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Living near highways

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Chapter 2

Extending the Scope of Highway Planning:

Accessibility, Negative Externalities and the Residential Context



Abstract*

The objectives of this review-based paper were twofold. Firstly, we aimed to explore the need and possibilities for broadening the scope of highway planning by taking account of the residential context, including residential satisfaction. Satisfaction appears to be an interesting, and in our opinion, valuable mediating planning concept between road infrastructure planning and the accompanying external effects on the one hand and household coping strategies on the other. Households living near highway infrastructure are influenced by both positive (i.e. accessibility gains) and negative road-related factors (e.g., noise nuisance and air pollution). Changes in these factors may trigger people to accept the new situation, adjust preferences, try to influence plans and/or even relocate. The second aim was to gain a greater understanding of the influence of both accessibility characteristics and negative externalities on the residential context of households. With respect to context, we make a distinction between residential satisfaction, housing prices and residential relocation. We see changes in residential satisfaction as a potential early predictor of opposition to plans, not only from active opposers but also from the more 'silent majority', and as a predictor of housing price changes and residential mobility. Insights into residential satisfaction around highways may help transportation planners to relieve locational stress and may also prevent protests and relocations.

Our literature review indicated that households prefer to live close to highways to benefit from high regional accessibility, but do not want to contend with the nuisances. This is also reflected in property values. However, the literature appears to put more emphasis on studying the impact of (regional) accessibility and externalities on location behaviour than on residential satisfaction. Because of the added value that the concept of residential satisfaction may provide in road planning, and the limited scientific insights, it is important to gain greater insight into how residential satisfaction is influenced by negative and positive externalities and into how residential satisfaction changes over time—from the stage when new road projects are discussed through to concrete planning, realization and the period after completion. Moreover, it would be worthwhile to gain a deeper understanding of the extent to which house prices, location behaviour and residential satisfaction near highways interrelate.

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2.1 Introduction

The planning of road infrastructure in many Western countries has become more complex over the years. This is due to social developments such as increasingly outspoken citizens, the growing influence of regulation and physical factors such as scarcity of space, with increasing demands being made on the available space (Arts, 2007). The growing uncertainty attached to this complexity puts more pressure on the planning process (Bertolini, 2005). The traditional reaction of planners has been to 'hedge' (Collingridge, 1983) the risks by reinforcing a sectoral and linear infrastructure planning process. An example of this is that decisions about main road infrastructure, such as highways, are often dominated by macro-scale accessibility issues in a region or part of the country because accessibility may be vital for achieving regional economic development (Banister & Berechman, 2001).

Nevertheless, accessibility is only one aspect of road infrastructure. On the other side of the coin, road infrastructure and mobility may have a large environmental and social impact (Hull, 2011). High noise levels, air pollution, barrier effects, community fragmentation, etc. are common problems in neighbourhoods located along highways. However, because of the isolated nature of current planning in many countries, the impact of road infrastructure on the neighbouring area is generally not taken into account effectively. What is missing is a more inclusive planning perspective from the outset, with a focus that incorporates issues such as a proper fit of the infrastructure into its physical and social environment. Furthermore, the importance of early consultation with different stakeholders and consensus building (Suskind et al., 1999) is often disregarded in current planning practice. This lack of involvement in the planning process may lead to suboptimal plans that invest considerable effort in mitigation measures once a decision has been taken rather than focusing on smart spatial designs at an early stage of the process. The feeling of being excluded from the discussion may also push people to protest against infrastructural plans (Healey, 1997). An example of this is NIMBY (not in my backyard) opposition.

A potentially promising avenue leading towards more sustainable infrastructure delivery could be to adopt a broader social environmental perspective and to take explicit account of household demands and preferences in road planning decisions. One way to do this is to consult people who live in the vicinity of planned road work (e.g., new construction, extension or maintenance). This may give useful context-specific insights into people's opinions on a project. However, it is debatable whether the information gleaned from consultation meetings and other such engagements is representative. People who oppose certain plans are often

those who participate. Such consultation is of course important because it is opponents who may eventually go to court, which at the very least leads to planning delays. However, it seems useful from a broader societal point of view to know more about the opinions of others who live near highways, such as the 'silent' majority. Useful information relates to the specific context of a project, but more generally applicable information may be used as well. An example of the latter would include gaining general insights into the effect of positive (i.e. accessibility) and negative externalities (noise, pollution, etc.) related to road infrastructure on location decisions and residential satisfaction. Those who live near a highway may benefit more from accessibility gains than those living further away, provided at least there is an access lane. Car accessibility may determine the decision to live in a city or neighbourhood; this relates to a more regional perspective (e.g., travel time to work and schools). On the other hand, undesirable effects such as noise, air pollution and local traffic are particularly important at the local level as they contribute to a reduction in the quality of the local environment (Bateman et al., 2001); these negative externalities may play a role in the decision where to locate in a neighbourhood. Once a location decision has been made, a stage of equilibrium occurs, which may be distorted by external changes, an example of which is (planned) road adjustment in the vicinity of a residential location, which may result in changes in accessibility and (perceived) hindrance. Actual and perceived effects or anticipated consequences of road infrastructure plans may affect people's residential satisfaction, and may even drive them to move (Arsenio et al., 2006).

Within the context of this problem, the objectives of this survey paper are twofold. Firstly, we aim to explore the need and possibilities for broadening the scope of highway planning by taking account of the residential context, including residential satisfaction. Satisfaction appears to be an interesting and valuable mediating concept between road infrastructural adjustments and the accompanying external effects on the one hand and household coping strategies on the other hand. Households living near highway infrastructure are influenced by positive (i.e. accessibility gains) and negative (e.g., noise nuisance, air pollution) road related factors. Changes in these factors may trigger people to accept the new situation, to adjust preferences, to try to influence plans and/or to even relocate. The second aim, therefore, is to seek a deeper understanding through an extensive literature review of the influence of accessibility characteristics and negative externalities on the residential context of households. With respect to context, we make a distinction between residential satisfaction, housing prices and residential relocation.

With this survey paper, we intend to lay out a research agenda as preparatory for further research papers. This paper is structured as follows. In Section 2.2, we conceptualize how households are influenced by and cope with road infrastructure and its changes, and we discuss possibilities for extending the scope of highway planning by including residential information. The subsequent Sections focus more specifically on the influence that roads have on the social environment. Section 2.3 deals with the literature regarding the effect of regional accessibility on residential location choices and residential satisfaction, while Section 2.4 explores the effects of both accessibility and negative externalities. In Section 2.5, we end with conclusions and concrete directions for further research.

2.2 Highway Planning: Extending the scope towards the residential context

2.2.1 Road Planning and Coping Strategies: A conceptual model

Both residential satisfaction and the location preferences of households seem to be influenced by the same types of attribute, which can be grouped into two main categories (see Figure 2.1): the characteristics of the dwelling (e.g., size, type, costs) and the physical and social characteristics of the neighbourhood (Buys & Miller, 2012; Galster & Hesser, 1981; Lu, 1999; Morris et al., 1978). The presence of a highway might influence some neighbourhood features, such as accessibility by car or the quality of the local environment. However, other non-road-related variables also help to shape a neighbourhood. These include, for instance, residential density, socioeconomic status, security, the presence of open spaces and walkability.

Reasons for moving have received particular attention in the literature. One of the motives behind moving is the desire to relieve the residential stress that stems from a ‘mismatch’ between a household’s residential needs and preferences and the characteristics of the current house and neighbourhood, that is, where people actually live (Lu, 1998). This incongruity between a household’s actual and desired living situation can arise from internal household changes, including changes in the life cycle and social aspirations, as well as changes that are external to the household (Rossi, 1955). An example of external change is a deterioration in the environmental quality of an area. Relocation could then reduce the gap between a household’s needs or preferences and its actual living situation. In the search process, households actually evaluate their current residential satisfaction on a set of housing and environmental criteria, and compare them to the level of perceived utility that could be derived from living elsewhere. The decision to consider moving, and moving behaviour, thus depends on two factors: (1) the level of satisfaction,

with relocation being more likely if satisfaction is low, and (2) the household's capacity to find and obtain access to more satisfactory housing (Clark & Onaka, 1985). In this conceptualization, residential satisfaction acts as an intervening variable, mediating the effects of household and location characteristics on residential mobility (Marans, 1976; Speare, 1974) (Figure 2.1).

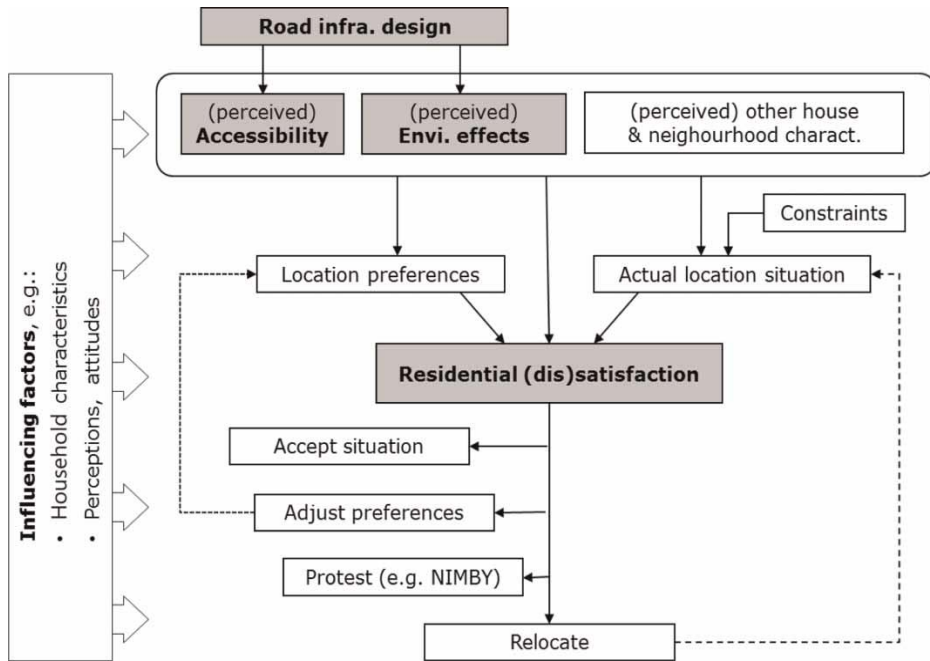


Figure 2.1 Relationships between household residential location decisions, road infrastructure and other influencing factors (NB: dotted lines indicate feedback loops).²

However, residential relocation is not the only option if households are dissatisfied. Moving could in fact be considered the 'extreme' option. The search process and the move itself cost a substantial amount of time and money—a good reason for not moving. In addition, people might not find the house they are looking for, or they may find it but might not be able to afford it. Rossi (1955) mentions other barriers to moving residence. Instead of moving, dissatisfied households may (1) just accept the situation and remain dissatisfied, (2) adapt their location preferences to relieve the dissatisfaction level, and/or (3) people may decide to protest (see Figure 2.1).

² The conceptual model as presented in chapter 1 and 9 is based on this model.

2.2.2 Residential satisfaction: Towards more inclusive highway planning

If we know more about how (changes in) certain factors, including accessibility and negative road-related externalities, influence satisfaction, this may help road and spatial planners with road redevelopments in inhabited areas. In many Western countries with a dense road network, changes often relate to adjustments, such as an increase in the number of highway lanes. Insights into household residential satisfaction near (planned) road adjustments may have at least two important merits for infrastructure planning. First of all, it provides insight into opinions and perceptions of the wider community of people living around a road project. This places NIMBY opposition, which is highly visible but may relate to individual or small group opposition, into a broader societal context of people living in the vicinity of a project, for instance, the 'silent majority'. From a societal point of view, such insights are relevant, because it may give a more balanced picture of people's ideas and opinions. If many people oppose a plan and are affected in their residential satisfaction, this is something for the policy makers and road planners to take seriously. Although an improvement of a major road may have regional or even national accessibility impacts, this does not mean that potential widely supported local discontent should not be dealt with in an appropriate manner. In the second place, insights into residential satisfaction and explanatory characteristics may be used to relieve locational stress by combining a road extension project with mitigation measures, such as noise barriers. This may solve congestion problems by increasing the road network capacity, while at the same time preserving the residential quality of areas located along highways. Such insights may also inform planners about how people wish to be involved in the planning process, with a view to influencing satisfaction, making plans acceptable and avoiding opposition and/or, ultimately, undesired relocations. Such insights are of course partly situation/project specific. However, also insights could be gained on how residential satisfaction, generally speaking, can be positively influenced by, for instance, mitigation measures, information provision and participation.

Although residential satisfaction is a relevant concept for road infrastructure planners, difficulties may arise as how to measure it on a large scale. It could be measured by means of surveys, but this is a time-intensive procedure. Housing prices, which are often more readily available, could potentially serve as a proxy indicator. One may expect housing prices to be positively related to accessibility gains and negatively influenced by all kinds of road-related nuisances. Similar expectations exist regarding relocation mobility. Although residential satisfaction, housing prices and residential mobility may be related, satisfaction is likely to be more volatile. Temporary changes in the environment, for instance, nuisances due to temporary road works, may directly influence satisfaction but are harder to

assess on the basis of housing prices, apart from exceptional cases where many houses are put on the market because of discontent with a plan or project. However, if changes are of a more structural nature, such as extending the road infrastructure, this may be reflected in changing housing prices in the longer term. This implies that an analysis of evolving housing prices might only reveal the general trend in household satisfaction, but does not reveal the complete picture. The same applies to residential mobility. Nevertheless, it is important to detect these temporary changes because changes in satisfaction may directly impact on people's attitudes towards a real or planned road project. In our opinion, this makes residential satisfaction a valuable indicator for road planners. There is not much evidence, however, on how (changes in) accessibility and negative externalities relating to highway infrastructures influence residential satisfaction. Even less is known about how residential satisfaction changes over time—from the stage where new road projects are being discussed through to concrete planning, realization and the period after completion.

2.3 Accessibility and residential location

Interestingly, accessibility has not generated an equivalent level of interest across all fields of study. Accessibility is a key element in micro-economic location theories (see, for instance, Alonso, 1964; Muth, 1969; Wingo, 1961). These studies have included it in their location model to help understand and predict the spatial distribution of economic and housing activities. Relatively less attention is paid to regional accessibility characteristics in the residential satisfaction literature. That is why we are directing attention here more specifically to the influence of accessibility on location preferences and choices. Although the interaction between land use and transport is a commonly accepted concept, questions remain regarding the strength of this relationship. Micro-economic location theories, which were further developed in the 1960s, are often used as a basis for building theories on the relationship between residential and work locations. These theories are based on the neoclassical microeconomic theory of consumer and producer behaviour. Both consumers and producers strive to maximize profit. Most of the micro-economic models look at the residential location choices of households given their work locations (Alonso, 1964; Muth, 1969; Wingo, 1961). Central to almost all theories is the influence of accessibility, often expressed in terms of transport costs. These costs are traded off against other factors such as land prices. The models make presumptions in order to compute where consumers (households) and producers (firms) find their economic equilibrium, leading to the final location choice.

Even though classical micro-economic location theory is a good starting point for explaining the location choices of households, it traditionally involves many simplifying assumptions and therefore has limited applicability in real-world situations (O'Farrell & Markham, 1975). The main general criticism is that classic theories attach too great an importance to transport, ignoring—or at least underestimating—the role that other factors play in location decision-making (O'Farrell & Markham, 1975; Weisbrod et al., 1980). These findings are largely based on more empirical studies, which have become popular since statistical techniques such as discrete choice models became more practically applicable. Studies of stated preferences indicate that the strength of transport impedance on household location decisions seems to be relatively small compared with people's personal characteristics and the attributes of the dwelling and neighbourhood (Molin & Timmermans, 2003; Rouwendal & Meijer, 2001; Timmermans et al., 1996; Weisbrod et al., 1980). This can be partly explained by the drastic spatial reorganisation that has reshaped urban areas in recent decades. The development of transport networks and the decentralization of economic activities have resulted in a decline in locational differences between places and in a homogenous high accessibility level (Giuliano, 1989). Under these conditions, once some basic level of accessibility has been reached, it seems logical that transport impedance is no longer a primary consideration in locational processes. Studies of hedonic pricing that have explored the impact of transport on property values also support these findings; the impact of accessibility on land values is limited compared with the physical characteristics of the property and its neighbouring environment (Adair et al., 2000; Henneberry, 1998).

Despite the influence of personal characteristics, location-related features and attitudes, several revealed-preference studies have found a relationship between commuting distance and location choices (Giuliano, 1989; Rouwendal & Rietveld, 1994; Van Ommeren et al., 1997; 1999). Thus although transport impedance may not be as important as micro-economic location theories would suggest, this does not mean that transport plays no role in relocation. Moreover, even in cases where transport impedance is not the trigger for relocation, it can have a major impact on the choice of a new residential area (Tillema et al., 2010). If someone decides to relocate because s(he) wants a bigger house, accessibility—together with other factors—may still influence where this bigger house will be. Unfortunately, empirical studies do not generally make a distinction between these two phases of the relocation process, that is, between the relocation decision and the choice of the new location (Tillema, 2007). The exact influence of accessibility on household location behaviour is still somewhat unclear, however. The current level of service in an area and the type of respondents, for instance, influence this relationship.

Differences in the way studies define accessibility also significantly complicate a simple conclusion regarding the precise effect of improved accessibility.

Finally, the more limited number of studies that incorporated accessibility as explanatory factor for residential satisfaction mainly focus on subjective evaluations of local accessibility, which often relate to the availability of facilities such as shops (Buys & Miller, 2012; Lovejoy et al., 2010; Mohan & Twigg, 2007; Parkes et al., 2002). Studies that also took account of more regional accessibility factors are Hur and Morrow-Jones (2008) and Howley et al. (2009). The conclusions about the importance of accessibility on residential satisfaction are somewhat mixed, which also may have to do with the various ways the concept has been measured in different studies.

2.4 Road proximity and residential location

2.4.1 Road proximity and externalities: A conceptualization

Generally speaking, new road infrastructure has a positive impact on accessibility. However, a road is also a potential source of undesirable impacts, called negative externalities, which may affect the residential satisfaction and location decisions of households. Congestion, noise, air pollution, visual impacts and barrier effects are some examples of the negative external effects of traffic and infrastructure. Economists use the term externalities because they are imposed by one group, for instance, car users, on an external third party such as people who live or work near a road. From an economic point of view, a new road may have two detrimental impacts on local residents. Firstly, it is likely to have a negative impact on their quality of life. The road makes the time they spend in and around their homes somewhat less comfortable. In economic terms, it means that local residents derive a lower value from living at that location. Secondly, the reduced value that people may derive from living at a particular location may be reflected, although not necessarily, in a fall in property prices (Bateman et al., 2001). The influence of these negative externalities on household quality of life and on property values seems, however, to largely depend on the distance between the road and the residential location. The residents who are assumed to suffer most are those living in houses adjacent to the road. At the same time, if they live in the vicinity of a highway access lane, they may also benefit more than others from the accessibility provided to regional and national markets.

Road-related factors exert an influence at different spatial scales. The effect of noise and air pollution, for instance, is generally limited to the first 100 m from the

road. Studies on noise valuation conclude that noise effects fade at a distance of 300–600 m from the road, depending on the methodology used (Eliasson, 2005). Within this range, accessibility can be considered constant (Wilhelmsson, 2000). Indeed, the few hundred additional metres that an individual would have to drive from his or her house to reach the highway access lane is generally negligible compared with the total length of the trip. In contrast with negative externalities, accessibility effects extend far beyond the immediate vicinity of the road. The development and extension of housing and/or business parks around highway access lanes is a nice example of the great attraction power of highways. The fact that the negative externalities relating to a road operate at a lower scale than accessibility suggests that these effects may play different roles, possibly at different times, in the location-choice process of households. Accessibility may guide the choice of neighbourhood. For example, households for whom accessibility by car is important will probably select a neighbourhood that is relatively well connected to the road network. Within this neighbourhood, they may then consider variations in local environmental quality. Due to their local character, road-related nuisances may hardly affect the choice of neighbourhood, but may strongly influence the decision about where to live in that specific area.

The relationships between road proximity, regional accessibility and the nuisances linked to the road are shown in Figure 2.2. We distinguish four hypothetical residential locations. In the first case, the house is located relatively far from the highway and access lane. The location has fairly poor accessibility by car but residents barely suffer from negative externalities caused by the road infrastructure. The second house is located far from the access lane but close to the highway. Thus accessibility is still poor and inconveniences associated with the road are relatively high. In the third situation, the house is located close to both the highway and the access lane. The house is easily accessible by car, but there are also substantial nuisances due to proximity to the highway. House number four, which is located quite close to the access lane and far from the highway, has the advantage of being well connected to the highway network. It also suffers little from negative external effects, assuming that the traffic intensity on the access lane is low. House number four therefore seems to be the best choice; that may be reflected in higher property values. It should be noted, however, that in many Western countries, neighbourhoods near highways are, generally speaking, well connected to a highway. Situation two, therefore, may occur primarily in rural settings, where some scattered houses may be located near major road infrastructure.

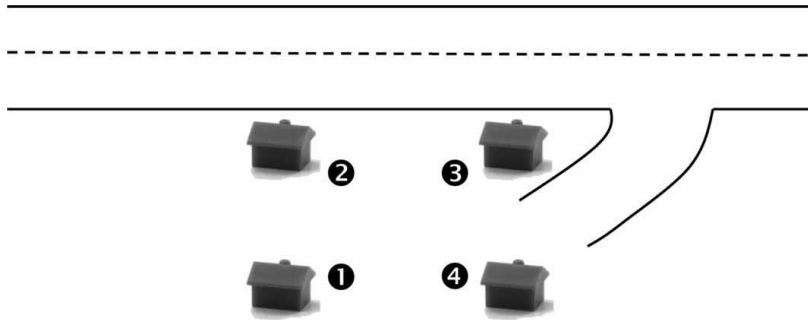


Figure 2.2 Relationship between road proximity and the positive and negative effects associated with road infrastructure.

2.4.2 Influence of negative road externalities on residential location

The negative externalities of a road and their influence on household location decisions have attracted some attention (Arsenio et al., 2006; Wilhelmsson, 2000). This is particularly true of the impact of noise, and to a lesser extent, air pollution in economic assessment studies. Other negative externalities relating to roads, such as barrier effects, visual impacts, vibrations and odour, seem to have generated less interest. Valuation of road-related external effects can be derived by using either market data (revealed preferences) or hypothetical data (stated preferences). In general, market-based methods produce lower valuations than hypothetical methods (Eliasson, 2005), probably because these two techniques measure different things. Studies using hypothetical methods generally measure average valuations, unless of course the hypothetical study explicitly samples people who have bought a house close to roads, while market-based methods measure the valuations of the ‘marginal buyers’ (i.e. those with the least willingness to pay to avoid transport externalities). Since houses are usually sold in what is essentially an auction, marginal buyers will buy houses near roads because they are willing to pay relatively more for those houses than people who are sensitive to transport externalities. This reasoning suggests that a process of self-selection based on sensitivity to transport externalities causes market valuations to be lower than average valuations. Ignoring self-selection effects may indeed lead to an underestimation—at least in the short and medium terms—of the nuisances associated with road infrastructures (Nijland et al., 2007; Van Wee, 2009). As far as we know, however, there are only a few studies that have empirically explored the existence of such self-selection processes with respect to exposure to transport externalities, and their results seem to be somewhat contradictory. While Nijland et al. (2007) do not find any statistical evidence for self-selection based on noise

sensitivity, Eliasson (2005) and Arsenio et al. (2006) do find proof of such a relationship.

Although results are slightly influenced by the assessment method used, it appears that in general, negative externalities relating to road traffic significantly influence both household location decisions and residential satisfaction levels. Households are even willing to pay a considerable amount of money to reduce these nuisances (Arsenio et al., 2006; Wilhelmsson, 2000). This is in line with the literature on hedonic pricing that finds significant price differences between houses located in areas of different environmental qualities. Noise impact upon housing values has received particular attention. In a review of nine empirical studies carried out in Canada and the USA, Nelson (1982) found an average reduction in housing value of 0.4% for each extra decibel generated by highway traffic or a total reduction of up to 8–10% for a house located adjacent to a major highway. Comparable results are found in Europe (Wilhelmsson, 2000). The influence of road-related nuisances seems to be limited, however, compared with other factors relating to the dwelling or neighbourhood. Noise level or air quality, for example, is rarely the main reason for moving or for choosing a new house (Nijland et al., 2007). Moreover, the value individuals attach to road-related externalities seems to vary according to household socioeconomic characteristics. In this respect, household income is the key variable, followed by household composition and size (Arsenio et al., 2006; Wardman & Bristow, 2004). Those with higher incomes are less sensitive to costs and attach higher monetary value to noise and air quality. Finally, the fact that variables such as noise and air quality are not easily observable makes them highly susceptible to individual perception. For this reason, researchers claim that the economic value of environmental goods should be based on subjective perceptions rather than on computer simulations or real-world measurements. However, it is not yet clear which the best indicator is to explain differences in the residential satisfaction and location preferences of households. While several authors conclude that the subjective assessments of different environmental variables are a strong predictor of residential satisfaction and location decisions (Arsenio et al., 2006; Eliasson, 2005; Galster & Hesser, 1981; Hur & Morrow-Jones, 2008; Parkes et al., 2002), some also find good estimates from models based on objective measurements, probably because negative noise perceptions only resemble part of all negative feelings as a consequence of noise nuisance (Kroesen et al., 2009, in a study of aircraft noise valuation).

A major drawback of all the studies mentioned is that they mainly focus on the negative external effects generated by a road and its users, and often fail to take into account positive effects such as travel-time gains. Without including accessibility-related variables in location models, one might misinterpret the

influence that (changes in perceived) noise, air quality and visual impact have on household (re)location decisions and vice versa (Bateman et al., 2001; Harrison & Rubinfeld, 1978; Theebe, 2004).

2.4.3 Combined impact of positive and negative road effects on residential location

Some studies have simultaneously included the positive and negative effects relating to transport activities in their location and residential satisfaction models. In addition to variables relating to the environment, housing and neighbourhood qualities, they also include accessibility characteristics, such as distance to onramps and train stations (see, for instance, Eliasson et al., 2002; Wardman & Bristow, 2004). The studies that included both negative intrusion effects and accessibility features can be classified into two groups depending on whether they apply revealed or stated preference approaches. The revealed-preference studies often focus on hedonic pricing, where among others the effect of negative externalities and accessibility on property values is determined (Andersson et al., 2008; Harrison & Rubinfeld, 1978; Theebe, 2004; Visser & Van Dam, 2006). The added value of this method, compared stated preference approaches, is that actual market prices are studied, but the drawback is that it is difficult to disentangle negative externalities from increased accessibility effects (see Eliasson et al., 2002).

Housing prices seem to be negatively correlated to both transport externalities and distance to the nearest highway access lane. Theebe (2004), for instance, finds less negative coefficients for noise when including accessibility features such as distances to onramps and train stations. In line with these results, but based on stated preference research in Edinburgh, Wardman and Bristow (2004) find that utility decreases both with travel times by car and bus and with air and noise intrusion. Eliasson et al. (2002) used both stated preference techniques and hedonic pricing to look at the intrusion and accessibility impacts on house prices. They show that short distances to roads, train stations and/or subway stations have a negative impact on house prices. However, the negative effects seem to reduce rapidly with distance, which may lead to the hypothesis that property prices close to the road, i.e. within a couple of 100 m, are relatively lower due to the fairly large nuisances associated with the road. As you move away from the road, property prices initially rise, reach a maximum and then fall as the disamenity of travelling over longer distances increases. However, this latter assumption is less realistic or

at least hard to measure in developed countries where road infrastructure provision is affluent.

Some studies included both hindrance factors and accessibility characteristics in their explanatory models for residential satisfaction (e.g., Buys & Miller, 2012; Howley et al., 2009; Hur & Morrow-Jones, 2008; Lovejoy et al., 2010). Some of these studies tend to point to noise having a higher explanatory power for residential satisfaction compared with accessibility characteristics. Noise in its turn seems to be of lower importance in the valuation of neighbourhood satisfaction than some other characteristics, such as safety. Satisfaction studies, generally speaking, mainly focus on noise hindrance and do not provide insight into the influence of air pollution and visual and barrier effects on satisfaction. Moreover, as we mentioned previously, most studies include local accessibility, which often relates to the availability of facilities such as shops. The benefit of a highway relates more to regional accessibility, such as access to jobs. And, finally, literature appears to study residential satisfaction in a state of equilibrium, whereas it would also be interesting to gain insight into how satisfaction is influenced by changes in the environment such as new facilities or road adjustments.

2.5 Conclusion and discussion

The objectives of this paper were twofold. Firstly, we aimed to explore the need and possibilities for broadening the scope of road/highway planning by taking account of the residential context, including residential satisfaction. The second—and related—aim was to gain a greater understanding by means of an extensive literature review of the influence of accessibility characteristics and negative externalities on a household's residential context, such as residential satisfaction, housing prices and residential relocation.

We argue that indicators such as residential satisfaction could be used to make road infrastructure planning more inclusive, and perhaps more sustainable. It is important to involve the local community in infrastructure planning processes because every project is unique and has its own specific context. However, the issue here is whether information could be used that would be of general benefit in different road infrastructure projects. We believe this to be the case. If we know more about how residential satisfaction is influenced by socioeconomic characteristics, accessibility and negative externalities, this may help in the planning process to assess, for instance, the groups of people who may need a special approach. This can, to a certain extent, relieve locational stress and prevent protests ('NIMBY-ism'), undesired relocations and time and cost overruns

due to unforeseen mitigation measures or litigation. Surveys could shed light on how residential satisfaction is influenced. There seems to be a time issue here, however. In surveys, it seems to make sense to distinguish between the different stages of a project's life cycle. Residential satisfaction may change over time, from the policy phase, where new road projects are discussed, through to concrete planning, realization and the subsequent period. In the long run, self-selection effects play a role, which may result in diminishing conflicts between the road infrastructure and its social environment. All such insights could be gained through longitudinal studies, following developments around a road project over time. However, this is a time-intensive and costly process. An alternative approach would be to use cross-sectional surveys and apply these to projects that are at a different stage of their life or planning cycle. Housing prices may also be a potentially useful indicator of residential satisfaction, although they may change less rapidly than satisfaction. However, it would at least be worthwhile to learn more about the relationship between housing prices and residential satisfaction, the more so because transaction prices are often easier to measure and obtain.

Regarding the second objective, our main finding is that both positive and negative effects relating to road infrastructure seem to influence household residential satisfaction and location choices and preferences. However, their influence appears to be modest compared with people's personal characteristics and attributes of the dwelling and neighbourhood. The distance between the road and the home location strongly influences the strength of these effects (the network distance in the case of accessibility and the straight-line distance in the case of external effects). In the location-choice process, households seem to prefer living further away from a road in order to reduce the nuisances caused by that road. This is according to expectation since nuisances decrease rapidly with distance to the source, i.e. in the order of hundreds of metres, whereas car accessibility is hardly influenced by small variations in distance. With respect to car accessibility, especially the regional or inter-neighbourhood accessibility, the distance to important potential activity locations outside the direct residential area, seems to be relevant. Generally speaking, the negative externalities relating to a road operate at a lower scale than accessibility. For this reason, accessibility and road externalities may play different roles in the location-choice process of households. The accessibility of a place may guide the selection of the neighbourhood, while road-related nuisances—due to their local character—may have little effect on neighbourhood choice, but may strongly influence the decision of where to live within that area.

We conclude that current road infrastructure planning often has a narrow scope. A promising avenue leading towards sustainable infrastructure delivery, higher

environmental quality and higher quality of life in general is to adopt a broader, more spatial approach and to take explicit account of households that live in the vicinity of planned road infrastructure. As discussed above, information about how residential satisfaction, as well as, for instance, about how housing prices are influenced by (changes in) positive and negative road-related effects, may be useful here. We are not aware of any attempts to include such information in road planning. In addition, we feel that little is known about the interrelationship between different constructs such as residential satisfaction, house prices and residential mobility around highways. This paper has highlighted a few methodological difficulties that must be overcome in order to gain a realistic understanding of residential satisfaction near highways. First of all, many studies focus on one type of road-related effect, either accessibility, noise or air pollution, which can easily lead to an erroneous assessment of road infrastructure impacts. Moreover, most studies focusing on residential satisfaction mainly include local accessibility factors such as access to shops. The benefit of a highway relates more to regional accessibility, such as access to jobs. Thirdly, self-selection may be an important source of bias for the estimated levels of annoyance relating to road infrastructure projects. Self-selection based on observable variables such as socioeconomic characteristics is generally included in research. However, people might also self-select with respect to exposure to transport externalities, depending on their sensitivity to environmental nuisances, a factor which is often not taken into account.

Based on the findings in this paper, we can point to several interesting directions for new research. The first would be to further explore housing prices near highways and the precise relationship to road proximity. In the Netherlands, revealed-preference data regarding housing prices are available on a national level. Moreover, the literature appears to study residential satisfaction in a state of equilibrium, whereas it would be interesting to gain insight into how residential satisfaction changes over time—from the stage when new road projects are discussed through to concrete planning, realization and the period after completion. To obtain the necessary data, surveys could be held among households living in the vicinity of major road infrastructure projects. In this paper, we also discussed the potential relationships between residential satisfaction, housing prices and residential mobility. It would be worthwhile to gain a deeper understanding of the extent to which such concepts interrelate and how this is influenced by positive and negative road-related factors. The final suggestion we would like to make about a future research direction is to explore how and to what extent residential satisfaction about road projects can be positively influenced by more explicitly involving households and their demands or wishes in the highway

planning process. This could be achieved by means of a longitudinal approach, tracking people's participation and measuring their residential satisfaction over time.

2.6 References

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