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Living near highways

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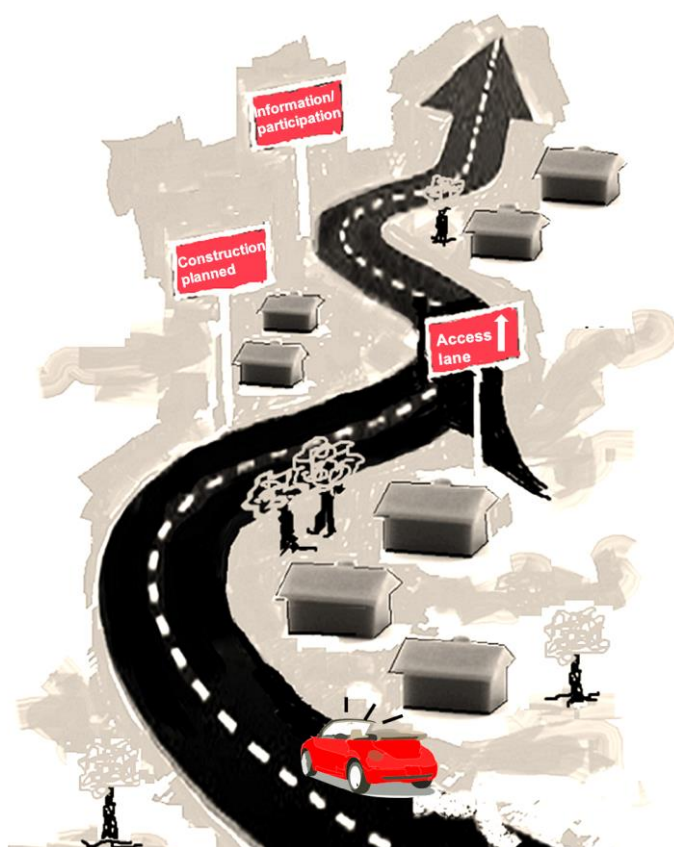
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Chapter 9

Conclusions



9.1 Introduction

This study addressed the impact of existing and planned highway infrastructure on residential satisfaction and potential (re)location behaviour. Three specific knowledge gaps in current literature and challenges to planning were addressed, to which the study contributes. First, the study tried to gain better insight to what extent residents trade-off positive and negative effects of existing highway infrastructure in residential satisfaction and potential (re)location behaviour, while also accounting for a potential difference between actual exposure to highways (“Physical characteristics”) and perceived impacts of highway infrastructure (“Resident’s perception”) (Knowledge Gap A). Second, the study aimed to gain better understanding into the extent to which highway projects change this impact, with attention to different phases of projects (before and after realization) and different types of development (new and redevelopment) (Knowledge Gap B). Third, the study investigated the role of involvement activities in addressing the impact of (planned) highway infrastructure, by distinguishing between information and participation activities (Knowledge Gap C). The knowledge gaps and related research questions are visualised in Figure 9.1.

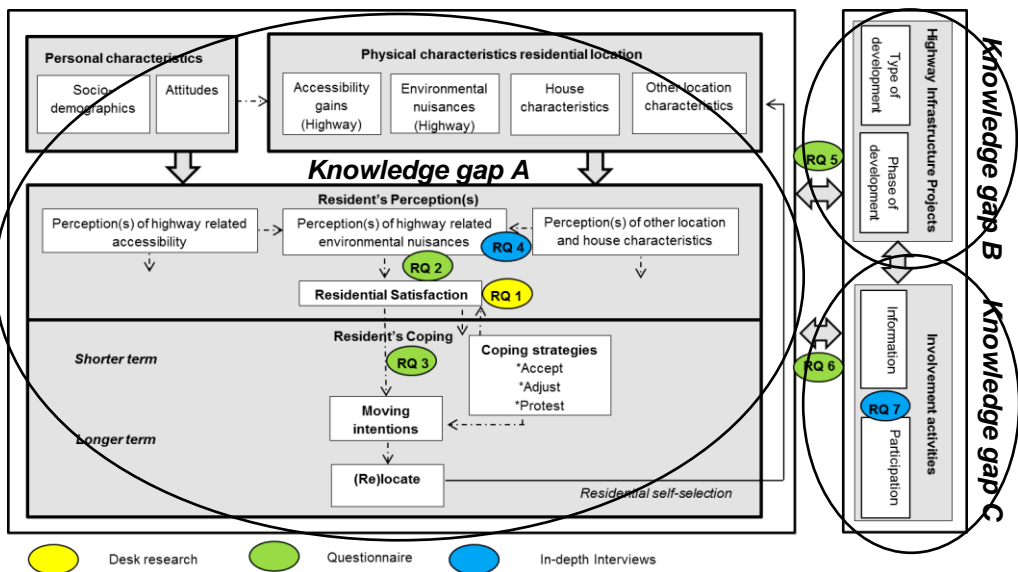


Figure 9.1 Conceptual model of the study.

The knowledge gaps were studied in the context of the Netherlands, a small, very densely populated country with contested claims on scarce space (Arts, 2007; Struiksma & Tillema, 2008; Heeres et al., 2012) (see also Chapter 1). In order to

create a comprehensive insight, a mixed method approach was used while applying both quantitative and qualitative research methods.

In this Chapter, conclusions are drawn and implications for further research and planning practice are identified. The Chapter starts with an overview of the main research results (Section 9.2), followed by a discussion of the three identified knowledge gaps (Section 9.3). Section 9.4 provides a reflection on the transferability of the findings, and the data and methods applied in the study. Subsequently, recommendations for further research and implications for planning practice will be discussed in Section 9.5 and 9.6, respectively, followed by a brief final note (Section 9.7). The conclusions are partly based on a discussion meeting among a group of experts in the field during which the main research findings were discussed.

9.2 Summary of main research findings

For the purpose of analysing the impact of existing and planned highway infrastructure on the wider residential community, seven research questions were defined (see Chapter 1) which were subsequently studied in Chapter 2-8 of the study.

The first research question aimed to further conceptualize the impact of existing and planned highway infrastructure on the resident's context by use of residential satisfaction:

RQ1) To what extent is the concept of residential satisfaction relevant for the study of the influence of highway infrastructure on residents, and how can this be used for understanding the impact of highway infrastructure on residents?

This research question was answered by an extensive literature review presented in Chapter 2. It is concluded that current insights on the impact of highway infrastructure on the residential context are incomplete, yet needed in order to assist planners in understanding the opinions of the wider residential community and include them more effectively. It is argued that highway infrastructure planning could benefit from a broader socio-environmental perspective, taking account of the preferences and perceptions of residents.

The Chapter proposed a pathway to come to such a broader socio-environmental perspective, and presents a conceptualization of the impact of highway infrastructure on the residential context, in which the concept of residential satisfaction is introduced as a way to measure those impacts. Compared to

studying house prices or household (re)location data, insight in residential satisfaction would be better able account for how the impacts of highway infrastructure on the residential context are *perceived*. Residential satisfaction represents the match between people's actual and preferred housing conditions and acts as a proxy for quality of life and future (re)location behaviour. However, although a strong link between residential satisfaction and relocation is likely to be expected, moving is not the only option if households are dissatisfied. There could be barriers to moving residence and households may also look for other coping strategies. In defining the potential impact of highway-related accessibility gains, the study argues that proximity to a highway is related to regional accessibility: reaching activities within a regional context. With regard to highway-related environmental effects, three types of highway nuisances are defined: noise, air pollution, and barrier- and visual effects. Furthermore, a distinction is made between 'objective' and 'perceived' indicators. Residential satisfaction could be influenced by both 'objective' and 'perceived' positive and negative effects of highways (alongside other characteristics), by (perceived) changes in those effects as a consequence of highway projects, and by information and participation. The Chapter presents a conceptual model which forms the basis for the remainder of the study.

Once the potential impact of highway infrastructure on residential satisfaction had been conceptualized, the trade-off between positive and negative effects of highways was specifically addressed (Knowledge Gap A, Figure 9.1). Research question 2 aimed to empirically explore the impact of positive and negative effects of existing highway infrastructure on residential satisfaction:

RQ2) To what extent do highway-related accessibility and nuisances influence residential satisfaction?

This research question was mainly addressed in Chapter 3 by analysing questionnaire data collected at seven highway locations in the Netherlands. One of the Chapter's main insights is that the relationship between highway infrastructure and residential satisfaction is not straightforward. Among the almost 1,400 respondents living within 1 kilometre of highway infrastructure, residential satisfaction is relatively high, the perception of highway-related noise, air pollution and barrier effects relatively low and satisfaction with residential location accessibility high.

The ordinal regression analysis that was performed, showed no direct relationship between exposure to highways and residential satisfaction of people living in the vicinity of highway infrastructure after correcting for other characteristics. However,

residential satisfaction was found to be negatively associated with the *perceived* level of highway noise and air pollution nuisances and positively with *perceived* residential location accessibility and highway interest. In other words: highway infrastructure mainly influences residential satisfaction in the event that positive or negative effects are perceived. In addition to perceived accessibility and nuisances, other appreciated location characteristics such as perceived attractiveness of building infrastructure, perceived traffic safety and perceived social cohesion were found to be of comparable importance in explaining residential satisfaction. This indicates that both accessibility gains and appreciated location characteristics could fulfil a compensating function on perceived negative environmental effects of highways.

Once an empirical justification for the trade-off between positive and negative effects of highways, but also an important role of other location characteristics had been found, the third research question takes it a step further. It tries to better understand *how* negative and positive effects of highway infrastructure alongside other location characteristics are related to each other, *as well as* to one of residents' most extreme coping strategies: the intention to move. Following the conceptual model (Figure 9.1), this latter relationship is proposed to be mediated by residential satisfaction:

RQ3) To what extent do highway-related accessibility and nuisances influence residential moving intentions, by accounting for a mediating role of residential satisfaction?

This research question was mainly addressed in Chapter 4 by analysing questionnaire data similar to those used for answering the second research question. By investigating the proposed relationships using a Structural Equation Model (SEM), the study confirms the important role of residential satisfaction in understanding moving intentions, and additionally emphasizes the complex relationship between highway nuisances, perceived accessibility gains and other location characteristics.

More specifically, the Chapter indicates that residents' future moving intentions are mainly influenced by the perception of highway infrastructure and other characteristics through their relationship with residential satisfaction. Whereas perceived highway nuisances (indirectly) increase moving intentions, perceived accessibility gains, other appreciated location characteristics - such as social cohesion and attractiveness of buildings and socio-demographics - reduce moving intentions via residential satisfaction.

Furthermore, Chapter 4 also shows that the perception of highway nuisances could not only be compensated but is also directly associated with perceived accessibility gains and other location characteristics. More specifically, the perception of highway noise, air pollution and barrier-effects was not only found to be positively associated with the level of (calculated) highway noise and air pollution and actual highway proximity, but also with a low preference for a highway location, negative attitudes about cars in general, and negatively perceived location characteristics (such as lower perceived traffic safety, lower perceived social cohesion and unattractiveness of buildings). In addition, with regard to socio-demographics, perceived highway noise and air pollution was e.g., found higher in older residents, the perception of noise and barrier-effect nuisance higher in house owners and the perception of air pollution higher in people with children.

Finally, results indicate that certain groups of residents, such as people with a lower highway interest, house buyers, older people, and residents in high noise exposure areas, are less likely to move in case of low residential satisfaction, which might be an indication for a lower coping ability.

Once insight into associations between highway infrastructure, residential satisfaction and moving intentions as described in Chapters 3 and 4 had been provided, the next research question tried to more deeply understand motivations behind those relationships by studying how the perception of highway nuisances develops during the resident's living experience.

RQ4) What are motivations of residents behind the development of highway nuisance perception during their residential experience?

This research question was mainly addressed in Chapter 5 by means of in-depth interviews among residents living close to the Southern Ring Road highway in Groningen, a mid-sized city in the northern part of the Netherlands. The Chapter shows how the perception of highway nuisances - as described by residents - develops in the interaction between people and their experiences in their broader residential environment. Five main themes emerged from the interviews that proved important in the development of highway nuisance perception during the residential experience, which are briefly discussed below.

First of all, the analysis indicated the importance of awareness of opting for a highway location; residents indicated that having evaluated the positive effects of accessibility and / or the negative effects of highways when making their location choice was a reason for a lower perception of highway nuisance. However, there were also residents who described that they were more or less surprised by the negative consequences of the highway after their location choice had been made,

which they mentioned as a reason for perceiving highway nuisances in the current situation. It is also noticeable that several people indicated that they did evaluate noise, but not air pollution when making their location choice; they became more aware of the potential effects of air pollution upon being confronted with dust in and around their house.

As a second theme, following on the insights from Chapter 3 and 4, residents described that perceived changes in the residential environment had changed their perceiving of highway nuisances; developments in highway infrastructure such as an increase in traffic intensity, the placing of a noise barrier, or changes in other environmental features such as changes in the direction of wind, the construction or removal of buildings causing reflection, or greenery associated with health, had influenced the development of highway nuisance perception through the residential experience depending on the situation in positive or negative ways.

A third important theme in the development of highway nuisance perception described by interviewees was increased information about the potential adverse health effects of air pollution, especially addressed by residents in relation to their children, their own health and to a low level of trust in the government. Residents described that extra information in the media about the consequences of air pollution had led them to realize that they might be more at risk of harm because of their residential location close to a highway, although not all residents described this to be the case.

Furthermore, as a fourth theme, residents referred to announced future highway adjustment plans in describing their nuisance perception, so-called anticipation effects. Residents described that recent information explaining that the highway was soon to be covered by a green park, relieved their current perception of highway nuisance. Conversely, people who felt frustrated about what they heard about future plans for highway development and were dissatisfied with the way they were involved in the planning process, described that they became increasingly stressed by the presence of the highway, resulting in their becoming more aware of its nuisances.

Finally, as a fifth defined theme, the ability to develop coping strategies during the residential experience appeared important; residents described cognitive coping strategies for mentally dealing with the situation such as habituation, but also cognitive dissonance, or trying not to focus on the nuisances. Those helped to reduce the perception of highway nuisance throughout the residential experience. Problem-focused coping strategies were also described, such as living far enough away, closing windows, placing grids and avoiding the balcony. However, another

group of residents described an inability to cope with the nuisance perceived. This group indicated that they had not found any proper way of reducing highway nuisance during their residential experience as it kept on persisting. Some residents explicitly referred to their socio-demographic characteristics which reduced their flexibility with regard to moving elsewhere, such as an older age or owning a house versus renting a house. This is consistent with the findings in Chapter 4 on moving intentions.

Once the influence of positive and negative effects of highway infrastructure in an existing situation had been investigated, the fifth research question turns the focus to highway infrastructure in a phase of *change*. More specifically, it studies the impact of highway infrastructure projects:

RQ5) To what extent does a planned highway project change residential satisfaction and induce a change in the characteristics of the population along the highway?

This research question was studied in both a situation *prior* to project execution – by analysing the proposed highway adjustments of the Southern Ring Road Groningen N7/A7 and the Utrecht Ring Road A12/A27 (Chapter 3, 7) – as well as *after* project execution, by analysing the development of the A50 highway in Son and Uden (Chapter 6). The insights were mainly gained by analysing questionnaire data. A key finding with regard to this research question is that planned highway infrastructure is described to change residential satisfaction both *prior* to and *after* project execution, but not by definition in a negative way, depending on the timing and characteristics of projects, characteristics of residents and residential areas.

Specifically, with regard to the situation *prior* to execution, Chapters 3 and 7 showed that perceptions of residents in Groningen and Utrecht were mixed: over the two projects, the groups of residents expecting a negative effect, no effect, or a positive effect on residential satisfaction, were about the same size. However, the expected impact of highway infrastructure projects was different for each of the studied areas. Chapters 3 and 7 indicate more positive expectations *prior* to project execution for residents living in Groningen (in the periphery of the Netherlands) compared to Utrecht (a medium-sized city in the centre of the Netherlands). Open questions as discussed in Chapter 7 indicate that in Groningen, more people seem to acknowledge the importance of the project for the regional economy. Impacts also differ between residents. Chapters 3 and 7 showed more positive expectations *prior* to project execution among residents living further away from the proposed highway project, males, the lower educated, highway users, people with positive

opinions about car driving, and people currently perceiving a lower amount of noise and air pollution nuisance.

The insights of Chapter 6 in a situation *after* project execution point in the same direction, but the general picture is more positive compared to the situation *prior* to project execution. The study aimed to explain the change in residential satisfaction, by also accounting for the perceived change in liveability and accessibility. Despite prior protests against highway development in the adjacent small town of Son, over the two residential areas of Son and Uden a majority of the respondents described a positive impact of highway development on residential satisfaction, which implies that most residents feel that perceived accessibility gains or liveability improvements trade off or even dominate the negative effects *after* highway development. Residents in the town of Uden – where people were already used to living close to a busy road – were more positive about highway development than residents in Son – where the highway was constructed on a new trajectory. Based on a Structural Equation Model (SEM), the insights of Chapter 6 also indicate that the change in residential satisfaction is positively associated with living further from the new highway, a preference for car accessibility and a low preference for environmental quality, mostly via a positive association with the perceived change in liveability or accessibility. However, changes in residential satisfaction at a closer distance to the highway and in Son were stronger, as was to be expected based on perceived accessibility and liveability changes.

Finally, the insights of Chapter 6 revealed indications that planned highway infrastructure seems to induce a change in the residential population. Although additional research is necessary, an analysis comparing the residential groups who arrived in the area *before* and *after* A50 highway development, indicates a somewhat more highway-oriented profile i.e. higher preference for car accessibility and lower preference for environmental quality among the latter group.

Once the general impact of highway infrastructure projects had been studied, the last part of the study further focused on the role of involvement activities in addressing this impact. As most residents' involvement does not extend beyond receiving information, research question 6 first aimed to gain better understanding of the relationships between information receiving and (expected) changes in residential satisfaction:

RQ6) What is the relationship between residents' information reception and expected changes in residential satisfaction as a consequence of planned highway projects?

This research question was mainly addressed in Chapter 7 by analysing questionnaire data gathered among residents in close proximity to two proposed highway adjustment projects, i.e. the Southern Ring Road Groningen A7 and the Utrecht Ring Road A12/A27. A main conclusion from the study is that receiving governmental project team information is associated with more positive expected changes in residential satisfaction, as it contributes to higher information satisfaction, but that not all residents are satisfyingly reached by such information.

More specifically, by use of regression analyses, Chapter 7 showed an association between information satisfaction –in addition to other characteristics- and positive expectations with regard to the change of residential satisfaction. People who received governmental project team information indicated a higher information satisfaction compared to people who only received information from other sources. Nevertheless, overall only a minority of residents appeared satisfied with the information provided, which indicates that project information is not yet sufficiently addressing all preferences. In addition, the study indicated that although project teams indicated they had been informing residents since the exploratory phase of the project, over the two highway projects, only 40% of the residents reported actually having received information from the project team. This suggests a mismatch between information provision and perceived information reception. Whereas receiving project team information was mainly associated with proximity to the highway project, attending information meetings organised by the project team was additionally positively associated with having a higher income, being male, making little use of the highway, having many contacts in the neighbourhood and having a higher perception of highway nuisance. As such, the group of people actively searching out information seems to be selective, differing from the more silent majority, which was also supported by the finding that those attending meetings showed a more negative expectation with regard to the change in residential satisfaction.

Finally, following the importance of information satisfaction, but also the mixed views on information satisfaction as found in answering research question 6, the last research question aimed to gain better understanding of how satisfaction with involvement develops during the plan process:

RQ7) What are motivations of residents behind the development of satisfaction with involvement activities provided by governments in a highway infrastructure planning process?

This research question was mainly addressed in Chapter 8 by means of in-depth interviews with residents along the Southern Ring Road Groningen, which is facing

a highway project in the near future. In answering the research question, the study investigated the development of satisfaction with involvement by accounting for a resident's preferred level of involvement; the study thereby distinguished between residents who preferred to be involved via passive information receiving (low involvement), the ones who preferred to be involved on a medium level by actively seeking additional information (medium involvement), and a group who preferred to be highly involved via actively participating (high involvement). An important contribution of the study is that it visualises how motivations of residents for satisfaction with involvement activities are related to the perceived quality of involvement activities provided by the government, but were also influenced by residents' contextual characteristics such as different involvement preferences.

All interviewees found it important to receive information about the project and thus to be at least passively involved in the project, although many of them were only minimally aware of the project details. Satisfaction with passively received information among interviewees was first of all described by the extent to which their concerns were addressed by the provided information. Residents indicated that concerns were addressed as they felt the project team provided sufficient information about the planning i.e. when to expect things, and the impacts of the project on the direct residential environment. However, residents also described contextual factors which made them feel more easily satisfied, such as a low interest in neighbourhood development, having intentions to relocate anyway, feelings that the project would not directly change their immediate environment or that the execution is still far away, or having a personal interest in good highway accessibility. Conversely, people with concerns about potential change in their immediate environment based on the information received, often described that they felt the provided information was not enough. In addition, trust in the information provided by the project team also appeared important to residents in describing their satisfaction with passively received information. Residents indicated that project team efforts to provide information on a frequent basis and about both the positive and negative consequences of the project positively stimulated trust, but that contradicting information during the planning process stimulated distrust. Trust in the information was also expressed by referring to experiences with governmental actions in the past, such as financial cutbacks in previous projects which influenced the extent to which people believed the information provided by the project team about the current project. Furthermore, residents provided examples of other (trusted) information sources which influenced the extent to which they felt the information provided by the project team was satisfactory, such as information they received from the action group against the highway project or from family and friends.

Some residents indicated a preference for seeking additional information, which was mainly motivated by interest in neighbourhood developments or having concerns regarding the plans based on the passively received information. Residents expressed their satisfaction by referring to the extent to which they perceived sufficient access to additionally preferred information, in which a good accessible website was described as positive, but a time consuming process to get additional information not available on the website as negative. Furthermore, residents described that satisfaction was related to the extent to which the information-seeking process resulted in a reduction of concerns. With regard to the latter, several residents expressed that the possibility for face-to-face contacts with project team members had a positive influence on reducing their concerns, but not getting answers to their questions had a negative influence.

A final group of residents also expressed a preference for active participation in addition to receiving or seeking information. These residents motivated their preference by having strong concerns, having ideas about city improvement, being triggered by social cohesion, or being triggered by earlier experiences with actions of the government they disliked and wanted to avoid this time. Residents motivated their satisfaction with provided participation activities by their perceived access to those activities. Residents who did not like to give their opinion in public were less satisfied in this respect and expressed a perceived lack of possibilities for giving their opinion in a written manner. Provided possibilities for getting assistance in formulating a formal reaction (In Dutch: “Zienswijze”) regarding the project were described as positive by residents as they make participation more accessible. In addition, residents referred to their feeling of being heard in expressing satisfaction; most residents who were involved in participation activities mentioned that although the project team was eager to change small things in the plan based on their views, they felt their influence on the plans was only marginal. This was especially the case for people who participated because of strong concerns with regard to the project. Some people described that dissatisfaction with participation activities led them decide to reduce their level of involvement in the project during the planning process to avoid too much stress, while others indicated that they felt they had to find other ways to express their dissatisfaction such as becoming involved in a citizen’s group.

9.3 Discussion on the impact of (planned) highway infrastructure on residential satisfaction

After having described the findings of the different research questions, this Section

will further discuss the main conclusions of the study, by reflecting on the research aim:

“To gain greater insight in how positive and negative effects of highway infrastructure, planned highway projects and involvement activities influence residential satisfaction and consequent (re)location behaviour as to facilitate highway planning”.

Overall, one could conclude that the impact of existing and planned highway infrastructure on residential satisfaction is not straightforward, given the plurality of views among the wider residential community studied in the context of this research. This places NIMBY opposition in a broader societal context and underlines the importance of including opinions of the wider community in order to draw general conclusions about the impact of highway infrastructure. However, at the same time, the finding that residents have different views about highway infrastructure, projects, and involvement, also asks for context-specific ‘tailor made’ solutions when it comes to the planning of highway infrastructure in specific residential areas.

Following the knowledge gaps as defined before, this Section will discuss what could be learned from the views of the wider residential community and of what could be generalizable. At the same time, it will also indicate what cannot be generalized and what needs a more context-specific, ‘tailor-made’ approach, all with regard to the facilitation of highway planning. Below, these aspects are discussed in relation to the trade-off between positive and negative effects (Section 9.3.1), the impact of highway projects (Section 9.3.2) and the role of involvement (Section 9.3.3).

9.3.1 The trade-off between positive and negative effects

The study started by arguing (Chapter 2) that current highway planning does not properly account for the impact of highway infrastructure on the neighbouring area, as it lacks an inclusive insight into how positive and negative effects of highways are dealt with from the perspective of residents. The current study therefore investigated the extent to which highway nuisances and accessibility gains are traded off by residents living close to highway infrastructure. The main conclusions are: *perceived* highway nuisances and accessibility gains are mutually traded off; the broader environment is important too; residential satisfaction near highways is generally quite high; nuisance perception seems lower among those who consciously locate close to highways; coping abilities seem to decrease perceived

highway nuisance; perceptions are first and foremost personal. Below, these issues are discussed in more detail.

Perceived highway nuisances and accessibility gains are mutually traded off...

A main conclusion of the study is that highway nuisances are indeed mutually traded off with accessibility gains, however, this depends on the extent to which both are perceived. Regarding nuisances, especially perceived highway noise and air pollution were evaluated as being important in residential satisfaction; barrier-effects appeared somewhat less important. That no additional effect of calculated highway exposure on residential satisfaction was found in addition to perceived highway noise, air pollution and barrier-effects, seems to indicate that the types of nuisances specified in this study indeed seem to largely cover the highway-related nuisances perceived by residents. The study suggests that when residents perceive accessibility gains, this could at least partly compensate and relax the perception of highway-related nuisances in residential satisfaction. This supports the importance for highway planning to have a broader perspective accounting for both negative *and* positive effects of highways to residents. Nevertheless, at the same time, the fact that perceptions of highway accessibility and nuisances were more important to residential satisfaction than 'objective' factors also indicates that such a perspective may need to go further than accounting for actual proximity to and exposure to highway infrastructure only.

...but the broader environmental context is important too

Additionally, the study findings suggest that perceived highway nuisances are not only traded off with accessibility gains, but also with other factors within the broader environment. Other location characteristics, such as the attractiveness of buildings, social cohesion and traffic safety, i.e. perceived neighbourhood quality, are at least as important in residential satisfaction. The highway is thus among the factors in the broader environment that influence residential satisfaction. This also indicates that (appreciated) characteristics of the broader environment could compensate for the negative effects of highway nuisances.

Meanwhile, the perceived broader environment and changes in this environment also seem to directly relate to how highway nuisances are perceived. The study indicates on the one hand that people perceive fewer nuisances in environments which are perceived as more attractive. On the other hand, the findings also indicate that nuisance perception develops in relation to, for example, changes in traffic intensity on the highway, variations in wind directions, the placing of

barriers, buildings in the broader environment causing protection or reflection, placement or removal of greenery, or announced highway projects causing changes in the broader environment in the near future. As such, the findings underline the importance of an integrated approach accounting for the interaction between highway planning and the broader environment, an urgency also indicated in other studies (see also Heeres et al., 2011; Arts et al., 2016).

Residential satisfaction near highways is generally quite high

Furthermore, a striking finding from the questionnaire results was that residents on average perceive only relatively little highway noise and air pollution nuisances when inside the house, and that residential satisfaction is generally high among residents living close to highways. This positive picture overall seems to indicate that, in general, current planning seems to do relatively well in mitigating nuisances and creating attractive locations to residents. Nevertheless, cognitive dissonance could also play a role; for example, some interviewees described how they mentally try to eliminate the negative effects of their choice for living close to a highway, a phenomenon also indicated in other studies referring to the perception of nuisances from polluting sources (e.g., Saksena, 2007; Bickerstaff & Wakefield, 2001).

Nuisance perceptions seem lower among those who consciously locate close to highways

In understanding the impact of highway infrastructure, it is also important to take account of the extent to which residents were aware of choosing housing close to a highway. The study suggests that people who have evaluated the potential positive or negative consequences of the highway while making their residential location choice attach less importance to highway nuisances than people who did not evaluate the highway specifically. This relates to the concept of residential self-selection; a phenomenon which indicates that residents match their residential location to their preferences (e.g., Morris, 2012; Cao et al., 2009; Van Wee, 2009; Silva, 2014; Cao et al., 2007). This might also at least partly explain the generally high level of residential satisfaction and low level of highway nuisance perception found by this study, which investigated residents who currently live close to highway infrastructure and who could have moved elsewhere had they not liked their location.

The insights of the study indicate that people who less consciously chose to live at a highway location perceive more highway nuisances. This could be a

consequence of being confronted with highway development while living in an area, or by not being aware of choosing housing close to a highway. Regarding the latter, the insights gained from interviewees as described in Chapter 5, for example, indicated that people sometimes choose to live at a highway location without having realized the overall consequences beforehand, due to limited information about those consequences, i.e. bounded rationality (Simon, 1957). Other residents described that although they did take account of noise from the start, the perception of air pollution developed later, after they had resided in the area for some time and starting to notice fine dust around their dwelling. This was described as an important reason for perceiving highway nuisances in the current situation and indicates that highway perception could be relieved when people are better informed about the consequences of a choosing a highway location or about future highway projects beforehand.

Coping abilities seem to decrease perceived highway nuisances

Coping abilities also proved to be an important factor in understanding the perceived impact of highways. Complementary to other studies investigating nuisance of polluting sources (e.g., Kroesen et al., 2008; Guski, 1999; Stallen, 1999), the present study emphasizes that the perception of highway nuisances is lower when people have developed ways to cope with them. Following Lazarus (1993), the study showed how residents applied both emotional/cognitive and problem-focused coping tactics, but some perceived more possibilities to cope than others.

Several residents described emotional/cognitive abilities such as cognitive dissonance or habituation, which helped them to be less focused on highway nuisances. Such cognitive processes could be seen as positive in the sense that they reduce stress about nuisances; however, in the meantime, this also means that people might not always be aware of the actual health effects of being exposed to nuisances, which is a point of attention for governmental policy.

Compared to cognitive/emotional coping, problem-focused coping abilities described by residents such as having a balcony or garden on the 'quiet' side of the house, being far enough away from the highway, ventilator grids, or, in the most extreme case, having the option to move, are directly focused on reducing the negative effects in such a way that people are less physically confronted with them. From that respect, problem-focused coping abilities are better when it comes to public health. Thinking about how houses and areas could be better designed to stimulate the ease of coping with highway nuisances could be worthwhile in that respect.

Finally, some residents indicated that they had found no ways of dealing with nuisances as they are constantly there, but that they did not intend to move away due to other location factors they appreciate. Others indicated that they perceived fewer options to move away from highway locations in case of lower residential satisfaction due to age, low income or owning a house. That those groups perceive more 'costs' of moving elsewhere is also suggested in other studies on moving behaviour (e.g., Coulombel, 2010), and might be a point of concern from an equity perspective.

...but perceptions are foremost personal

Finally, despite the fact that some general conclusions could be drawn, the study also stresses that perceptions of residents of (existing) highway infrastructure are principally personal and that a context-specific approach is advisable here. That perceptions of highway nuisances are only partly related to 'objective' highway proximity and largely explained by personal characteristics corresponds with other studies investigating the relationship between actual and perceived exposure to polluting sources (see e.g., Kroesen et al., 2010; Kroesen et al., 2008; Miedema & Vos, 1999). This study suggests, for example, a lower coping ability of elderly and noise-sensitive people with regard to highway nuisances, a lower perception of highway nuisances among residents with highway interests and with a positive attitude towards car driving, and a stronger concern with regard to the consequences of air pollution among people with children. The fact that people have different perceptions also means that they could have different thoughts about how mitigation measures for highway infrastructure and attractive neighbourhoods could be realized. It is thus important to take note of residents and their characteristics, in order to further reduce the perception of highway nuisances in residential areas.

9.3.2 The influence of highway infrastructure projects

To assure the quality of the network, investment in highway infrastructure is a continuous process (e.g., Arts, 2007; MIRT, 2016; TEN-t, 2014; FHWA, 2013). However, such projects often face NIMBY conflicts (e.g., Arts et al., 2016). Therefore, this study also paid specific attention to the impact of highway projects on residential satisfaction. The main conclusions are: the impact of highway projects among residents is mixed; highway projects are evaluated on their impact on accessibility and on the broader environment; uncertainty could influence expectations in a negative way; the presence of a highway seems to make a

project less impactful; people tend to have more concerns when they live closer to projects; specific resident and area characteristics matter. Below, these issues are discussed in more detail.

The impact of highway projects among residents is mixed

Overall, the insights of the study indicate that the impact of highway projects on residential satisfaction is mixed and dependent on how residents personally trade off accessibility and liveability impacts. This mixed picture indicates that the wider residential community seems to be more positive than the active population who attend public meetings, and who are, generally speaking, more likely to oppose highway projects. This finding is also suggested in other literature on NIMBY opposition (e.g., Woltjer, 2000; Mansfield et al., 2001) and indicated by the findings in Chapter 7 showing a more negative expectation about highway projects among the ones attending meetings. The mixed picture as shown by the study indicates the importance to more structurally include a wider group of residents in the planning process of projects. This may also better assure legitimacy of projects as it could help to create a more representative picture of what the wider residential community thinks about the project.

Highway projects are evaluated on their impact on accessibility and the broader environment

The insights of the study indicate that people evaluate the impact of highway projects on residential satisfaction by accounting for perceived changes in both, accessibility and liveability. Both are thus relevant indicators when it comes to the planning of highway projects in residential areas. Nevertheless, the insights of the study also indicate that perceived liveability impacts of highway projects on residential satisfaction go beyond looking at highway nuisances only. Residents' responses to highway projects do not only relate to highway noise or air pollution, but especially also to other aspects in the broader environment they appreciate and which are changed or likely to be changed by the project. For example, as important reasons for being concerned about projects, residents mentioned aspects such as the (possible) replacement or removal of trees or greenery they are attached to, traffic safety in their streets which is likely to be changed, and the view from their windows which is expected to be disturbed. This again underlines the importance of having an integrated view accounting for the broader environment when planning highway projects and being aware of what people value in their residential area.

Uncertainty could influence expectations in a negative way

An important distinction between a situation *prior* to and *after* highway planning could be made. The study indicates that feelings of uncertainty about a potential future decrease of residential satisfaction could increase awareness of the presence of highway infrastructure and its nuisances in phases prior to project realization. By finding indications for such anticipation effects, the study contributes to a small number of other studies, suggesting that perceptions of nuisances are related to expectations regarding future changes (Hatfield et al., 2001; Job et al., 1996; Brown & Van Kamp, 2008). Following Kahneman's prospect theory (1979) and NIMBY literature (e.g., van der Horst, 2007; Dear, 1992), concerns could cause that potential negative effects are likely to be overestimated in situations which contain uncertainty. Although project-specific differences will also matter, this could at least help to explain the generally more negative picture for the two analysed cases *prior to*, compared to the analysed cases *after* project execution in which uncertainty is reduced. This stresses the importance of involving residents in phases prior to project realization. In addition, as opinions of people might change during the different phases of projects, it could be advisable to monitor and evaluate projects both prior to, during and after realization in order to get a comprehensive insight into legitimacy and acceptance of the wider residential community (e.g., Arts, 1998).

The presence of a highway seems to make a highway project less impactful

The insights of the study also indicate the potential importance of distinguishing between new highway developments and highway adjustment projects. Although it would be worthwhile to study more cases, the findings suggest that the impact of highway projects on residential satisfaction is likely to be less negative in a situation of highway or road adjustment, compared to a situation of new development, as in the former case the people living in those areas are already used to living close to highway infrastructure. This is also likely to be influenced by residential self-selection; the study provides several indications that people already living close to highway infrastructure seem to be more accepting of highway infrastructure.

People tend to have more concerns when living closer to projects

Furthermore, the study indicates that residents living in closer proximity to a project – where most changes will take place – have more concerns than people living further away, a phenomenon which corresponds to the development of NIMBY protest (e.g., Dear, 1992; Siedentrop, 2010). In areas where many changes are

expected to take place, the chance for a future mismatch between a resident's housing conditions and preferences is higher. This underlines that involvement actions should especially pay attention to those people living in closest proximity to projects.

Specific resident and area characteristics matter

The findings with regard to the impact of highway projects also again stress the importance of accounting for resident- and area-specific differences. An example of the former is that it became clear that residents are more positive about projects *prior* to and *after* project execution when they have a personal interest in good highway infrastructure. In addition, projects are more positively evaluated when people see the benefit for the region/area in which they live. Although additional study is needed here, this might also relate to a difference between peripheral and central areas. Highway proximity, for instance, seems to have a more positive influence on house prices in more peripheral areas of the Netherlands compared to more central locations (Visser & Van Dam, 2006). Another example, which appeared from the interviews, is that negative experiences with governmental actions in the past are likely to create a more negative attitude towards projects in the present. This and other factors stress the importance of having a good overview of the type of region in which highway projects are developed.

9.3.3 Role of involvement activities

A final contribution of the study was to gain more insight in the role of activities to involve residents in projects; such activities are seen as an important way for governments to address the impact of existing and planned infrastructure (e.g., Luyet et al., 2012; Innes & Booher, 2004; Gil et al., 2011; Henningsson et al., 2014; Woltjer, 2002). The main conclusions are: good involvement activities may relax concerns; involvement activities ideally follow different criteria, but this is easier said than done; involvement satisfaction also depends on personal characteristics; it is advisable to tailor involvement activities to different interests as much as possible. Below, the main conclusions with regard to the role of involvement activities are discussed in detail.

Good involvement activities may relax negative concerns about highway impacts

An important conclusion of this study is that involvement activities seem to contribute to relaxing the impact of highway infrastructure, on the condition that those activities are perceived as satisfactory. This relationship was empirically confirmed by the discovered association between information satisfaction and more

positive expectations about highway projects, as described in Chapter 7 and described by residents in Chapter 8. Nevertheless, the study also stressed that many people were not satisfied with information, and that satisfaction with involvement activities is not only related to provided project team activities, but also to personal contextual factors. This means that achieving satisfaction is a challenging process.

Involvement activities ideally follow different criteria

Based on residents' views as presented in Chapter 8, the study first of all indicates that in order to stimulate residents' satisfaction, project teams should provide high quality involvement activities. Involvement activities should e.g., assure 1) proper communication by a) addressing residents' concerns through providing information about the impact of projects on the broader environment and on the planning of the project such that residents could estimate impacts on their activity patterns such as reaching their work location, and b) delivering trustworthy information through frequent communication about the positive and negative impacts of projects, 2) transparency, by providing open access to information residents prefer, 3) inclusivity, by making involvement activities available to different groups and 4) co-design, by giving residents who prefer to participate possibilities to be actively involved in the design of projects. To a certain extent, those aspects are also addressed by other studies into involvement in environmental and transport issues (e.g., Dietz & Stern, 2008; Luyot et al., 2012; Bickerstaff et al., 2002; Rowe & Fewer, 2005).

...but this is easier said than done

Nevertheless, incorporating those aspects into planning processes of highway projects is currently not easy, given the context in which project teams responsible for planning highway projects have to operate. They, for example, 1) have to deal with national and different local interests, 2) do not yet have available all the information that residents want (as project details are often decided upon in later stages), 3) often have a tight project scope as a consequence of project management (dealing with limited financial capacity to invest in residents' interests and a limited time frame for decisions to be made), and 4) the projects being planned are mainly involuntary exposed to people (decided upon from a macro-scale accessibility perspective) (see also Hamersma, 2014). This sets limitations to the amount of information which could be provided, the amount of input residents could deliver within the current planning system (see e.g., Leendertse et al, 2015),

and, as a consequence, the amount of acceptance which could be created among the local population.

Given the limitations just described, it is advisable for project teams to at least put effort into being open and communicating frequently about developments. This includes providing residents with answers to their questions with regard to the impact of projects on the broader environment, and involving them in the aspects project teams are still not yet sure of. In addition, it might be worthwhile for project teams to focus on asking residents for input on aspects where it is actually possible to include their opinions, in order to avoid disappointment. However, in the meantime, the study also stresses the need to further investigate how opinions of residents could acquire a more substantial role in the planning of highway infrastructure, towards more empowerment of residents (e.g., Arnstein, 1969; Edelenbos, 2000). The findings indicate that when people have the feeling that they are taken seriously and could really contribute their thoughts about how their neighbourhood will be redesigned, this could improve acceptance of projects and further relax the impact on residential satisfaction.

Involvement satisfaction is also dependent on personal characteristics...

Additionally, personal contextual factors also influence a resident's satisfaction with involvement and thus could hinder the effectiveness of involvement activities. The study, for example, indicates that many residents do not easily absorb information despite it being provided (Chapter 7). The study also revealed characteristics of some groups of residents which are less likely to attend meetings, such as the ones with a lower income, those who have limited contacts in the neighbourhood, people with children, women, and people who perceive fewer highway nuisances in the current situation.

In addition to a lower perceived access to involvement activities as was described as a reason for not being involved by residents, it is important to note that not all people have a preference to be actively involved in projects. Interviewees for example mentioned that their low level of involvement is among other things influenced by a lack of interest in projects. Nevertheless, a lack of interest in the first phases could also cause people to sometimes become active rather late, after their interest has increased due to more concrete information about the project which has become available later on, even though fewer changes in projects can be made in later stage.

Another important personal factor mentioned by residents in understanding satisfaction with involvement activities was trust in government. The study

indicated that many residents do not trust information from the project team due to an overall distrust in the government, often influenced by earlier experiences, or by other (trusted) information sources providing a different message about the project. The importance of stakeholders' trust in government has also been emphasized in many other studies (Rowe & Fewer, 2000; Bailey, 2010; Edelenbos & Klein, 2007) although not explicitly for the case of residents. As trust in government is at least partly created by experiences in the past, it is not easily influenced by actions of the project team.

... it is advisable to tailor involvement activities to different interests

One way in which project teams could support involvement of residents, is by trying to sufficiently address the variety of involvement preferences among residents by using different information channels and providing different ways to participate. In addition, it might be worthwhile to adjust the intensity of involvement activities to the characteristics of residential areas where projects are imposed; areas where more changes will take place, areas where people are more attached to their neighbourhood or where trust in the government is lower due to (e.g.) historical reasons may need more attention.

9.4 Reflection on transferability, data and methods

9.4.1 Transferability of findings

Although the study is based on a limited number of cases in the Netherlands, the insights are largely also transferrable to other areas. The seven highway locations in which the questionnaire was set were carefully selected, while taking account of different phases of highway infrastructure planning and including both more central and more peripheral areas (see also Chapter 1). As such, the general levels of residential satisfaction, perceived accessibility and highway nuisances, and the relationships estimated in the study could be interpreted as representative for the broader situation in the Netherlands. Nevertheless, as the study results also emphasize the importance of context-specific factors in understanding the impacts, it is still important to be aware of the specific context. This is particularly true for the insights with regard to highway infrastructure projects, which are based on a limited number of cases only. The same applies to transferring insights to international contexts, at least to other developed countries in which the highway network has also reached a certain level of saturation, and where environmental consequences of highway infrastructure have gained considerable attention. General findings and relationships as found by the study might also be applicable there, although levels

of residential satisfaction in existing and planned situations might deviate somewhat due to e.g., different planning cultures.

Furthermore, although exact details need to be analysed further, the found importance of a broader, integrated perspective on the planning of highway infrastructure is also relevant to the study of other types of infrastructure, such as (living in proximity to) rail, airports, harbours and busy roads that are not highways but also contain both positive and negative implications for residents. To a lesser, but still valuable extent, insights of the study may also be relevant when considering living in proximity to other polluting sources, such as industry or windmills, that do not have explicit advantages to people in terms of accessibility, but are also likely to be evaluated in their broader environmental context.

Also, the insights gained from the interviews with residents along the Southern Ring Road highway in Groningen regarding motivations behind perceived highway nuisance and their involvement in the planning process have their validity in other cases. It might be true that the choice to focus in-depth on one case study instead of studying more cases might have impacted generalization of findings. Nevertheless, choosing a single case study provided the opportunity to look at it in some depth, and could at least add to generalization as supplement or alternative to other methods (Flyvbjerg, 2006, p. 228).

9.4.2 Reflection on data and methods

This study made use of a mixed-method approach consisting of both quantitative and qualitative research methods, in order to gain a more comprehensive insight into the impact of highway infrastructure from a resident's perspective. Below, a reflection is provided on the use of both methods in the context of this study.

Quantitative analysis

To gain insight into the size of the impact of (planned) highway infrastructure and relationships with residential satisfaction and (re)location intentions, the study made use of questionnaire data collected among residents at seven highway locations in the Netherlands. The questionnaire proved to be a valuable way of getting an overview of opinions and background characteristics of residents in relation to (planned) highway infrastructure. The questionnaire had a response rate of more than 25%, which is relatively high for a questionnaire set out by mail (see also Malhotra, 2007). Respondents appeared to be fairly representative for the selected neighbourhoods in terms of demographics. Response was equally spread

with regard to proximity to the highway, which provides no indications for respondent bias (see also Appendix A.1). Nevertheless, some remarks could be made with regard to the data used for the quantitative analyses and the way analyses were performed.

First, there were some limitations with regard to the measurement of accessibility in this study. The study aimed to analyse the impact of perceived accessibility derived by the highway as compared to the impact of 'objective' accessibility. 'Objective' accessibility was measured by calculating the nearest distance from each 6-digit postal code to a highway access lane using GIS. Perceived accessibility was derived from the questionnaire and was measured by overall satisfaction with residential location accessibility. Overall satisfaction with accessibility of the residential location could be influenced by highway proximity, but also by proximity to other types of infrastructure, for example. Therefore, additional measures were included, such as the extent to which people had a preference for living at a highway location as a measure of highway interest. The in-depth interviews performed after the questionnaire provided the possibility to make the relationship between perceived highway accessibility and residential satisfaction more explicit.

Another point has to do with the composition of respondents in the dataset. Although the questionnaire included data on a variety of residents within different locations close to highways, it did not include residents who had recently been (involuntary) confronted with highway (re)development. The questionnaire did include people who live close to the A50, which had been newly developed about six years before the questionnaire was set out, but within this period the people with the most negative experience with highway development could have already left. Insights into the implications of highway development on the residential population could thus have been somewhat more negative had a case been analysed just after project realization.

A final point has to do with the analysis of the questionnaire data. We chose to vary between different statistical techniques to match different research questions, such as analyses based on observed variables and on latent constructs. However, through using and experimenting with different statistical techniques some minor differences in outcomes were also found, especially with regard to overall accessibility satisfaction in Chapter 3 and 4. In-depth interviews helped to further understand the relationships.

Qualitative analysis

Following on this, the in-depth interviews undertaken in the context of this study provided a valuable way to get a more comprehensive understanding of motivations and experiences of residents with regard to living close to highways. Planning the interviews after the quantitative analysis provided the possibility to also reflect on aspects which appeared somewhat unclear from the quantitative data analysis. However, also some issues popped up during data collection and analysis; a brief reflection is provided below.

A first issue was related to getting sufficient relevant respondents. To further elaborate on the impact of the Southern Ring Road highway to residents, a first aim was to interview respondents who participated earlier in the questionnaire. This would provide the option of linking the answers of residents to the questionnaire data. However, due to the time lag between the moment of questionnaire and the planning of interviews, it proved to be impossible to find a sufficient number of respondents living in high exposure areas following this approach. Therefore, it was decided to additionally recruit interviewees who had not participated in the questionnaire. As such, the residential group that was interviewed only partly corresponds with the respondents in the questionnaire.

Another relevant issue was how to reduce potential respondent bias. We attempted to limit the amount of information about the specific purposes of the study before conducting the interview, in order not to influence residents' stories too much, and to inform residents more specifically about the contents of the research afterwards whenever they indicated interest. However, when people asked for more information beforehand, it was unavoidable to at least provide some content regarding the specific interest of the study, as from an ethical perspective, residents have the right to be informed about the purposes of the study. As a result, some of the interviewed residents were slightly better informed than others. However, there were no indications that this influenced the residents' stories in any real sense.

A further issue which needs to be mentioned in the context of the performed interviews is the positionality of the researcher (Hennink et al., 2011; Sultana, 2007). Especially for people with negative feelings about highway proximity or the planned Southern Ring Road project, the interest in their story might have raised expectations for improvement of the situation. This was addressed by indicating that the insights gained from the study might not change the present, but might be taken into account in improving the future.

Mixing quantitative and qualitative methods

Overall, the choice for a mixed method approach using both quantitative and qualitative data provided the possibility to gain a more comprehensive insight into the influence of highway infrastructure from the perspective of residents. The interviews largely complemented and deepened the findings based on the questionnaire, and in that way supported research triangulation. Discussions with people from the areas of policy as well as practice additionally helped to think about how the findings of the residents' perspective could support planning.

9.5 Future research directions

Based on the study findings and the described limitations, several directions for future research can be identified. The main research recommendations are presented in textbox 9.1 and are discussed in more detail below.

- *Increase insight into the impact of project type*
- *Further investigate causality by longitudinal research*
- *Investigate preferences of residents during the realization phase of projects*
- *Further investigate how to develop trust*
- *Study (former) residents who moved away from highway locations*

Textbox 9.1 Main research recommendations.

Increase insight in the impact of project type

Future research could study the impact of project types on (the change in) residential satisfaction in a more comprehensive way. This research touched upon the role of highway infrastructure projects by comparing a limited number of cases in different phases of planning, but did not explicitly study different types of projects such as small or large projects, or projects with more or less attention for liveability. More insight into such differences could provide better understanding of which project factors influence (expectations regarding) residential satisfaction in positive and negative ways.

Further investigate causality by longitudinal research

Longitudinal research allows for further investigation of causality of the findings of this study. In the present study, the aim was to study the impact of highway infrastructure on the wider residential community by analysing different types of cases in several phases of planning in a cross-sectional way. This way of investigating was influenced by the limited time frame of the study, which did not

allow for a measurement before, during and after a highway planning process. Causality was mainly investigated during in-depth interviews, by asking people to describe changes in their perception of the highway or involvement. This way of data collection provided some further understanding on the causality of associations found by the study. Nevertheless, causality could be more systematically studied by a longitudinal study design. Comparing opinions of residents at several phases of highway projects, or before and after mitigation measures, in a more quantitative way might provide such additional insight.

Investigate preferences of residents during the realization phase of projects

Additionally, it might be worthwhile to further investigate what residents find important *during* the realization of highway projects. Although the present study touched upon aspects which are important to residents with regard to their residential satisfaction and preferences for information and participation activities which also account for the realization phase of projects, it mainly focused on the phase prior to and after project execution. Future research might take more specific account of the preferences of residents during project execution by asking residents to evaluate how their residential satisfaction was influenced and what determined their satisfaction with involvement activities during that phase of highway planning.

Further investigate how to develop trust

More insight into how to develop trust among residents could be beneficial to highway infrastructure planning. The in-depth interviews indicated that trust plays an important role in people's evaluation of projects and related involvement activities. Trust is partly formed by earlier experiences with projects and governmental actions, but also develops during a project by the activities carried out by project teams. The study touched upon this aspect by asking people during interviews what kind of activities increased and decreased trust. However, additional research could make more explicit which involvement activities increase and decrease trust. For example, this topic could be discussed in focus groups with residents in different highway planning processes, for the purpose of improving involvement activities and indirectly creating more acceptance of projects.

Study (former) residents who moved away from highway locations

Although this research focused mainly on residents currently living close to highways, future research might touch upon people's motivations for not locating to

or moving away from those locations. Chapter 6 provided some insights into the opinions of residents who did not ‘voluntarily’ chose to live close to a highway, since a new highway was developed after they had started living in the researched area. Nevertheless, as there was a time span of about seven years between the development project and the moment of the questionnaire, residents who were most negative about the highway development might have already moved away. Insights into former residents who moved away from highway locations might provide further in-depth knowledge on the social impacts a highway (development) has on people who are ‘involuntary’ confronted with highway development.

9.6 Implications for planning policy and practice

In the discussion, some directions are given for what could be done to more effectively include the perceptions of the wider residential community. Below, some guidelines are described following those directions, which could facilitate highway planning policy and practice.

A. Positive and negative effects of highways are traded off in a broader environment:

An integrated perspective would be worthwhile

- *Align transport and (local) environmental policy*
- *Go beyond the use of calculated exposure measures as base of actions*
- *Efforts to reduce highway exposure are needed despite high residential satisfaction*

B. Highway projects are evaluated differently: Include opinions and preferences of the wider residential community

- *Be aware of characteristics of residents and residential areas in planning projects*
- *Assess the opinions and values of the wider population for highway projects*

C. Strive to deliver satisfactory involvement

- *Communicate frequently about the impacts of the project on the individual situation*
- *Be approachable and open as a planner even if things are still not sure*
- *Provide a variety in involvement activities to reach the wider residential community*
- *Create ways in which residents could actively participate in neighbourhood (re) design*

Textbox 9.2 Main implications.

A) Positive and negative effects of highways are traded off in a broader environment. An integrated perspective would be worthwhile

The findings of the study suggest that a resident's perception of highway nuisances could be (partly) compensated by and is directly related to perceived accessibility and other characteristics of their broader environment. This stresses the importance of having a broader, integrated perspective on highway infrastructure close to residential areas in enhancing residential satisfaction. Below, some guidelines are provided for highway planning policy and practice in order to stimulate such a perspective.

Align transport and (local) environmental policy

In striving towards more integration, it is important to think about how highway infrastructure planning and the broader environment could be better matched. A sectoral planning approach – focusing primarily on enhancing accessibility and mitigating environmental nuisance – limits the possibilities for integrating highway planning with the local context (see also Heeres et al., 2012; Arts et al., 2016). Further alignment of highway planning and (local) environmental policy could support such integration, which may enable planners to better address the various issues that residents may experience in their neighbourhood. This could, for example, help in a better consideration of how the design of residential areas and changes in those areas influences the way highway nuisances are perceived, with regard to enhancing overall residential satisfaction. Already, such efforts are increasingly taken, but they could be intensified further. For example, it might be worthwhile to consider how the design of dwellings could facilitate coping ability, how buildings in the neighbourhood could be designed in such a way that the chance for reflection of nuisances is reduced or protection against highway nuisances is increased, or by investing in greenery or attractive buildings which increases attractiveness of the broader environment. In order to do so, it is also important to combine efforts and finances of the various authorities (national and local) to enable overall, inclusive planning approaches and measures.

Go beyond the use of calculated exposure measures as base of actions

As the study indicated that perceived nuisance of highways could only partly be explained by calculated highway exposure, it would be worthwhile to take effort to better account for the perception of highway nuisances. Current efforts to mitigate highways nuisances are mainly based on the extent to which calculated noise and air pollution exposure levels exceed the limits set by the European Union. Having

such norms and calculations is important for giving guidance as to how public health can be ensured by taking specific measures. Nevertheless, additional actions could be taken to better adjust to residents' perception of highway nuisances and the overall perception of the residential environment.

For example, as already referred to, current ways of measuring exposure could be improved by taking more account of the relationship between the perception of exposure and (changes in) the broader environment. More attention could be paid to environmental factors such as buildings in the surrounding area which could cause reflection of noises or visual nuisance, and as such influence the perception of highway exposure. In that respect, it might also be worthwhile to think about how fluctuations in exposure levels might be better accounted for, e.g., fluctuations caused by the direction of the wind and the number of cars throughout the day, as these influence the perception of highway nuisances. Currently, exposure calculations and related norms are mainly based on average exposure. Additionally, it might be advisable to complement current mitigation measures with more investment in liveability aspects, such as greenery and location characteristics appreciated by residents, as these seem to have a mitigating function as well.

Furthermore, it is also important to carefully involve residents when mitigating nuisance. Residents' perceptions are highly personal, and residents generally feel that exposure calculations based on average exposure are difficult to understand and cannot be trusted. Residents could be involved in thinking about how their residential location could be designed in such a way that the perceiving of highway nuisance could be reduced. Using measurements performed by independent institutions could also help in this respect, as those might be more trusted by residents.

Efforts in reducing highway exposure are needed despite high residential satisfaction

This study showed generally high levels of residential satisfaction and low levels of highway nuisance perception among residents living close to highway infrastructure in the Netherlands. Such insights suggest that current highway planning has done well in mitigating the negative effects of highways, which could indeed be validated by the increasing investments in mitigation measures and efforts to involve residents already from the early stages of the planning process (Elverding, 2008) and the introduction of protocols to guide stakeholder managers

in designing participation processes (see also “Code Publiekparticipatie Sneller en Beter”).

Nevertheless, the empirical insights also showed that the low levels of highway nuisance perception as found in this study may be at least partly due to residential self-selection, habituation and cognitive dissonance, or a lack of information about or awareness of negative effects. This also indicates that people may not always be aware of the actual negative effects highway-related pollution could bring to their health. There is an increasing recognition that fine dust, caused - among other things - by car traffic on highways, leads to negative health effects on the longer term, even at lower levels than the current European Union norms (WHO, 2006). Currently, the potential harm of ultrafine dust is under scrutiny (Keuken et al., 2015; Janssen et al., 2016), and the need is stressed to further study its exact consequences on health of populations, especially those surrounding traffic intensive areas. Taking this into account, it is clear that planners should not lay back, but should keep on investing in ways to reduce health effects of highway infrastructure for the benefit of those living near highway infrastructure.

In the meantime, there is also a role for governmental authorities and brokers to provide information in order to create awareness among residents of the potential negative consequences of living at a highway location. Although it is also a responsibility of residents to inform themselves before making a location choice, residents could be helped in such decisions by providing access to information about the positive aspects, but also the negative consequences of such locations in terms of noise and air pollution. They could also be informed about future planned projects to reduce the likelihood of negative ‘surprises’. (Local) governments could make such information more easily available, for example in digital ways, and make people aware of where to find this information. In the Netherlands, initiatives like the “Atlas leefomgeving”-website (“Atlas living environment”), which provides environmental information for the Netherlands in maps, and the “Milieu-atlas” (“Environmental atlas”), in which municipalities provide information about the environmental conditions in their area (see also Zuidema & Visser, 2007), could be helpful in this respect. When information is made available, people have more options to make a more conscious choice when it comes to living close to highway infrastructure.

B) Highway projects are evaluated differently: include opinions and preferences of the wider residential community

With regard to the impact of highway projects, the study indicates that perceptions of residents are mixed; apart from the stakeholders that voice their opinion, there is also a more 'silent' group of residents who are not participating actively. As a consequence, this study indicates that it may be worthwhile to also include opinions and preferences of the wider community in highway planning processes in order to not only increase acceptance, but also to assess the legitimacy of projects. Below, some guidelines are provided on how to include those opinions more systematically.

Be aware of characteristics of residents and residential areas in planning projects

First of all, although it is acknowledged that perceptions of residents are highly personal, some general observations on groups with distinctive characteristics could be drawn. In terms of e.g., enhancing equity, it might be advisable to take account of characteristics of areas in the pre-phase of highway projects in order to guide design and involvement decisions.

For example, the finding that people indicated their more advanced age as a reason for appreciating the view of the highway because of liveliness may be taken into account when thinking about designing for mitigation; areas with many elderly residents may show different preferences, for example with regard to the design of noise barriers in terms of views of the highway, than areas with few elderly residents.

Furthermore, in terms of equity issues, the fact that some groups such as the elderly, house owners, and lower incomes, have more difficulties moving elsewhere should they be dissatisfied indicates that those groups may need some extra attention when it comes to planning highway projects. Similarly, the study suggests that it may be advisable to especially attempt to include preferences of, and to involve those residents living in closest proximity to projects where most changes in the residential environment are expected to take place, as the study suggests that people living in close proximity of highway projects are often more concerned about and also more interested in being informed about projects.

Moreover, the finding that people seem to be more willing to 'accept' highway infrastructure and related projects in their environment in cases where they 'consciously' chose to live at those locations, suggests that it may be worthwhile to distinguish between new highway development and highway adjustment projects. It

is advisable for project teams to be prepared for a potentially more negative attitude towards projects in areas where people are newly confronted with highway development, compared to areas where people were already living close to a highway.

Finally, the study indicates that residents with a higher interest for good highway infrastructure generally perceive fewer nuisances, are more satisfied when living close to highways and more positive about highway projects than residents with a lower highway interest. It may be worthwhile to be aware that in areas with a lower number of highway users, a more negative attitude towards highway planning may be expected. In addition, it might be advisable to take account of the different preferences of both groups when thinking about the design of future highway locations.

Assess the opinions and values of the wider population for highway projects

As the opinions of residents about highway projects are mixed, the study indicates that it is important to take account of opinions and preferences of the wider residential community, especially in areas close to highway projects which are likely to be undergoing considerable changes. The study indicates that perceived impacts of highways go beyond noise and air pollution changes as currently mainly taken into account in assessment studies based on expert calculations (Stolp, 2003); it is therefore important to broadly assess preferences of residents such as appreciated environmental features, but also their activity patterns which might be influenced by highway development. As people's perceptions about projects might change during the planning process when plans are becoming more concrete, it seems worthwhile to assess the opinions and preferences in the pre-phase, but also in subsequent stages of the project. By accounting for the opinions and residential preferences of the wider community, acceptance and legitimacy of plans could be increased.

There are several ways of assessing those preferences and opinions. For example, people could be invited to participate in a questionnaire, either digitally or on paper. The increasing possibilities for using digital ways of assessment (e.g., Roth, 2006; Ganapati, 2011; Kim & Lee, 2012) are worthy of further exploration in this respect. For example, Geographical Information Systems (GIS) and Electronic (E) participation could be used to provide the opportunity for a broad range of residents to indicate their preferences and opinions using the internet. However, it is important to provide different methods, to take account of the variation in preferences and use of participation methods/approaches among residents, as will

be further discussed below. An approach such as the one studied by Annelies Stolp (2006) in her study of Citizen Value Assessment, in which both interviews and questionnaires are used to grasp insights into what residents' environmental preferences and opinions are, might also be helpful. Opinions and preferences gathered could be further worked out in workgroups with a representative group of people willing to contribute their thoughts based on the values and opinions of the broader population. In this way, a better match between highway projects and residential preferences could be assured.

C) Strive to deliver satisfactory involvement

The findings of the study indicate that satisfactory involvement could relax the impact of highway projects. However, realizing satisfaction among all residents is difficult to achieve given the limitations project teams perceive on the one hand, and the importance of personal contextual variables on the other hand. The study provides several insights into how this satisfaction might be increased. Those insights partly complement the Strategic Stakeholder Management approach (In Dutch: "Strategisch Omgevings Management", "SOM"), which was recently developed in the Netherlands to assist stakeholder managers in involving stakeholders in projects (Wesselink & Paul, 2010).

Communicate frequently about the impacts of the project on the individual situation

It is worthwhile to put specific emphasis on frequently providing information on the positive and negative impacts on a resident's immediate environment, and on the planning of the project and what this means for a resident's activity pattern, so that they know what and when to expect. Residents are specifically concerned about what a project will mean for their immediate environment and for the accessibility of their most important activities, such as their work location. Due to this interest in the impact of projects on the broader environment, it might also be worthwhile to cooperate closely with municipalities who have more specific knowledge of the local environment. It seems advisable, wherever possible, to avoid people getting confronted with things they could not have been aware of, as this may increase distrust. It might also be worthwhile to search for ways to visualise future changes in order to make them more concrete to people and thereby reduce uncertainty; simulations might help in this respect.

Be approachable and open as a planner even if things are still not sure

The findings of the study indicate in multiple ways that it is important to take residents and their concerns seriously. People may have many questions about what is going to happen, also on aspects a project team is not yet sure about, given that projects develop over time. Project teams are often hesitant when it comes to providing information which is not yet definitive. Nevertheless, not providing information gives the impression that information is being withheld and could result in distrust (e.g., Pinto-Correia et al., 2006; Kasperson et al., 1992). Therefore, it is advisable to be as approachable as possible and to inform residents, while also indicating which things are, and which are not yet definitive, and why. This could create a more transparent image and could increase trust among residents.

Provide a variety in involvement activities to reach the wider residential community

One important barrier to overcome in working with residents is that they often do not participate, or become active rather late in the process, at a stage when only limited possibilities are left for making changes to the project. Involvement behaviour of residents is related to underlying motivations which are mostly outside the immediate reach of the project team. Nevertheless, project teams could stimulate involvement of residents by providing a variety of ways for them to be involved. For example, with regard to information provision, different interviewees indicated different preferences with regard to how they would like to receive information. Whereas some prefer digital information, others prefer to receive printed information, or to attend an information meeting. A combination of printed, digital and oral information could be provided in order to reach as many groups of residents as possible. In addition, (free) newspapers are an important information source to people and could be used for information purposes, especially for people not directly connected to their neighbourhood and not being informed by other neighbourhood members or family about the plans. Attention could also be stimulated by being creative and making use of social media, movies, mobile phones and GPS. For example: a resident suggested that the project team could give immediate updates about the project (during construction, too) via an app or sms to people who sign up for this service. In terms of visibility, residents also suggest to place information points in the different neighbourhoods surrounding projects. Assuring that people have access to information is also crucial to avoid that people will be mainly informed by other information sources potentially spreading a different message.

With regard to participation activities, as already referred to, project teams should not stick to oral assessments alone. Consulting opinions via public meetings or work groups could be complemented with possibilities for residents to provide their ideas in digital and written ways. This could stimulate the 'ease' of participating (participating from home), but could also make participation more accessible for people who prefer to provide their opinions more privately. In addition, a feeling of "having no expert knowledge" about how projects work was mentioned several times by residents as a reason to avoid participation in projects. Therefore, it would also be advisable to make participating 'easier' by providing assistance in handing in formal reactions ("zienswijzes") and letting people particularly participate in things they have knowledge of, such as the design of their neighbourhood.

Create ways in which residents could actively participate in neighbourhood (re)design

As addressed before, it is important to look for ways to truly stimulate active participation by residents in plans in order to create trust, increase acceptance and legitimacy of plans towards more empowerment of residents (Arnstein, 1969; Edelenbos, 2000). As already referred to under "B", it is therefore worthwhile to collect the preferences of the wider residential community, and more systematically incorporate them in the decision process of highway projects. Given their experience with living in the area, residents could have valuable knowledge from which the project could benefit. In order to create more satisfaction among residents, it is important to also explicitly show and communicate how their preferences are taken into account. Given that people often feel that their influence is only limited, it is important to not only consult them by collecting their preferences, but to also give them more control over how to (re)design their neighbourhood as a consequence of the highway project (see also Kroesen et al., 2011 on gaining trust in aircraft noise annoyance policy).

By a continuous focus on residents and their preferences, a stronger alignment between highway projects and their broader environment could be stimulated. Several residents have indicated that they would participate more if it would be clearer to them that participation actually makes a difference. This might also ask for a shift from a more narrow focus on stakeholder management i.e. including interests of stakeholders in order to assure the success of a project (Olander & Landin, 2005; Aaltonen, 2011), to a more outset perspective focusing more on environmental cooperation. In that way, highway infrastructure and environments could be better integrated for the better of enhancing residential satisfaction and quality of life.

9.7 Concluding remarks

To conclude, this study has showed in multiple ways that residents perceive both positive and negative effects of existing and planned highway infrastructure in relation to their broader residential environment. In the meantime, perceptions about highway accessibility and nuisances, highway projects and related involvement differ between residents and between residential areas. In thinking about improving residential satisfaction, it seems thus worthwhile to pay specific attention to the mutual relationship between highways and their broader residential environment. They are part of the same physical space, which asks for the use of an integrated approach that addresses not only highway-related issues, but also other issues in the residential area. In order to facilitate such an approach, and to account for the variation in residents, it is important to explicitly include the preferences and perceptions of residents within those areas. In other words, this study suggests that in order to carefully understand and account for the perspective of residents, focus is needed on the living environment as a whole, rather than on the highway environment only. Thus, to better reflect the perception of residents, it might be apt for highway planning to broaden the scope from “*living near highways*”, to “*highways as part of the living environment*”.

9.8 References

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