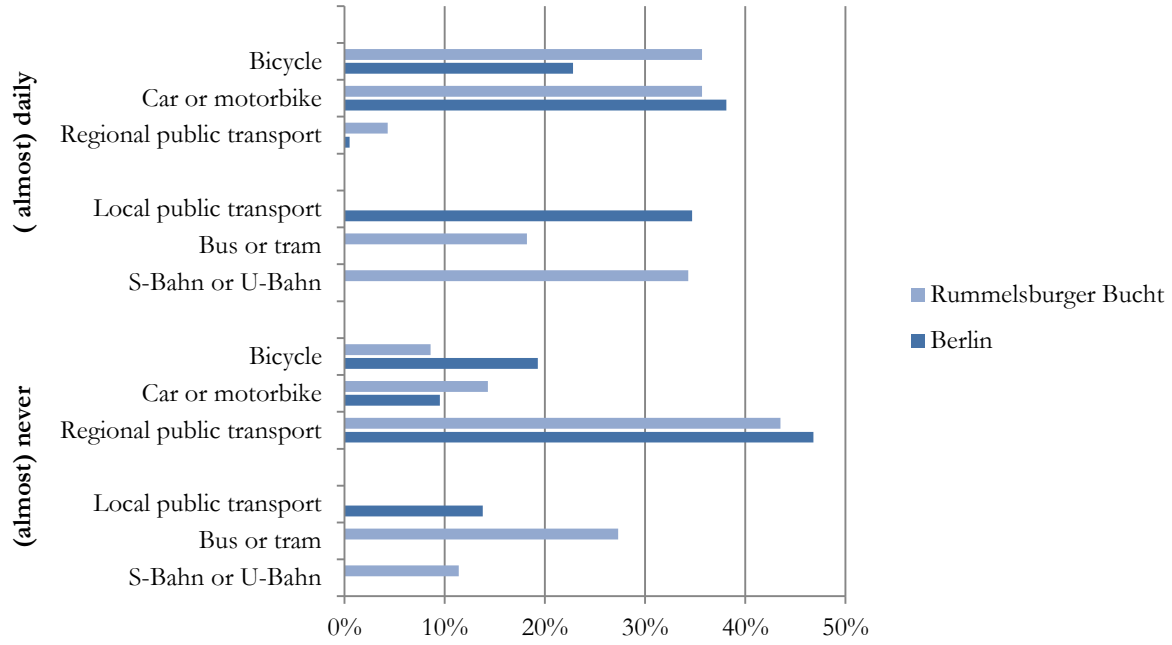
correlation between a preference for a walking-oriented neighbourhood and cycling which showed that households with a preference for a walking-oriented neighbourhood also tend to cycle more. Lastly, a significant negative effect was found for car-preference and public transport usage (τ = -.31), meaning that the usage of public transport declines when households had a larger preference for a car-oriented neighbourhood.

This section has indicated that role that mobility plays in the decision to relocate is limited, as motives resulting from changes in the life-course trajectories form the main triggers for a relocation. On the other hand, mobility aspects did play a role in the relocating process as it affected the choice to relocate to that area. Still, the influence that mobility had in the location decision was on most aspects found to be lower than aspects of the built environment and accessibility. Although correlations were found between the preference to relocate to neighbourhood that facilitated the preferred transport mode and the actual transport mode usage, the selection effects are expected to be low as they seem only limitedly supported by motives for relocation. The role that daily mobility plays for residential mobility thus seems to be limited. In the next section it is questioned if on the contrary, residential mobility influences daily mobility.

6.3 The linkage between relocation and a change in mobility

This section addresses the question '*to what extent and for whom has a residential relocation to the Rummelsburger Bucht led to a change in daily mobility and in what sense has the daily mobility changed?'*. In *chapter 2.4* Stanbridge, Lyons & Farthing (2004) indicated that a residential relocation can prompt a reconsideration of transport mode choice during one or more points in the moving process. Other studies confirmed that this reconsideration of transport mode choice is indeed often translated in a change in daily mobility patterns after relocation. These studies are here in line with the life-course perspective, as a relocation always means a change in the situational context and is often further enhanced by a change in personal preferences and resources that can lead to a change in travel behaviour. From the case study on the Rummelsburger Bucht (*see chapter 4)*, it became clear that the area offers a wide range of transport opportunities and therefore also enough opportunities for a shift in transport mode choice. Besides, the resources available for the households in the area (e.g. income, mobility tools) also placed fewer restrictions on the households to perform their desired travel behaviour. Consequently, it is expected that a residential relocation to the Rummelsburger Bucht leads to a change in daily mobility which in this section will be measured by a change in transport mode choice, travel distances and travel time. Before attention will be paid to a change in mobility, the focus will be on the current transport mode usage (**figure 6.5)**.

Figure 6.5: Usage of transport modes in the Rummelsburger Bucht and Berlin



Source: INFAS-DLR, 2008 – Author, 2012

In order to compare the daily mobility of the households in the Rummelsburger Bucht and similar households in Berlin (based on age and educational level), the extremes in transport mode usage are showed. It should be noted that the data for Berlin entails the whole city and thus contains the transport mode usage from households living in the city centre as well as from the outskirts of the city. From *chapter 3.6* it became clear that the transport mode choice differs between different spatial typologies. Consequently, the expectations are that people in the city centre travel less by car and more frequently use public transport and slower modes of transport than people living more outside the city centre. When looking at the data for the districts of Berlin, this appears to be true, for example people in the central district of Friedrichshain-Kreuzberg have a lower share for car usage in total amount of trips (17%) than people in the more remote district of Treptow-Köpenick (40%) (SenStadt, 2010). Unfortunately, the data for the districts of Berlin was not available in the same format as used for this research, so a direct comparison could not be made. It should therefore be kept in mind that the results from the comparison with the whole city do not automatically apply to all districts of the city. In **figure 6.5** the transport mode usage for cycling, local public transport, regional public transport and car or motorbike are shown. Unfortunately no data on walking was available for Berlin so a comparison could not be made. Besides, the group local public transport is for the Rummelsburger Bucht specified into bus or tram and S- or U-Bahn. A comparison for bicycle use shows a difference between the Rummelsburger Bucht and Berlin, as people in the Rummelsburger Bucht more frequently used the bicycle than people in Berlin. Besides cycling, no major differences were found for other modes of transport except for a small difference for people that use the car several times a week (23% for the Rummelsburger Bucht and 35% for Berlin) and a slightly higher usage of regional transport by people in the Rummelsburger Bucht. Additionally is was found that the usage of regional public transport tends to be low in both areas.

Changes in travel time and travel distance

One of the aspects by which a change in mobility can be seen is a change in travel times and travel distances. A comparison of the results on a change in travel time and travel distance showed the same direction of change and almost identical values for both variables. Consequently, it has been decided to only show the results of a change in travel time (**table 6.3**), as people's travel decisions are determined by time (*see section 2.1 about time constraints)* rather than by distance and because of the more unambiguous and less-subjective nature of travel times compared to travel distances. It should nevertheless be noted that findings for travel time can also be applied to travel distances. The scores for change represent the average decrease or increase in travel time between the previous and current place of residence and have been tested on significant effects by using Sign Tests. The scores of change are ranging from -1 and +1, with -1 meaning a decrease, +1 an increase and 0 no change in travel time for all households.

Table 6.3: Changes in travel time

Destination	Change (mean)		Decrease (%)	No change (%)	Increase (%)
work	0.03		31	34	34
daily shops	0.49	*	10	31	58
green spaces	-0.59	*	61	35	4
city centre	0.19		21	38	39
bus/tram stop	-0.37	*	42	51	6
U- or S-Bahn stop	-0.03		29	44	26
regional train-/bus station	-0.27	*	44	38	18
overall travel time (mean)	-0.08				

*significant at 0.01 level

The overall score demonstrates a slight decrease in travel times to various destinations. However, a more specific look shows that there is a wide variation between different travel destinations. The travel time to work was found to be relatively stable. This can be a consequence of the previous finding that most people moved from the central zones (A and B) of Berlin to the Rummelsburger Bucht and have kept their jobs in the central city. This finding can also be seen when looking at travel time to the city centre, which for most people remained stable (38%) or increased (39%). The largest significant increase can be found in travel time (58%) to daily shops. This high increase is a consequence of the temporary lack of shops in the area itself and is expected to drop once the area is fully developed (*see chapter 4.3)*. The largest significant reduction is found in the travel time to green spaces (61%). On the peninsula itself green spaces could be found, but also the neighbouring Treptower Park (a 5 minute walk) is in close proximity, providing the residents of the Rummelsburger Bucht with multiple options to recreate in the green within close proximity. A focus on the changes in travel time to public transport facilities demonstrates that there overall there was a significant decrease in travel time to bus and tram stops, even though more than half of the respondents indicated that there was no change. This increase is mainly a consequence of the bus route through the neighbourhood, which enables the residents to reach a bus stop within a few minutes. Fewer changes can be seen for the travel time to the U- or S-Bahn stations. Although the area is closely located to two S-Bahn stops, travel time only slightly decreased. This can largely be explained by the previous place of residential location

of the households, which was in nearly all cases in central Berlin and consequently near a U- or S-Bahn station. A slight decrease does however not mean that there cannot be a larger change in the *usage* of the U- and S-Bahn, because of the connectivity options that both the S-Bahn stops Treptower Park and Ostkreuz give (*see table 6.4)*. Lastly, travel time to the regional train and bus station clearly and significantly decreased. This decrease can mean that people will now have a better access to reach other destination such as neighbouring cities and the Berlin airport.

The changes in travel time were expected to be related to the previous location. Previously it was shown that approximately half of the respondents used to live in Berlin's most central zone and the other half outside of this zone. A comparison between the changes for both groups shows that households who moved from other areas than the most central zone to the Rummelsburger Bucht had a lower increase in travel time to shops and a higher decrease of the travel time to the bus/tram stops. On the other hand, the travel time to U-and S-Bahn stops increased (0.25) for households from the central zone and decreased (-0.40) for households from outside this zone. These findings seem to be a result of the difference in transport and shopping opportunities between the previous place of residence and the Rummelsburger Bucht. Another significant difference was found for the travel time to green spaces, which decreased more for households from the central zone, a consequence of the higher availability of green spaces in the outer zones. For the travel time to work and to the city centre no significant differences were found. The differences found in travel time for both groups are expected to result in differences between these groups for changes in transport mode usage.

Changes in transport mode usage

From the previous section the question arises if a change in mobility for travel distances and travel times is also reflected in a change in transport mode. To see for whom a change occurred, a comparison has been made between groups that had a high or a low preference for a car-oriented neighbourhood and for the previous residential location of the households by using Mann-Whitney tests (*Appendix X*) In **table 5.4** the changes in mobility can be found for several modes of transport for three trip purposes: commuting trips, daily shopping trips and leisure trips. Like in the previous table, the scores of change range between -1 and +1 with -1 meaning a decrease, +1 an increase and 0 no change in transport mode usage for all households. The significance of the changes has been tested with Sign Tests (*Appendix X*). The results on changes in walking show that there is hardly a change in walking as a mode to commute. This can be related to the work location as this location did not change for a majority of people and is still not reachable by foot. A clear significant decrease (-0.34) in walking can be found for daily shopping trips. As mentioned before, this decrease results from a lack of shops in the area. Whereas walking is normally popular for performing daily shopping trips, it seems that in the Rummelsburger Bucht its gets largely replaced by a significant increase in cycling (0.28) and to a lesser extent the car (0.11). Here an increased use of the bicycle for daily shopping is particularly apparent for households that had a low preference for a car-oriented neighbourhood, whereas households with a high preference for a car-oriented neighbourhood did not show an increase in bicycle use but rather increased their usage of the U- and S-Bahn and the car for shopping. A significant increase in walking could be found for leisure trips (50% of the respondents walk as often as before and 40% walk more often than before). A similar significant increase of usage for

leisure trips can be found for the bicycle. These increases in walking and cycling are a not only a consequence of the good opportunities that the area provides to walk and to cycle within close proximity, but also gives good walking and cycling opportunities to recreate outside the city because of the area's location at the edge of the city centre and location near to parks, forests and the riverside. This can also explain an increase in bicycle use to work. Interestingly however, this last finding proved not to be the case for households that preferred a car-oriented neighbourhood, as they showed a decrease in cycling to work.

Table 6.4: Changes in transport mode usage

Transport mode	Trip purpose	Change (mean)		Change in transport mode usage (%)			
				More often than before	As often as before	Less than before	Still not
Walking (> 10 min)	Commute	0.02		23	44	21	11
	Daily shopping	-0.34	**	10	42	43	3
	Leisure trips	0.31	**	40	50	9	1
Bicycle	Commute	0.19	*	32	40	15	13
	Daily shopping	0.28	**	38	34	13	15
	Leisure trips	0.40	**	46	39	9	4
Bus, Tram	Commute	0.10		25	35	18	21
	Daily shopping	0.05		22	25	19	35
	Leisure trips	0.00		19	40	19	23
U-Bahn, S-Bahn	Commute	0.19	*	32	41	15	11
	Daily shopping	0.06		23	37	18	23
	Leisure trips	0.11		27	49	16	8
Regional trains-, busses	Commute	0.12		16	43	8	33
	Daily shopping	-0.03		7	35	9	50
	Leisure trips	-0.03		8	47	10	35
Auto, Motorbike	Commute	-0.15		14	50	26	10
	Daily shopping	0.11		29	46	17	9
	Leisure trips	-0.10		13	59	21	7

* significant at 0.10 level

** signifcant at 0.01 level

Only minor changes are found for the usage of the bus, tram and regional trains and busses. This relatively stable usage can to a large extent be explained by the fact that a lot of people do not use these transport modes at all (a relatively high percentage of households indicated that they still do not make use of these transport modes, a finding which is confirmed by the transport mode usage in *figure 6.5)*. The minor changes indicate a slight increase in the usage of the bus or tram and regional trains and busses for commuting, a finding which seems to be a direct result of a reduction in travel distances and travel times to stops for these modes of transport. Finally, a reduction in car-use for commuting and leisure trips can be found (-0.15 and -0.10), although most people indicated that their usage of the car did not change between their previous and current place of residence. This high percentage of non-change might indicate that car-travel is often habitual (*see section 6.4)*. The reduction of car-use is a consequence of an increased usage of the bicycle and (local) public transport for commuting trips. Especially the significant increase in U- and S-Bahn usage is interesting, as the travel distance and travel time to their stops only slightly decreased (*see table 6.3)*.

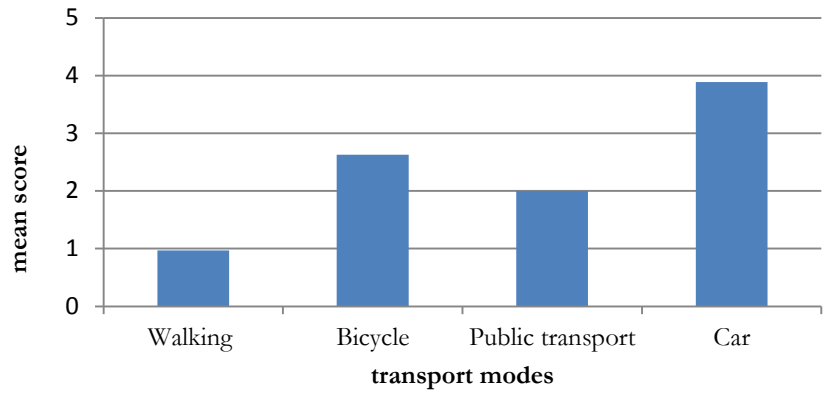
The increase in U- and S-Bahn usage can largely be explained by the previous residential location of the households. A comparison between groups that moved to the Rummelsburger Bucht from Berlin's most central zone and those that relocated from other areas shows that U- and S-Bahn usage increased significantly for all three trip purposes for households that previously lived in another area than the most central zone. This increase in U-and S-Bahn usage seems to replace car-use, as car-use decreased for all three trip purposes. This is in contrast with the changes in transport mode usage for the households that relocated from the most central zone, as they hardly show any changes in transport mode usage. In their case, only car-use for shopping trips showed a clear increase. Additionally, the comparison showed a significant difference in the increase of train use and walking to work, as these did not change for households from the most central zone but increased for the other group. These results show that the previous location is a strong explaining variable when changes in transport mode usage are concerned. For households that moved from outside Berlin's most central zone, a clear change in transport mode usage occurred. This is expected to be related to the availability of (transport) facilities, as also travel time to these facilities decreased for them. On the other hand, for households that moved from Berlin's most central zone to the Rummelsburger Bucht showed less changes in especially car, train and U- and S-Bahn usage. Despite these differences, walking for leisure trips and cycling for all trip purposes increased for both groups.

This section has demonstrated that a residential relocation had an impact on the travel times, travel distances and transport mode choice of the households that relocated to the Rummelsburger Bucht, which were mainly dependent on the previous residential location of the households. In the next section, the question is addressed of whether a relocation can also lead to possibly break of car-habit.

6.4 Breaking the habit?

In *chapter 2.2* the habitual nature of daily travel behaviour was discussed, whereby travel behaviour becomes a repeated performance of actions. For travel behaviour this means that choices that are made, for example on transport mode choice and route, are decided routinely and without deliberation. It was argued however that a change in the stability of the context can lead to a sensible phase in which the habitual (travel) behaviour might be broken. A residential relocation might be such a case and previous research indeed found habit-breaking effects. In order to see the habitual nature of the travel behaviour of the households of the Rummelsburger Bucht, the households were asked to indicate which transport mode they would use to perform a variety of activities using the response-frequency measure as described in *chapter 5.2*. In **figure 6.6** the habit score for walking, cycling public transport and car usage can be found. The habit score gives the mean of the amount of times that people choose this mode of transport to perform a variety of activities. In the previous section, **table 6.5** showed that especially car usage for most households did not change for different trip purposes, which already indicated that households might have a habit for car-use. **Figure 6.6** confirms this, as the usage of the car was the most frequently mentioned transport mode to perform the activities, followed by the bicycle. This is not surprising as the car is the transport mode that is the most associated with habits because of its high level of convenience.

Figure 6.6: Habit score for different transport modes



To test if a residential relocation can indeed have the suggested habit-breaking effect, the habit score of car-use has been compared with the change in car-use for commuting, daily shopping and leisure trips. A change in this usage indicates that people are using the car either less or more, whereby a reduction of car-use is preferred as it means that habitual car drivers made less use of the car and replaced their car-use by more sustainable modes of transport. To see the habit-breaking effect, the sample has been split by the mean in two groups, with one group representing households with a lower score on car-habit and one group representing households with a higher score on habit. A Mann-Whitney test shows that the two groups do not differ significantly for the three trips purposes. However, when a lower probability is taken (α=0.10) a significant difference is found for commuting, meaning that there is a difference in change in car-use for commuting between households with a low and a high car-habit. Taking a closer look at the mean scores between the two groups, this difference can be explained by a -0.36 decrease of car-use for commuting for the low car-habit group, compared to a 0.11 increase for the high car-habit group. It thus seems that a residential relocation had a two-fold effect on habitual car-use. There is still a group with a high car-habit that did not change their usage of the car for commuting or even showed a small increase. On the other hand, there is a group with a low-car habit that showed a reduction of car-use for commuting. However, as the data on habit-score is collected after relocation this relation not clear. This means that a reduction of car-use for the low-habit group might be either caused by a reduction of car-use of households that already had a low car-habit or by a reduction of car-use of households that before had a higher car-habit. In conclusion, it seems that the group with a higher car-habit retained their car habit, while the groups with the lower car-habit reduced their car-use. This relation is however not clear, as the research was only able to measure habits at one moment in time.

7 Discussion of the results

This research was concerned with the mutual interactions between daily and residential mobility. This relation has been investigated by a theoretical analysis and quantitative empirical research that took place in the Rummelsburger Bucht in Berlin. The aim of the research was to provide more insight into the role that daily mobility played in the decision for a residential relocation to the Rummelsburger Bucht and the extent to which and for whom this relocation could have led to a change in daily mobility. The answers to these questions can contribute to debates on the role of mobility in the relocation process, the influence of urban form on mobility, the effects of self-selection, the role of habitual travel behaviour and if residential newly built inner city areas can contribute to re-urbanisation.

In order to see for whom changes in mobility took place the characteristics, mobility tools and the previous residential location of the households that relocated to the Rummelsburger Bucht were analysed. The findings showed that households can be characterized by a high income and high education and were in most cases in a relationship and had children. They also had a high ownership and access to mobility tools (e.g. driver's license availability and frequent car access). These characteristics are normally associated with higher travel distances and more frequent car-use (Buehler, 2011; Schwanen, Dijst & Dieleman, 2002), but differences in car-use between households of the Rummelsburger Bucht and Berlin were not found. Differences on the neighbourhood level are however expected when the area is compared to the car-oriented outer areas of the city and the public transport oriented city centre.

More than half of the households that relocated to the Rummelsburger Bucht previously lived in the most central zone in Berlin. This finding is interesting when looking at the motives for relocation to the area, as the households attached a high importance to aspects that are normally associated with a residential location outside the city (e.g. an own garden, a quiet area and the availability of green spaces and terraced-housing). This means that the Rummelsburger Bucht can offer opportunities for people in Berlin who otherwise might have left the city to satisfy their preferences and at the same can attract people from outside the city to Berlin. Areas like the Rummelsburger Bucht can therefore contribute to the re-urbanisation process of the city (Spaans 2004; Doutcet, 2010). This is particularly of importance in the case of Berlin, as the city is struggling with financial problems and needs to attract and retain wealthy residents and businesses.

The role that daily mobility would play in the relocation process was expected to be limited, as motives resulting from changes in the life-course trajectories form the main triggers and restrictions for a relocation (Mulder & Hooimeijer, 1999; Blotevogel & Jescke, 2003; Lee & Wadell, 2010; Molin & Timmermans, 2003). These expectations were confirmed, as mobility was not found to be a motive for a relocation. On the other hand, mobility aspects did play a role in the relocating process as it affected the location decision. Still, the influence that mobility had in the location decision was on most aspects found to be lower than aspects of the built environment and accessibility. Although correlations were found between the preference to relocate to an area that facilitated the preferred transport mode and the actual transport mode usage, the residential self-selection effects are expected to be low, as they seem to be only

limitedly supported by motives for relocation. The role that daily mobility plays for residential mobility thus seems to be limited.

A residential relocation is always expected to result in changes in daily mobility as a relocation automatically means a change in situational context and the activity space (Mulder & Hooimeijer, 1999). The theoretical analyses showed that the relocation process can prompt a reconsideration of the transport mode choice and form a sensible phase in which travel decisions can change and be influenced (Stanbrigde, Lyons & Farthing, 2004; Bamberg, Rölle & Weber, 2003). Although mobility patterns are largely dependent on the socio-demographic characteristics of the relocaters, urban form was found to be of influence on mobility patterns (see e.g. Ewing & Cervero, 2010; Stead & Marshall, 2011; Maat, 2010). The Rummelsburger Bucht forms an interesting case here as its urban form, as an urban intensification area, is expected to result in mobility patterns that are more desirable in the light of environmental sustainability than other newly built urban forms (Snellen, Hilberts & Hendriks, 2005). Another study by Konings, Kruythof & Maat (1996) however argued that newly built inner city areas are not expected to lead to any significant changes. This research found an impact of the residential relocation on daily mobility for travel times, travel distances and transport mode choice. Overall, no major changes in travel times and travel distances were found but a closer look showed that there was an increase in travel time and travel distance for daily shopping trips and a decrease to green spaces, bus/tram stops and regional train-/bus stations. The direction and magnitudes of these effects proved to be especially dependent on the previous residential location. Differences in travel time and travel distances were found between households that relocated from the most central zone of Berlin and from other locations as the first showed a decrease to green spaces and the later a decrease to shops and public transport facilities.

Changes in mobility were also found for the use of transport modes for commuting, shopping and leisure trips. Generally, a relocation to the Rummelsburger Bucht led to an increase in cycling for all three trip purposes and an increase in walking for leisure trips. It seems that independent of (low) self-selection effects and socio-demographic variables a change in the urban form has led to a change in cycling for all groups. The frequency of walking did however decrease for shopping trips, a finding which can be explained by the lack of shops in the area. Interestingly, the decrease in walking got compensated by an increase in bicycle use for households that were less car-oriented; car-oriented households on the other hand showed an increase in car-use for shopping. Other (smaller) changes in transport mode use were found for U- and S-Bahn use for commuting which increased and for car-use for commute and leisure trips which slightly decreased. These changes can largely be explained by the previous residential location, as a move from a location outside Berlin's most central zone to the Rummelsburger Bucht resulted in an increase of U- and S-Bahn usage and a decline in car-use for all trips. For people that moved from Berlin's most central zone to their new location, no changes in these transport modes were found. This is interesting as an increase of the distance and travel time to the city centre was expected to result in shift towards car-use and an increase in kilometres and can possibly be explained by a higher connectivity of the transport facilities in and around the Rummelsburger Bucht. Considering the importance that households attached to aspects of the area that would normally be found outside of the city and the characteristics and mobility tools of the households, it can be concluded that it makes sense to develop newly built inner city areas like

the Rummelsburger Bucht in the light of environmentally more desirable mobility patterns. It should however be kept in mind that these mobility patterns are dependent on the transport opportunities that are available in the area. Besides, as previous research showed (Bamberg, Rölle & Weber, 2003; Fuijii & Kitamura, 2003), it is likely that even more changes in mobility can be achieved if new residents receive information concerning their mobility that is personally relevant and which contains persuasive information and get introduced to other modes of transport.

The stable situation that was found for car-use could probably be explained by its habitual nature (Verplanken, Aarts & van Knippenberg, 1997; Oulette & Wood, 1998). The habitual travel behaviour is however mostly present when the situational context remains stable and can possibly be influenced when a change in the context occurs (Bamberg, Ajzen & Smidt, 2003; Fuijii & Kitamura, 2003). The car was found to be the most habitual mode of transport included in this research as the majority of respondents indicated that no changes in car-use took place and because of its higher score on travel habits. Based on the height of the habit-score, the households were divided into two groups that were tested on the change in car-use for commuting. The group that scored higher on car-habit showed no changes in car-use, while the group with a lower car-habit score reduced their car-use for commuting. It thus seems that the group with a higher car-habit retained their car habit, while the groups with the lower car-habit reduced their car-use. However, as the research only measured habits after relocation this relation is not entirely clear and requires a longitudinal approach. These findings mean that although for a reduction of car-use was found for one group, no clear conclusions can be made about the habit breaking effect of a residential relocation.

The findings of this research can give a good indication of the interactions between daily and residential mobility. Nonetheless, the results have only been based on a small data set. This limited the options to perform several statistical analyses. No differences were found between the available household characteristics of the sample and the population of the Rummelsburger Bucht, which increases the external validity of the research. However, a higher share of apartments and variations in the distances to transport facilities for other parts of the Rummelsburger Bucht could have led to variations in the findings. Differences can also exist between the respondents and the non-response, as the households who could not have been reached might show distinctive mobility patterns. Furthermore, the theoretical analysis showed that the role of the spatial structure and political, socio-economic and cultural context have a high impact on mobility patterns. It is therefore advised to be cautious when interpreting and applying the results for other spatial contexts as the direction of the relation might be the same, but variations in strength are expected.

To see if the findings of this research also apply to other newly built inner city areas, further research is recommended to look at the effects between different projects within the same and between different spatial contexts, for instance by comparing the findings for the projects within one city with the results for another city. When larger data sets are used, these findings can also be analysed for example by logistic-regression models, which were infeasible for this research. Due to time restrictions the findings of this research have been based on empirical research that took place at one moment in time. This meant that now direct comparison between travel behaviour before and after relocation could be made and that the research had to rely on the

estimations of the respondents for the indication of the change in mobility. Despite the recent date of relocation to the area, respondents might have not been able to exactly assess their travel behaviour at their previous location. Besides, the research method that was used might have resulted in subjective and socially desirable answers. Consequently it is advised that further research will concentrate on daily mobility before and after relocation by using a longitudinal design and travel diaries. Another interesting perspective for further research will be a focus on qualitative methods that can also pay attention to the role of attitudes and lifestyles in connection to travel behaviour and transport opportunities. Lastly, this research has concentrated on physical mobility. A focus on virtual mobilities might, especially in the light of its current developments, provide new insights into the role that mobility in total can play.

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Appendix

Appendix A: Empirical studies on the relation between urban form and mobility

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Appendix A

Empirical studies on the relation between urban form and mobility

To see if a effect was found of urban form on mobility in the European literature, a selection of sixteen articles was made based on the availability of literature and the familiarity of the author with some studies. The aim was to include articles which considered different (spatial) variables in their analyses to get an overview of findings on several travel determinants and outcomes. This selection has resulted in studies on several cities, countries and regions in Europe which focus on different urban scales and topologies. A majority of the literature originated from the Netherlands. This is mainly a result of the county's long tradition of intensive spatial planning, as a consequence of its high density and problems with traffic related pollution and congestion

The table demonstrates that the studies show a wide variety of values on different variables. The variable *spatial scale* shows that the focus of the studies has a high spatial variation. This confirmed the expectations from earlier research (e.g. Ewing & Cervero, 2009) that previously mentioned that the influence of the urban form on travel behavior highly differs between spatial scales. A comparison of the results for different spatial scales can therefore be made, as well as for the different spatial typologies (*see paragraph 3.6*). The studies have used a large variety of indicators for urban form and land use measures, with as most common indicator several kinds of density measures. The other indicators used can most of the time by classified to one of the other mentioned D's for the urban form; diversity, design, destination accessibility, distance to transit and demand management. Some of the studies only use a few indicators, whereas others also include indicators that are more focus on the residential living environment such as green spaces, the type of dwelling and pedestrian priority zones. The effects of these indicators on travel outcomes have mostly been measures in the amount of trips made, the distance covered and the mode of transport. The methods of analyses used show a rather similar pattern, with almost all studies starting with a descriptive analysis followed by either multi/bi-variate analyses or a form of regression analysis.

Table 2. Empirical studies on the relation between urban form and mobility with a focus on Europe

Author(s)	Study sites	Spatial scale	Spatial typologies	Urban form & land use measures	Travel outcome measures[5]	Method of analysis
Buehler (2011)	USA Germany	National Metropolitan	-	Population density Mix of population and workplaces Household distance to public transport Mix of land-use Trip purpose	Trips	Bi-variate analysis Multiple regression
Den Hollander, Kruythoff & Teule (1996)	Randstad (Netherlands)	Neighbourhood	City expansion	Location of area Type of housing Residential environment Accessibility to public transport Previous residential location	Distance (commuting) Distance (commuted) Mode of transport (commuting) Travel time (commuting) Response to commuting	Cross-section Longitudinal Multi-response Multi-variate
Giuliano & Narayan (2003)	USA Great Britain	Metropolitan	-	Metropolitan size Population density	Daily trips Travel distance Travel time Mode of transport	Regression
Hilbers, Snellen & Hendriks (2006)	Netherlands	Region Metropolitan Neighbourhood	City expansion City intensification	Neighbourhood type Location of area within region/metropolitan area	Distance (during rush hour) Distance to centre of city-region Car-kilometres on intensively used roads (during rush hour)	Regression (not specified)
Konings, Krutyhoff & Maat (1996)	Noord-Brabant province (Netherlands)	Region	City intensification (low/high density) City-expansion (low/high density) Peripheral (low/high density)	Type of structure Housing density Type of housing Urbanization rate Distance to public transport stop	Mode of transport for commuting Distance Distance (commuting)	Multi-variate analyses Regression
Limtanakool, Dijst & Schwanen (2006)	Netherlands	Municipality	In/outside metropolitan area Core cities Suburban areas More/less urbanised areas	Population density Type of municipality Availability of railway station Specialisation of land Land use balance	Mode of transport Trips	Multi-variate analyses
Maat & Timmermans (2009)	Netherlands	Metropolitan Region	Mono/poly-centric areas	Dwelling type Residential density Distance to railway station	Mode of transport (commuting) Distance (commuting)	Binary and multi modal modes

[5] *Indicator refers to daily activities when not specified*

Table 2. Empirical studies on the relation between urban form and mobility with a focus on Europe *(continued)*

Author(s)	Study sites	Spatial scale	Spatial typologies	Urban form & land use measures	Travel outcome measures[6]	Method of analysis
Meurs & Haaijer (2001)	Netherlands	National	High/low density High/low configuration High/low accessibility beyond neighbourhood High/low accessibility within neighbourhood	Type of housing Garden Garage View On cycling route Easy parking Distance to public transport Pedestrian priority area 30 km/h zone Traffic calming measures Number of housing per hectare Planting Accessibility for shopping Suitable for pedestrians/cyclists Time to reach main road Shopping accessibility Type of residential environment	Trips (weekly)	Cross-section regression
Milakis, Vlastos & Barbopoulos (2008)	Athens (Greece)	Municipality	Compact regions Suburban regions	Residential density Land use balance Distance from centre Road space per person	Trips Length of trip Energy consumption by car	
Næss (2011)	Copenhagen (Denmark)	Metropolitan	Micro/macro level areas within the metropolitan regions	Location of the dwelling relative to the metropolitan level centre structure and rail stations Density in the surroundings of the dwelling Availability of service facilities Local green recreational areas Local street pattern Distance to downtown, second-urban centre, urban rail station and various functions Population and workplace density	Distance (per week)	Bivariate correlations Multiple regression
Schwanen (2001)	Amsterdam Brussels Copenhagen Frankfurt Hamburg London Munich Paris Stockholm Vienna Zurich	Urban	Urban area Inner area	Population density Urban structure City size	Distance (commuting) Travel time (commuting) Mode of transport (commuting)	Linear regression
Schwanen, Dijst & Dieleman (2002)	Netherlands	Metropolitan Urban	Mono / poly-centric Urbanised/non-urbanised areas Large cities, medium cities, growth cities Suburbs	City size Urbanisation level	Travel time Trips (purposed) Mode of transport	Regression Multi-variate
Snellen (2001)	Netherlands	Neighbourhood	Medium sized cities	Urban shape Transport network type Distance to city centre Location within metropolitan area Urbanisation level	Distance Mode of transport Travel time Trips conducted	Multilevel analysis

[6] *Indicator refers to daily activities when not specified*

Table 2. Empirical studies on the relation between urban form and mobility with a focus on Europe *(continued)*

Author(s)	**Study sites**	**Spatial scale**	**Spatial typologies**	**Urban form & land use measures**	**Travel outcome measures**[7]	**Method of analysis**
Timmermans et al. (2003)	Midlands (United Kingdom), Portland (USA), Canada metropolitan areas, Fukuoka (Japan), South-Rotterdam region (Netherlands)	Metropolitan Urban	Urban areas Suburban areas Countryside	Type of area	Trips Mode of transport	Multiple regression
Vance & Hedel (2008)	Germany	National	-	Outlet density Road density Outlet diversity Walking minutes to public transit	Car ownership Distance (non-work)	Censored regression
Snellen, Hilberts & Hendriks (2005)	Netherlands	Neighbourhood National	City expansion City intensification	Age of construction Region Location Service provision Mix-use Public transport provision Car accessibility	Car ownership Distance Mode of transport	Multivariate Regression

[7] *Indicator refers to daily activities when not specified*

Appendix B

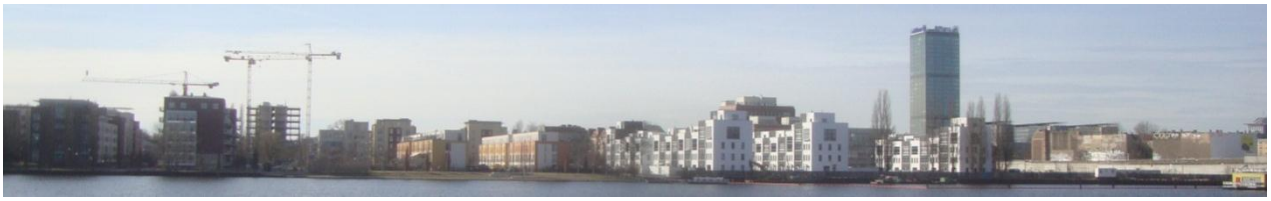
German questionnaire

Haushaltsbefragung Wohnstandortwahl und Mobilität, Rummelsburger Bucht Stralau 2012

Deutsches Zentrum für Luft- und Raumfahrt e.V.
in der Helmholtz-Gemeinschaft

(Wird vom Interviewer ausgefüllt werden)

Fragebogen Nummer: .....
Datum: .....
Zeit: .....
Art des Gebäudes: .....



Sehr geehrte Damen und Herren,

wir möchten Ihnen gerne einige Fragen zu den Motiven für die Wahl Ihres jetzigen Wohnstandorts und zu Ihrem alltäglichen Mobilitätsverhalten stellen. Dieser Fragebogen ist Teil einer Abschlussarbeit für den Masterstudiengang Stadtgeographie an der Universität Utrecht (Niederlande), die vom Institut für Verkehrsforschung des Deutschen Zentrums für Luft und Raumfahrt (DLR) Berlin betreut wird. Sie haben in den letzten Wochen bereits eine Ankündigung von uns erhalten. Über Ihre Mitwirkung würden wir uns sehr freuen. Zur Beantwortung des Fragebogens lesen Sie bitte zunächst die nachfolgenden Punkte:

♦ Das Ausfüllen des Fragebogens wird etwa 10-15 Minuten Ihrer Zeit in Anspruch nehmen.

♦ Der Fragebogen ist in drei Teile gegliedert. Der erste Teil betrifft Ihren vorherigen Wohnstandort. Der zweite Teil behandelt Ihr alltägliches Mobilitätsverhalten. Im dritten Teil möchten wir gern einige persönliche und haushaltsbezogene Merkmale erfahren.

♦ Die Umfrage besteht aus zwei Arten von Fragen: offene Fragen und geschlossene Fragen. Bitte kreuzen Sie bei geschlossenen Fragen nur eine der möglichen Antworten an. Im Falle eines Fehlers, streichen Sie bitte deutlich Ihre ursprüngliche Antwort durch und markieren sie Ihre neue Antwort.

♦ Es gibt keine richtigen oder falschen Antworten. Ihre Antworten werden vertraulich und anonym und ausschließlich im Rahmen unserer Forschungsaktivitäten behandelt.

♦ Wenn Sie Fragen oder Bemerkungen haben, zögern Sie nicht Rutger van Raalten (führt die Befragung durch - rutger.raalten@dlr.de, Tel. 030-670 55 7936) oder Dr.-Ing. Dirk Heinrichs vom Institut für Verkehrsforschung des DLR (dirk.heinrichs@dlr.de, Tel. 030-670 55 196) zu kontaktieren. *Vielen Dank im Voraus für Ihre Kooperation!*

I Vorheriger Wohnort

In diesem Teil möchten wir Ihnen einige Fragen zu Ihrem vorherigen Wohnort stellen und nach den Motiven für Ihren Umzug an den jetzigen Wohnort fragen.

1. Wie lange wohnen Sie in Ihrer <u>aktuellen</u> Wohnung?

□ weniger als 6 Monate □ 1 bis 2 Jahre □ 3 bis 4 Jahre

□ 6 Monate bis 1 Jahr □ 2 bis 3 Jahre □ mehr als 4 Jahre

2. Wo befand sich Ihr <u>vorheriger</u> Wohnstandort?

□ Berlin, innerhalb des S-Bahn Ringes (Zone A)

□ Berlin, außerhalb des S-Bahn Ringes (Zone B)

□ Berliner Umland (Zone C)

□ in einer städtisch geprägten Region

□ in einer ländlich geprägten Region

3. Wie würden sie Ihr <u>vorheriges</u> Wohngebiet bezüglich der Einwohnerdichte charakterisieren? Ein Wert von 1 bedeutet eine 'sehr hohe Dichte'; ein Wert von 5 bedeutet eine 'sehr geringe Dichte'.

(sehr hohe Dichte)	*1*	*2*	*3*	*4*	*5*	*(sehr geringe Dichte)*
	□	□	□	□	□	

4. Welcher Gebäudetyp trifft am besten auf Ihre <u>vorherige</u> Wohnung zu?

□ Ein- oder Zweifamilienhaus

□ Reihenhaus

□ Mehrfamilienhaus

□ anderer Gebäudetyp

5. Welche der folgenden Gründe haben bei Ihrer Entscheidung umzuziehen eine Rolle gespielt? Sie können mehrere Antworten geben.

Mit dem/der Partner/in zusammenziehen	□
Familienzuwachs	□
Verkleinerung der Haushaltsgröße	□
Wohneigentum erwerben	□
Wechsel des Arbeitsplatzes	□
Größere Wohnung	□
Kleinere Wohnung	□
Finanziell günstigere Wohnung	□
Sonstige Gründe	……
	……

6. Inwieweit treffen die folgenden Aussagen für Ihre Umzugsentscheidung zu? Sie können auf einer Skala von 1-5 antworten, wobei 1 'trifft sehr zu' und 5 'trifft gar nicht zu' bedeutet.

	1 (Trifft sehr zu)	*2*	*3*	*4*	*5 (Trifft gar nicht zu)*
Mir war wichtig in ein Wohngebiet zu ziehen, in dem ich Vieles gut zu Fuß erreichen kann.	□	□	□	□	□
Mir war wichtig in ein Wohngebiet zu ziehen, in dem ich Vieles gut mit dem Fahrrad erreichen kann.	□	□	□	□	□
Mir war wichtig in ein Wohngebiet zu ziehen, in dem ich eine gute Anbindung an den öffentlichen Nahverkehr habe.	□	□	□	□	□
Mir war wichtig in ein Wohngebiet zu ziehen, das gut zum Autofahren geeignet ist (z.B. Parkplatzangebot, Anbindung an Hauptverkehrstrasse).	□	□	□	□	□

7. Wie wichtig waren die folgenden Merkmale der Rummelsburger Bucht für Sie beim Umzug in Ihre <u>jetzige</u> Wohnung? Sie können auf einer Skala von 1-5 antworten, wobei 1 'sehr wichtig' und 5 'sehr unwichtig' bedeutet.

		1 (sehr wichtig)	*2*	*3*	*4*	*5 (sehr unwichtig)*
a.	Zentrale Lage in der Stadt	□	□	□	□	□
b.	Nähe zu Grünflächen/Parks	□	□	□	□	□
c.	fußgängerfreundliche Wohnumgebung	□	□	□	□	□
d.	Nähe zu Schulen	□	□	□	□	□
e.	ansprechendes Design/Architektur im Wohngebiet	□	□	□	□	□
f.	Erreichbarkeit von Einkaufsgelegenheiten	□	□	□	□	□
g.	Nähe zum Arbeitsplatz	□	□	□	□	□
h.	Erreichbarkeit von Gesundheitsdienstleistungen (z.B. Apotheke, Krankenhaus)	□	□	□	□	□
i.	Kontakte zu Nachbarn	□	□	□	□	□
j.	Erreichbarkeit des öffentlichen Nahverkehrs	□	□	□	□	□
k.	ein eigener Garten	□	□	□	□	□
l.	fahrradfreundliche Wohnumgebung	□	□	□	□	□
m.	guter Zustand der Wohnung	□	□	□	□	□
n.	Lage am Wasser	□	□	□	□	□
o.	Verfügbarkeit von Parkplätzen	□	□	□	□	□
p.	kinderfreundliche Wohnumgebung	□	□	□	□	□
q.	Sonstige Merkmale					
	…….	□	□	□	□	□
	…….	□	□	□	□	□

II. Mobilitätsverhalten

In diesem Abschnitt möchten wir gerne erfahren, in welchem Umfang sich Ihr alltägliches Mobilitätsverhalten möglicherweise durch Ihren Umzug verändert hat.

8. Wie häufig nutzen Sie die folgenden Verkehrsmittel für <u>tägliche</u> Wege?

	(fast) täglich	*mehrmals pro Woche*	*mehrmals pro Monat*	*selten*	*(fast) nie*
zu Fuß *(Wege >10 min)*	□	□	□	□	□
Fahrrad	□	□	□	□	□
Bus, Tram	□	□	□	□	□
U-Bahn, S-Bahn	□	□	□	□	□
Regional-, Fernverkehr	□	□	□	□	□
Auto, Motorrad	□	□	□	□	□

9. Hat sich Ihre Nutzungshäufigkeit der verschiedenen Verkehrsmittel im Vergleich zur Zeit vor dem Umzug verändert? Diese Verkehrsmittel nutze ich nun…

a. **Arbeitswege**

	…häufiger als zuvor	*…genauso oft wie zuvor*	*…seltener als zuvor*	*…nach wie vor gar nicht*	*keine Antwort*
zu Fuß *(Wege >10 min)*	□	□	□	□	□
Fahrrad	□	□	□	□	□
Bus, Tram	□	□	□	□	□
U-Bahn, S-Bahn	□	□	□	□	□
Regional-, Fernverkehr	□	□	□	□	□
Auto, Motorrad	□	□	□	□	□

b. **Täglicher Einkauf/Besorgungen**

	…häufiger als zuvor	*…genauso oft wie zuvor*	*…seltener als zuvor*	*…nach wie vor gar nicht*	*keine Antwort*
zu Fuß *(Wege >10 min)*	□	□	□	□	□
Fahrrad	□	□	□	□	□
Bus, Tram	□	□	□	□	□
U-Bahn, S-Bahn	□	□	□	□	□
Regional-, Fernverkehr	□	□	□	□	□
Auto, Motorrad	□	□	□	□	□

c. **Freizeit**

	…häufiger als zuvor	*…genauso oft wie zuvor*	*…seltener als zuvor*	*…nach wie vor gar nicht*	*keine Antwort*
zu Fuß *(Wege >10 min)*	□	□	□	□	□
Fahrrad	□	□	□	□	□
Bus, Tram	□	□	□	□	□
U-Bahn, S-Bahn	□	□	□	□	□
Regional-, Fernverkehr	□	□	□	□	□
Auto, Motorrad	□	□	□	□	□

10. Im Folgenden werden einige mögliche Aktivitäten aufgelistet. Stellen Sie sich vor, dass Sie diese Aktivitäten spontan ausführen möchten. Welches Hauptverkehrsmittel würden Sie dazu normalerweise nutzen? Bitte wählen Sie nur <u>eine</u> Option pro Aktivität und kreuzen sie die Antwort nach Möglichkeit ohne viel Überlegen an.

		zu Fuß	*Fahrrad*	*öffentliche Verkehrsmittel*	*Auto, Motorrad*
a.	einen Sommerausflug mit Freunden an einen See machen	□	□	□	□
b.	eine(n) Freund/in besuchen	□	□	□	□
c.	die Eltern/Verwandten besuchen	□	□	□	□
d.	zum Sport gehen/fahren	□	□	□	□
e.	einen Stadtbummel machen	□	□	□	□
f.	abends in eine Bar gehen	□	□	□	□
g.	einen Ausflug an einem schönen Tag machen	□	□	□	□
h.	Lebensmittel einkaufen	□	□	□	□
i.	ein Restaurantbesuch	□	□	□	□
j.	ein Kinobesuch	□	□	□	□

11. Können Sie bitte angeben, inwieweit sich die folgenden Aspekte Ihrer täglichen Mobilität durch Ihren Umzug <u>verändert</u> haben?

		Abnahme	*keine Veränderung*	*Zunahme*
a.	Entfernung zur Arbeit	□	□	□
b.	Entfernung zu Einkaufsgelegenheiten	□	□	□
c.	Entfernung zu Grünanlagen/Parks	□	□	□
d.	Entfernung zum Stadtzentrum	□	□	□
e.	Entfernung zur Bus- oder Tramhaltestelle	□	□	□
f.	Entfernung zur U- oder S-Bahn-Haltestelle	□	□	□
g.	Entfernung zum Fern- und Regionalbahnhof	□	□	□
h.	Zeitdauer zur Arbeit	□	□	□
i.	Zeitdauer zu Einkaufsgelegenheiten	□	□	□
j.	Zeitdauer zu Grünanlagen/Park	□	□	□
k.	Zeitdauer zum Stadtzentrum	□	□	□
l.	Zeitdauer zur Bus- oder Tramhaltestelle	□	□	□
m.	Zeitdauer zur U- oder S-Bahn-Haltestelle	□	□	□
n.	Zeitdauer zum Fern- und Regionalbahnhof	□	□	□

III Persönliche & Haushaltsmerkmale

Abschließend möchten wir Ihnen einige Fragen zu Ihrer aktuellen persönlichen Situation und der Ihres Haushalts stellen.

12.	**Was ist Ihr Geschlecht?**	□ weiblich	□ männlich	
13.	**Wie alt sind Sie?**	…… Jahre		
14.	**Wie hoch ist Ihr monatliches Haushalts-Nettoeinkommen?**	□ weniger als 900 Euro	□ 1.300 bis unter 1.500 Euro	□ 2.000 bis unter 2.600 Euro
		□ 900 bis unter 1.300 Euro	□ 1.500 bis unter 2.000 Euro	□ 2.600 Euro oder mehr
		□ keine Angabe		
15.	**Was ist Ihr höchster Bildungsabschluss?**	□ kein Schulabschluss	□ Hochschulreife, Abitur, Erweiterte Oberschule (EOS) 12. Klasse	
		□ Volks-oder Hauptschulabschluss, Polytechnische Oberschule (POS) 8. Klasse	□ anderer Abschluss	
		□ Realschulabschluss oder Mittlere Reife, Polytechnische Oberschule (POS) 10. Klasse	□ bin noch Schüler(in) (habe noch keinen Abschluss)	
		□Fachhochschulreife oder Berufsausbildung mit Abitur	□Weiß nicht	
16.	**Wie ist Ihre Haushalts-situation?**	□ allein stehend	□ in Partnerschaft/Ehe	
		□ allein stehend mit Kindern	□ in Partnerschaft/Ehe mit Kindern	
17.	**Sind Sie Eigentümer oder Mieter Ihrer Wohnung?**		□ Eigentümer	□ Mieter
18.	**Haben Sie einen PKW/Motorrad-Führerschein?**		□ Ja	□ Nein
19.	**Haben Sie regelmäßig Zugang zu einem Auto oder Motorrad?**		□ Ja	□ Nein
20.	**Haben Sie regelmäßig Zugang zu einem Fahrrad?**		□ Ja	□ Nein
21.	**Steht Ihnen jederzeit ein eigener Parkplatz zur Verfügung? (z.B. gemietet, auf eigenem Grundstück)**		□ Ja	□ Nein
22.	**Haben Sie eine Monats- oder Jahreskarte für öffentliche Verkehrsmittel?**		□ Ja	□ Nein

Dies ist das Ende des Fragenbogens. Vielen Dank für Ihre Mithilfe. Möchten Sie über die Ergebnisse des Fragebogens informiert werden? Dann notieren Sie bitte hier Ihre E-Mail.

……@……

Appendix C

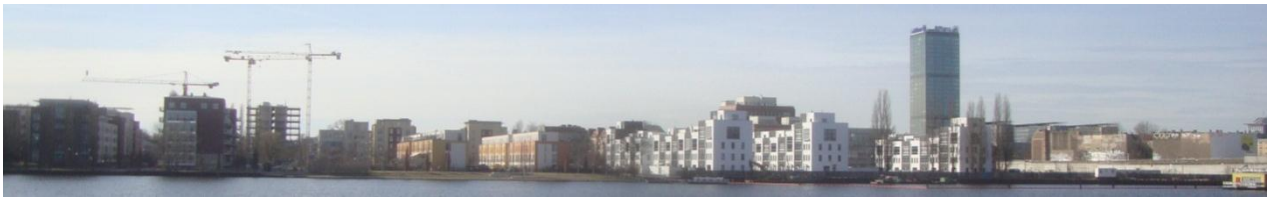
English questionnaire

Household survey Residential relocation and Mobility, Rummelsburger Bucht Stralau 2012

Deutsches Zentrum für Luft- und Raumfahrt e.V.
in der Helmholtz-Gemeinschaft

(To be completed by the conductor of the survey)

Survey Number: .....
Date: .....
Time: .....
Type of housing: .....



Dear Ms., Mr.,

With this questionnaire we would like to ask you some questions about your motives to relocate to your current place of residence and your daily mobility behaviour. This questionnaire is part of the final thesis for the master Urban Geography at Utrecht University (the Netherlands) and is conducted in cooperation with the department of transport research of the Deutsches Zentrum für Luft und Raumfahrt (DLR) Berlin. In the last weeks, we informed you about the questionnaire. We would really appreciate your cooperation and kindly request you to pay attention to the following:

♦ The completion of the questionnaire might take about 10-15 minutes of your time.

♦ The survey is divided in three parts. The first part is concerned with your previous place of residence. The second part pays attention to your daily travel behaviour. In the third part we want to ask you about some personal/household characteristics.

♦ The survey consists of two types of questions: open questions and closed questions. We would like to ask you to only tick one box per answer at the close questions. In case of a mistake, please clearly put a cross through your original answer and indicate your new answer.

♦ There are no right or wrong answers. Your answers will be processed confidential and anonymously, and will exclusively be used for our research activities.

♦ If you have any questions or comments, do not hesitate to ask Rutger van Raalten (the conductor of the survey - rutger.raalten@dlr.de, Tel. 030-670 55 7936.) or Dr.-Ing. Dirk Heinrichs of the Institute for Transport Research of the DLR (dirk.heinrichs@dlr.de, Tel. 030-670 55 196).

Thank you in advance for your cooperation!

I Previous place of residence

In this first part, we want to ask you same questions about your previous residential location and your motives to move to your current location.

1. For how long do you live in your <u>current</u> place of residence?

□ less than 6 months □ 1 to 2 years □ 3 to 4 years

□ 6 months to 1 year □ 2 to 3 years □ more than 4 years

2. Where was your <u>previous</u> place of residence?

□ Berlin, inside the S-Bahn Ring (Zone A)

□ Berlin, outside the S-Bahn Ring (Zone B)

□ Greater Berlin (Zone C)

□ in a region that is regarded as urban

□ in a region that is regarded as rural

3. How would characterize the population density at your <u>previous</u> place of residence? A value of 1 indicates a 'very high density', a value of 5 a 'very low density'.

(very high density)	*1*	*2*	*3*	*4*	*5*	*(very low density)*
	□	□	□	□	□	

4. Which building type matches best with your building type at your <u>previous</u> place of residence?

□ Detached/Semi-detached house

□ Row house

□ Apartment/Flat

□ other type of building

5. Which of the following reasons played a role in your decision to relocate? You can indicate several reasons.

Living together with my partner	□
Family Extension	□
Reduction of the size of the household	□
To gain ownership	□
Change in employment location	□
Bigger dwelling	□
Smaller dwelling	□
Financially affordable dwelling	□
Other reasons	……
	……

6. To what extent do the following statements apply to your residential relocation? You can answer on a scale from 1-5. Hereby a value of 1 means 'completely agree' and a value of 5 'completely disagree'.

	1 *(completely agree)*	*2*	*3*	*4*	*5* *(completely disagree)*
It was important for me the relocate to a residential environment in which I can easily reach a lot by foot.	□	□	□	□	□
It was important for me to relocate to a residential environment in which I can easily reach a lot by bicycle.	□	□	□	□	□
It was important for me to relocate to a residential environment in which I have a good connection to public transport.	□	□	□	□	□
It was important for me to relocate to a residential environment that is suitable for drive a car (e.g. provision of parking spaces, connection to main road network).	□	□	□	□	□

7. How important were the following characteristics of the Rummelsburger Bucht for you when you relocated to your <u>current</u> dwelling? You can answer on a scale from 1-5. Hereby a value of 1 means 'very important' and a value of 5 'very unimportant'.

		1 *(very important)*	*2*	*3*	*4*	*5* *(very unimportant)*
a.	Central location in the city	□	□	□	□	□
b.	Proximity to green spaces/parks	□	□	□	□	□
c.	Pedestrian-friendly residential environment	□	□	□	□	□
d.	Proximity to schools	□	□	□	□	□
e.	Appealing design/architecture in the residential environment	□	□	□	□	□
f.	Reachability of daily shopping facilities	□	□	□	□	□
g.	Proximity to place of work	□	□	□	□	□
h.	Reachability of health facilities (e.g. pharmacy, hospital)	□	□	□	□	□
i.	Contact with the neighbours	□	□	□	□	□
j.	Reachability of public transport	□	□	□	□	□
k.	An own garden	□	□	□	□	□
l.	Cycling-friendly residential environment	□	□	□	□	□
m.	Good condition of the dwelling	□	□	□	□	□
n.	Location at the waterfront	□	□	□	□	□
o.	Availability of parking spaces	□	□	□	□	□
p.	Child-friendly residential environment	□	□	□	□	□
q.	Other characteristics					
	…….	□	□	□	□	□
	…….	□	□	□	□	□

II. Mobility behaviour

In this part we would like to know, to which degree your daily mobility behaviour has changed as a consequence of your residential relocation.

8. How often do you <u>daily</u> use the following modes of transport?

	(almost) daily	*several times a week*	*several times a month*	*seldom*	*(almost) never*
Walking (> 10 min)	☐	☐	☐	☐	☐
Bicycle	☐	☐	☐	☐	☐
Bus, Tram	☐	☐	☐	☐	☐
U-Bahn, S-Bahn	☐	☐	☐	☐	☐
Regional trains-, busses	☐	☐	☐	☐	☐
Auto, Motorbike	☐	☐	☐	☐	☐

9. Has the frequency in which you use several modes of transport changed in comparison to your usage before your relocation? Now, I use these modes of transport…

a. **Commuting to work**

	…more often than before	*...as often as before*	*… less than before*	*…still not*	*no answer*
Walking (> 10 min)	☐	☐	☐	☐	☐
Bicycle	☐	☐	☐	☐	☐
Bus, Tram	☐	☐	☐	☐	☐
U-Bahn, S-Bahn	☐	☐	☐	☐	☐
Regional trains-, busses	☐	☐	☐	☐	☐
Auto, Motorbike	☐	☐	☐	☐	☐

b. **Daily shopping**

	…more often than before	*...as often as before*	*… less than before*	*…still not*	*no answer*
Walking (> 10 min)	☐	☐	☐	☐	☐
Bicycle	☐	☐	☐	☐	☐
Bus, Tram	☐	☐	☐	☐	☐
U-Bahn, S-Bahn	☐	☐	☐	☐	☐
Regional trains-, busses	☐	☐	☐	☐	☐
Auto, Motorbike	☐	☐	☐	☐	☐

c. **Making leisure trips**

	…more often than before	*...as often as before*	*… less than before*	*…still not*	*no answer*
Walking (> 10 min)	☐	☐	☐	☐	☐
Bicycle	☐	☐	☐	☐	☐
Bus, Tram	☐	☐	☐	☐	☐
U-Bahn, S-Bahn	☐	☐	☐	☐	☐
Regional trains-, busses	☐	☐	☐	☐	☐
Auto, Motorbike	☐	☐	☐	☐	☐

10. Listed below are a few activities that you might often perform. Assume that you spontaneously decide to engage in one of these activities. Which mode of transport would you be most likely to use? Please choose <u>one</u> option per question and respond quickly without much deliberation.

		walking	*bicycle*	*public transport*	*car, motorbike*
a.	Taking a summer excursion with friends to a lake	□	□	□	□
b.	Visiting a friend	□	□	□	□
c.	Visiting your parents	□	□	□	□
d.	Engaging in sports	□	□	□	□
e.	Strolling through the city	□	□	□	□
f.	Visiting a bar in the evening	□	□	□	□
g.	Taking a trip on a nice day	□	□	□	□
h.	Routine grocery shopping	□	□	□	□
i.	Eating in a restaurant	□	□	□	□
j.	Going to the movies	□	□	□	□

11. Can you please indicate, to what extent the following aspects of your daily mobility have <u>changed</u> as a consequence of your residential relocation?

		decrease	*no change*	*increase*
a.	Distance to work	□	□	□
b.	Distance to daily shops	□	□	□
c.	Distance to green spaces	□	□	□
d.	Distance to city centre	□	□	□
e.	Distance to bus/tram stop	□	□	□
f.	Distance to U- or S-Bahn stop	□	□	□
g.	Distance to regional train-/bus station	□	□	□
h.	Travel time to work	□	□	□
i.	Travel time to daily shops	□	□	□
j.	Travel time to green spaces	□	□	□
k.	Travel time to city centre	□	□	□
l.	Travel time to bus/tram stop	□	□	□
m.	Travel time to U- or S-Bahn stop	□	□	□
n.	Travel time to regional train-/bus station	□	□	□

III

Personal- and household characteristics

Finally, we would like to ask you some questions about some of your current individual- and household characteristics.

12.	**What is your gender?**	□ Female	□ Male	
13.	**How old are you?**	…… years		
14.	**How high is the monthly net-income of your household?**	□ less than 900 Euro	□ 1.300 to 1.500 Euro	□ 2.000 to 2.600 Euro
		□ 900 to 1.300 Euro	□ 1.500 to 2.000 Euro	□ 2.600 Euro or more
		□ No comment		
15.	**What is your highest completed level of education?**	□ No school completed	□ University/College	
		□ Primary school	□ Other completed education	
		□ Junior high-school	□ Still a student (do not have a completed education)	
		□ Senior high-school	□ I do not know	
16.	**How is your current household situation?**	□ Single	□ In a relationship/married	
		□ Single with children	□ In a relationship/married, with children	
17.	**Are you the owner of your dwelling or a renter?**		□ Owner	□ Renter
18.	**Do you have a driver's license for a car or motorbike?**		□ Yes	□ No
19.	**Do you have frequent access to a car or motorbike?**		□ Yes	□ No
20.	**Do you have frequent access to a bicycle?**		□ Yes	□ No
21.	**Do you currently have a private parking space available? (e.g. rented, on own property)**		□ Yes	□ No
22.	**Do you have a monthly- or yearly public transport card?**		□ Yes	□ No

End of the survey. We really appreciate your cooperation. Do you want to be informed about the result of the survey? Please write down your email address.

……@……