Residential location preferences, accessibility and road proximity: towards a better or more inclusive infrastructure planning?

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Samenvatting

Woonvoorkeuren, bereikbaarheid en nabijheid van weginfrastructuur: naar een betere of meer omvattende infrastructuurplanning?

De sectorale wegenplanning in Nederland heeft geregeld te maken met tijd- en kostenoverschrijdingen en een suboptimale kwaliteit van planningsvoorstellen. Een gebiedsgerichte planningsbenadering met als doel om zowel de 'fysieke' als de sociale (actoren) omgeving beter te betrekken bij de planning van weginfrastructuur zou deze problemen kunnen verlichten. Inzichten in de kennis, ideeën en voorkeuren van belangrijke stakeholders zouden bijvoorbeeld gebruikt kunnen worden ter verbetering van zowel de ruimtelijke kwaliteit als het planningsproces zelf. Dit soort gedetailleerde inzichten kunnen voor elk specifiek project ter plekke worden vergaard. Maar ook meer algemeen toepasbare kennis zou bruikbaar kunnen zijn voor gebiedsgerichte planning van wegen. Een voorbeeld is kennis betreffende de invloed van nieuwe infrastructuur op woonlocatiebeslissingen van huishoudens. Dit artikel heeft specifiek als doel gehad om op basis van literatuur en conceptueel denken inzicht te geven in hoe huishoudens positieve (b.v. bereikbaarheidswinsten) en negatieve externaliteiten (b.v. geluidsoverlast, luchtvervuiling) van weginfrastructuur meenemen in hun woonbeslissing.

Uit de schaarse literatuur op dit gebied bleek dat mensen inderdaad positieve en negatieve effecten van weginfrastructuur tegen elkaar afwegen in hun beslissing ergens te gaan wonen. De sterkte van deze effecten hangt af van de afstand tot de weg. Huishoudens lijken een lagere bereikbaarheid te accepteren als ze daarmee de negatieve externaliteiten van die weg kunnen verlagen. Dit vertaalt zich ook in de prijs van grond /onroerend goed. Het zodanig operationaliseren van negatieve en positieve effecten dat mensen zich er een voorstelling van kunnen maken blijft lastig. Maar als het goed lukt om afwegingen tussen deze effecten op de woonlocatiekeuze te bepalen, binnen een bredere context van locatiebeslissingen in de buurt van weginfrastructuur, heeft dit grote voordelen. Het zorgt bijvoorbeeld voor meer inzicht in waar een toerit tot een snelweg de meeste (economische en sociale) meerwaarde heeft maar ook waar maatregelen ter verbetering van de ruimtelijke en milieukwaliteit het effectiefst zijn. Dit soort informatie kan worden gebruikt voor een betere afstemming tussen weginfrastructuur en (projecten in) de omgeving en kan als gevolg daarvan leiden tot meer algemeen geaccepteerde en kwalitatief betere plannen. Terugkomend op het thema van het congres zou de conclusie kunnen zijn dat de effectiviteit van het huidig ingezette meer gebiedsgerichte beleid versterkt zou kunnen worden ondermeer door het verkrijgen van meer inzicht in woonvoorkeuren en woonbeslissingen van (groepen) huishoudens in de buurt van wegen.

1. Introduction

Because of the large negative effects of traffic congestion, fighting it is high on the political agenda. Policy measures aimed at reducing traffic congestion include traffic demand measures and/or supply related measures. Although traffic demand measures such as dynamic traffic management and road pricing are effective measures to reduce congestion, the current view is that demand measures alone are not sufficient. To enlarge capacity, new transport infrastructure is also needed (V&W, 2008). However, the planning of new road infrastructure in The Netherlands does not run smoothly. One could say it is best characterized by its shortcomings. These shortcomings concern, amongst other things, time and cost overruns and a lack of quality of the realized transport infrastructure (see e.g. Flyvbjerg et al., 2003). Difficulties are likely to relate to the traditional linear and sectoral character of transport infrastructure planning (see Struiksma et al., 2008). Macro scale accessibility problems in a region or part of the country are often the only or primary reason for considering new road infrastructure; a more inclusive planning perspective from the start by focusing also on issues such as a proper fit of infrastructure into its environment is lacking. Also the 'structuring' potential of road for a certain area is, generally speaking, not sufficiently exploited; opportunities of combined road, housing and working developments are disregarded. In addition, the stakeholders (the market, decentral public institutions, people living in the neighbourhood, etc.) in the physical and social environment are not always sufficiently involved in plan making, which may lead to suboptimal plans (that invest much in mitigation measures instead of focusing on smart sustainable spatial designs) and to opposition.

The area-oriented approach is a more inclusive planning approach that has recently become more popular in Dutch road infrastructure planning. It includes the 'physical' surrounding area into road infrastructure planning and also aims to pay attention to the social/actor environment. Regarding the latter, disaggregate analyses can provide insights into knowledge, ideas and preferences of important stakeholders, which subsequently can be used in improving both the spatial quality and process of planning. Such micro level analyses may be made for each infrastructure project separately because projects may differ in type and context. However, plan making may also benefit from generally applicable knowledge. Accessibility and location trade-offs by households and firms, for instance, are quite independent of specific plans. The accessibility likely improves through new or improved road infrastructure. This can be seen as a positive effect. People who live nearby may benefit more from accessibility gains than those living further away. On the other hand, there are negative externalities accompanying road infrastructure such as air pollution, noise nuisance, and destruction of the landscape. These negative effects are higher more adjacent to the source (in this case the road). Such negative side-effects may offset improved potential location advantages caused by the accessibility increases and may even lead to opposition against infrastructure plans. An example of this is the so-called not in my backyard (NIMBY) opposition. The strength of these negative effects on location decisions and on residential satisfaction may, however, largely depend on the distance between the road and the home location. Insights in trade-offs between accessibility and location characteristics can lead to better understandings of where improvements of roads and access lanes have the highest added value as well as where measures for enhancing spatial quality are most effective and useful. Such information can be used for better coordination of road infrastructure

and area-oriented development projects, and, as a consequence, may lead to more commonly accepted and high(er) quality plans. Also it may be relevant for substantiating project proposals ('business cases'). Well-grounded proposals may facilitate decisions of governmental parties and market parties to start or join a project (e.g., the appraisal of 'business cases' for public-public and public-private partnerships).

In this paper, we intend to gain some more insight into the trade-off between the positive effects (i.e. accessibility gains) and negative externalities (e.g., noise nuisance, air pollution) of road infrastructure in residential location decisions of households. Distance to the road may be a key factor in this trade-off because both positive and negative effects of infrastructure are highest close to the road itself, at least under the assumption that there is an access lane present. We start by analyzing the position that transport takes in the overall household location literature (section 2.1) and, subsequently, aim to provide more insight into the influence of transport on residential location decisions of households (section 2.2). With respect to transport we thereby make a distinction between studies that focus on the overall impacts of transportation investments (new infrastructure) on the one hand, and studies that look at the importance of accessibility (level of service) on the other hand. Accessibility is a broad concept that often is defined differently. This may also influence the explanatory power of accessibility in residential location decisions of households. In section 3 we elaborate more on the influence of operationalization. Subsequently, in section 4 we switch from the narrow perspective of looking at benefits of infrastructure only (i.e. accessibility improvements) by exploring the influence of negative externalities. After an introduction into negative external effects of road infrastructure and NIMBY opposition (section 4.1), we focus on the influence of externalities on location decisions (section 4.2). Subsequently, section 4.3 includes both the positive and negative effects of infrastructure and explores their combined influence on residential location choices. Finally, conclusions follow in section 5.

2. Residential location choice: important influencing factors and the role of transport

2.1 Household location literature: directions and trends

A large body of literature is available on residential mobility originating from different fields of research, such as geography, sociology, economy and psychology (Dieleman, 2001). Some authors have attempted to categorize the many research directions (see, for example, Clark, 1982; Dieleman, 2001). These categorizations are partly time-dependent, because shifts in research focus and new study fields may emerge over time. Clark (1982) provides an extensive overview of research on migration and characterizes the literature until the beginning of the 1980's. He classifies the literature into three geographical (migration) scales, namely international, interregional and intra-urban migration, and in particular works out the research directions for the latter two spatial levels. Within these geographical layers available studies can be assigned on the basis of whether they use a 'macro' or 'micro' approach. Many early studies on residential relocation are based on macro-approaches analyzing migration processes at an aggregate level, without distinguishing between different agents (i.e. individuals, households). These macro-analyses are not an ideal level of research because existing

aggregate-level models do not possess a high degree of predictive power and furthermore the understanding of the nature of individual responses to environmental conditions (i.e. the micro-approach) will provide a sounder basis for evaluating a number of decisions related to planning of growth, development and reorganization of urban areas (Brown and Moore, 1970). Thus, the individual approach, also known as the behavioural approach, was largely stimulated by the lack of specificity that could be derived from aggregate analyses of migration flows. The 'micro-based' literature identifies who is likely to move and what their choice of housing is likely to be (Dieleman, 2001). In this respect Rossi (1955) can be considered one of the pioneers in the field of migration research from a micro-perspective, whereby he particularly focuses on the impact of life cycle characteristics on residential relocation.

Although, as pointed out by Clark, the literature before the 1980's makes a strong distinction between interregional and intraregional migration (i.e. intra and partly inter-urban), this difference has lost a lot of meaning since (Van Wee, 1994). Van Wee explains this by the spatial expansion of the labour and housing markets, caused partly by the improved infrastructure networks. Therefore, the physical boundary between geographical scales becomes less important. Nevertheless, the classical distinction between the two spatial scales implies that making a distinction between geographical/spatial scales is useful (Van Wee, 1994).

A more recent review article in the field of residential mobility was written by Dieleman (2001). Rather than reviewing all (new) publications he singles out the ones that seem to break 'new ground'. He focuses specifically on the micro-level research because of its earlier mentioned advantages and because of the progress made in the development of discrete choice models (see, for example Train, 2003) since the second half of the 1970's. With respect to the residential migration research at the micro-level, three elements of the mobility process (according to Dieleman) have been given systematic attention in recent years. Firstly, the observation that the decision-making frequently involves more than one individual has led to the household being the relevant research object. Secondly, systematic attention is given to the observation that many households cannot find or afford the dwelling of their first choice and have to find an acceptable alternative. In the third place the relationship between changing jobs and changing houses takes an important place in literature. The job-related and residential locations can be regarded as an interdependent construct; job relocation may lead to changes in commuter accessibility (expressed in generalized transport costs) and may form a trigger to change the residence location and vice versa. This research direction seems to have won ground since the review article of Clark (1982), although he already pointed to the relationship (summarized as 'accessibility') between urban residences and workplaces too. In spite of the importance of the commuting trip for the job and residential location, literature does not provide an unambiguous answer to the question whether the work or the residential location is the dominant one. Although there are different views on this subject, as yet no a priori choice of dominance of one location above another one seems to be preferable in research (see Verster 1986; Van Wee, 1994).

2.2 Influence of transport on location decisions of households

Although interaction between land-use and transport is a commonly accepted concept, questions remain regarding the strength of the relationship between transport and land-

use. Micro-economic location theories, especially (further) developed in the 1960's, are often used as a basis for building theories regarding the relationship between residential and work locations. These theories are based on the neoclassical micro-economic theory of consumer and producer behaviour. Consumers as well as producers strive for profit maximization. Most of the micro-economic models look at the residential location choices of households given the work locations (Wingo, 1961; Muth, 1969; Alonso, 1964). Central to (almost) all theories is the influence of transport costs. Transport costs are traded off against other factors such as land prices. The models make presumptions in order to make it possible to compute where consumers (households) and/or producers (firms) find their economic equilibrium, leading to the final location choices. The main (general) criticism is that the classical theories that emerged in the 1960's overemphasize the importance of transport costs in people's location decisions compared to other factors like household characteristics (for example, O'Farrell and Markham, 1975; Weisbrod et al., 1980). These findings are based in particular on more empirical studies, which have become popular since several statistical techniques, such as discrete choice models, have become more practically applicable.

These empirical studies have investigated the importance of transport (costs) on relocation decisions. This body of empirical research can be grouped into studies that focus on the overall location (and in the end land-use) impacts of transportation investments (e.g. building new roads or railway infrastructure) on the one hand, and studies that look at the importance of (commute) trip impedances (i.e. level of service of infrastructure) on the residential or work location choice of households on the other hand. Building new infrastructure (i.e. first literature class) can influence the economic processes at different geographical levels. Nevertheless, the influence of (new) infrastructure on relocations of households is not very clear. The location effects of new road infrastructure partly seem to depend on the quality and density of the available infrastructure (see Giuliano, 1989; Geurs and Ritsema van Eck, 2001). In places where a dense road network is available relocation effects of building a new road may particularly have local effects (for example, it may attract (new) households). On a larger scale (i.e. regional or higher) redistributive effects may occur (i.e. redistribution of spatial activities between regions).

The studies (implicitly or explicitly) concerned with studying the importance of (commute) trip impedances on household location choices (i.e. second group of literature) seem to suggest that transport resistance is less important in location decisions than assumed in the classical micro economic location theories. Characteristics of house and work in addition to people's personal characteristics are possibly more influential (see, for example, Blije, 2005; Molin and Timmermans, 2002; Rouwendal and Meijer, 2001; Timmermans et al., 1996; Weisbrod et al., 1980). With respect to personal characteristics, for instance, it appears that households' socio-economic characteristics and life course events have a strong influence on housing preferences, on the propensity to move, and on the tenure choice (Clark and Dieleman, 1996). Moreover, in addition to personal characteristics, also attitudinal issues may play an important role in residential location behaviour. In this respect we mention the work of Gärling and Friman (2001) and Mulder (1996) regarding the housing decision-making process (and the different phases in this process). Goals and expectations underlying the reasons for moving or for migration were also largely explored (see, e.g., De Jong and Fawcett, 1981).

Furthermore, the role of values and perceptions in the evaluation of housing, environment, and transport attributes have been addressed in several studies (see e.g. Coolen and Hoekstra, 2001; Tillema, 2007; O'Farrell and Markham, 1975). Figure 1 schematises the relationships linking these different kinds of variables and households' residential location preferences/choice.

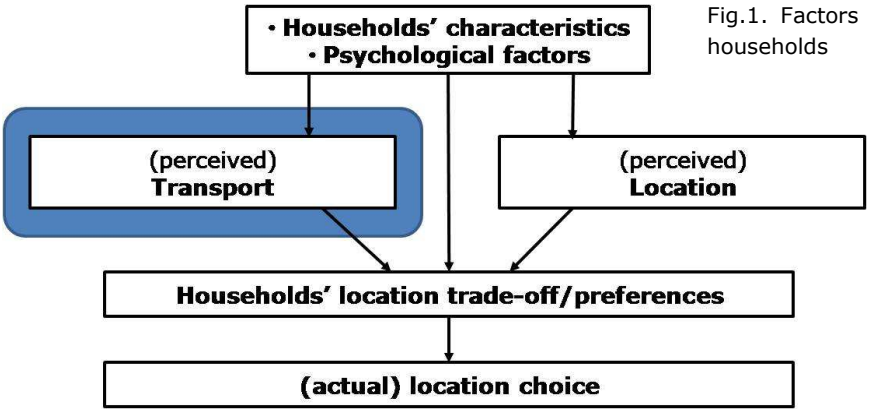


Fig.1. Factors influencing location choice of households

Despite the influence of personal characteristics, location related features and attitudes and perceptions, several studies still find a relationship between commuting distance and location choices (Giuliano, 1989; Rouwendal and Rietveld, 1994; Van Ommeren et al., 1997; Van Ommeren et al., 1999). Thus, although transport impedance may not be as important as micro-economic location theories would have us believe, that does not mean that transport does not play a role in relocations. Moreover, even in cases where transport impedance is not the trigger causing relocation itself, it can have an important influence on the choice of a new residential or work location. However, the exact influence on location choices is still somewhat unclear. This is also due to different studies varying considerably in the way they deal with accessibility, on the one hand because they appear to use different factors to explain accessibility, and on the other hand because studies do not always make it clear what it is when they talk about accessibility. The next section aims on gaining some more (conceptual) insight into the influence of the operationalization of accessibility on the observed influence of accessibility in residential location decisions.

3. Accessibility: measurement and influence on location choice

3.1. Definition and measurement of accessibility

The concept of 'geographical accessibility' takes an important place in transport geography. It combines characteristics of the transport system (e.g. travel resistance) and the land use system (e.g. location of activities such as job locations). Geographical accessibility is a theoretical notion which is often used as an 'intermediate' concept in land-use transport modeling (see Wegner and Fürst, 1999): changes in the transport resistance affect the geographical accessibility (i.e. intermediate concept) of agents and possible accessibility changes may result in categories of people and firms deciding to change their short (e.g. trip behaviour changes) and/or long-term (e.g. location) behaviour. These behavioural changes in turn have an impact on the land use and transport system and thus change accessibility. Focusing on passenger transport, Geurs and Van Wee (2004) define accessibility as the extent to which land-use and transport

systems enable (groups of) individuals to reach activities or destinations by means of a (combination of) transport mode(s).

Geographical accessibility is not only used as a phase in land-use-transport interaction modeling. Accessibility can also be applied as a research indicator itself (see, for example, Geurs and Ritsema van Eck, 2001). Accessibility indicators or measures give the opportunity to gain a quick and interpretable insight into the (accessibility) effects as a result of changes in the land-use or transport system (e.g. caused by certain policy interventions). In line with this geographical view on accessibility Geurs and Van Wee (2004) identify four components that are theoretically important in measuring it: the land-use component, the transportation component, the temporal component, and the individual component. The land-use system consists of (a) the amount, quality and spatial distribution of opportunities supplied at a destination, (b) the demand for these opportunities at origin locations and (c) bringing together supply and demand for opportunities. The transportation component describes the transport system. The temporal component reflects possible temporal constraints caused by people's time schedule and the availability of opportunities at different times of the day. The individual component reflects the needs, abilities and opportunities of individuals.

3.2. The influence of accessibility measurement on location choice

Different accessibility definitions are likely to have implications for the observed influence of accessibility on residential location decisions of households. We (conceptually) explore to what extent the type of operationalization of accessibility influences its explanatory strength in households' residential location decisions. More specifically, and in line with the concept of geographical accessibility, we successively look at the influence of the type of impedance and of different opportunity locations.

Travel impedance can be expressed in different ways, of which travel distance, travel time and/or travel costs are most often used. The value people attach to accessibility in their residential location choice likely depends on the operationalization. Impedance measures are often interconnected, but also have their own characteristics. Travel time and costs, for instance, to a large extent depend on the distance covered but encompass other elements of the trip as well. Travel time can also incorporate delays due to, for instance, traffic congestion, and includes transport mode effects (e.g., car, bus, bicycle). Because people often want to arrive somewhere at a certain time, travel time may be closer to people's actual decision realm. Generalized transport costs, furthermore, are even more inclusive than travel time. Travel times can be converted in monetary terms by multiplication with a value of time. In addition, extra cost components can also be added, such as road tolls, car insurance costs and maintenance costs. Although it is methodologically possible to include several cost components, it is unclear, however, whether this more inclusive impedance representation will more closely fit people's perception of impedance. Many, for instance, may not include car maintenance costs in their decision to use the car, although a more frequent car use may increase the needed maintenance. This discussion highlights the diversity that exists between the different resistance measures and their possible influence in location decisions.

The kind of opportunities that are taken into account may also influence the importance of accessibility in residential location decisions. Commuting (i.e. accessibility of

workplace) is used in a majority of studies (see also section 2.1). This may be due to the fact that such trips are undertaken on a daily basis, which may quite well increase their influence compared to (non-work) trips. However, the idea that the job location is the most influencing variable in households' location choice may not always be reflected in reality (e.g. Geurs and van Wee, 2004; Tillema, 2007). Some authors have explored the role that other non-work trips play in households' location choice. Ortúzar et al. (2001) and Molin et al. (1999, in Molin and Timmermans 2002) have carried out SP experiments amongst, respectively, Chilean and Dutch families in order to explore the relative importance of different variables (including school accessibility) on the residential location decisions of these families. In these cases, the researchers found that households (with children) attach more importance to school accessibility than to work accessibility. However, the influence of the type of opportunity studied strongly depends on the context within which the study is carried out (e.g., having children, perceived importance of education, employment status). Moreover, shop accessibility seems to influence the location choice/preferences of households. According to the stated preference experiment carried out by Hunt et al. (1994), the travel time for home-based work trips is 2.18 times as important as the equivalent time for home-based shopping trips when selecting housing locations. Kim et al. (2005) have reached similar conclusions regarding travel costs. In contrast, Timmermans et al. (1996, in Molin and Timmermans 2002) have found a higher coefficient for distance to shopping than for distance to work (almost twice as big). One explanation may be that the respondents were recently divorced and hence may rely relatively heavily on the local environment. Further, the kind of shopping considered in the studies was not always specified. This may, however, slightly influence the results. Finally, in Katoshevski and Timmermans (2001), trips to the kindergarten and trip to recreational activities were also found to significantly influence the location preferences of large families.

4. Road proximity and residential location choice

4.1. Road proximity, externalities, and NIMBY effect

New road infrastructure, generally speaking, has a positive impact on accessibility. It is, however, also a potential source of undesirable impacts, called negative externalities, which may affect the residential location preferences of households. Congestion, noise, air pollution, visual impacts, and barrier effects are some examples of negative external effects of traffic and infrastructure. Economists use the term externalities because they are imposed by one group (e.g. the car users), on an external third party (e.g. those who live or work near a road) (Bateman et al, 2001). From an economic point of view the new road may have two detrimental impacts on local residents. Firstly, it is likely to have a negative impact on their well-being. In economic terms it means that local residents derive a lower value from living at that location. Secondly, the reduced value that people may derive from living at a particular location may well, but not necessarily, reflect itself in a reduction in property prices (Bateman et al, 2001).

The influence of these negative effects on households' well-being and on property values, however, seems to largely depend on the distance between the road and the residential location. The residents that are expected to suffer most are those living in houses adjacent to the road. However, at the same time, they may also benefit from the accessibility increase more than others do. Distance is an important variable influencing

both the exposure to positive and negative effects of road infrastructure. However, different kinds of distances are relevant in both cases. With respect to the positive effect on accessibility, network distances (i.e., the distance between the residential location and the road) are important. If a highway is nearby but the nearest access lane is at a large distance, then positive accessibility effects of that road may be limited. On the other hand, in the case of the negative externalities (air pollution, noise nuisance), the airline distance rather than the network distance is important because noise and air pollution spread through the air. It is important that this distinction between straight or network-based distance is made when evaluating the costs and benefits generated by a road and its users. The relationship between road proximity, accessibility, and the nuisances linked to the road is also schematised in Fig.2. In this figure we distinguish five hypothetical residential locations. In the first case, the house is located relatively far from the highway and access lane. The location has a relatively poorly accessibility by car but residents also hardly suffer from negative externalities caused by road infrastructure. The second house is located far from the access lane but close to the highway. Thus, accessibility is still poor and inconveniences associated with the road are relatively high. In the third situation, the house is located close to both the highway and the access lane. The house is well accessible by car. Nevertheless there are also substantial nuisances due to the proximity to the highway. House number 4 is located relatively close to the access lane and far from the highway. This house enjoys the advantages of being well connected and does not suffer much from the negative external effects. Therefore, house number 4 seems to be the best choice. This will probably reflect itself into higher housing/property prices. Finally, a last possibility for the households who want to reduce their commuting time/costs is to find a house in the vicinity of their workplace (number 5). In that case, they do not need to use the highway that often.

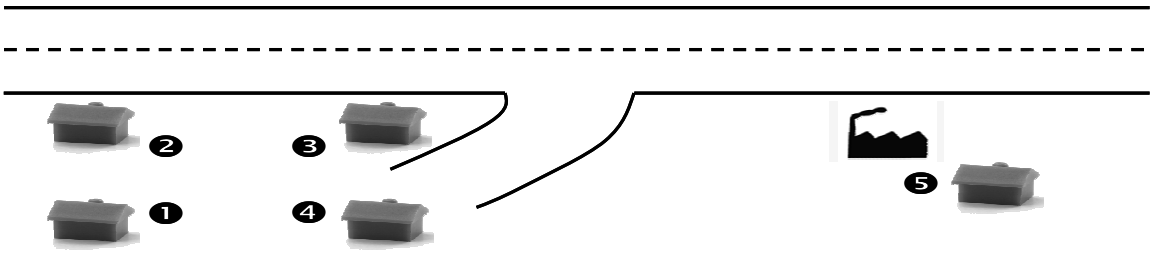
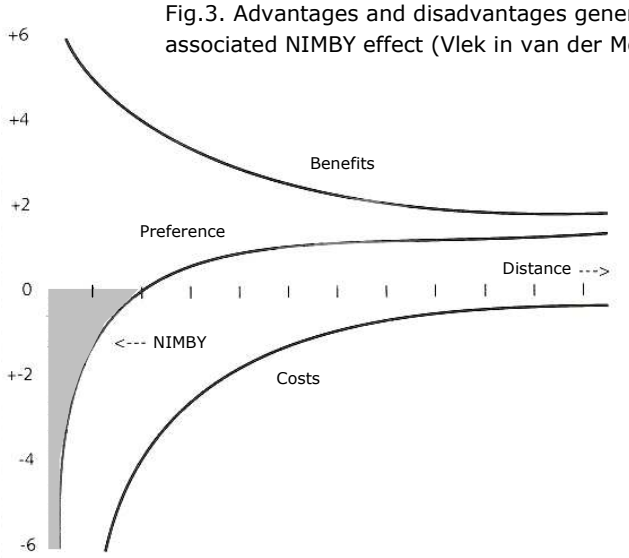


Fig.2. Relationship between road proximity, and the positive and negative effects associated to the road

An analogy between road infrastructure and an industrial plant can be drawn in the sense that both can be regarded as a potential source of air and noise pollution. The relationship between distance to a facility and the costs and benefits associated with it has been conceptualised by Vlek (in Van der Moolen and Voogd, 1995) (Fig.3). This diagram conveys that, from an individual or community point of view: (1) both advantages and disadvantages generated by a facility (rapidly) decrease as distance rises, (2) people value costs generated by a facility higher than its benefits (difference in curve bend), and (3) before a certain distance the perceived costs generated by the road prevail upon the benefits; the project is judged as not acceptable (hatched zone). This situation refers to the so-called not in my backyard (NIMBY) effect, i.e. the social response to unwanted facilities (such as a road, a rail line, waste disposal, apower plant) (Wolsink, 2000).

Fig.3. Advantages and disadvantages generated by a facility and the associated NIMBY effect (Vlek in van der Moolen and Voogd, 1995)



This general model can be used to understand how and to what extent road proximity affects households' location choice and/or residential satisfaction, and how it may lead to a NIMBY reaction. In fact, two situations can be distinguished:

- Road building or adjustment in an *already inhabited area*. This road contributes to congestion reduction and may well improve the driving conditions on the entire (regional) road network ("advantage" curve). However, for the neighbouring residents, the road may also be a source of nuisances and risks ("disadvantage" curve). In reaction to the potential feeling of injustice generated by the unfair spatial distribution of costs (locally concentrated) and benefits (regionally spread) associated with the road, the local citizens may feel that they are being saddled with the consequences of something that is of benefit to the whole society (e.g. Wolsink, 1994; van der Moolen and Voogd, 1995). As a result, they may decide to protest if they consider the road project being undesirable (i.e. NIMBY reaction). Furthermore, if the costs generated by the road are too heavy to bear, the residents could also decide to move to another place.
- Road building or adjustment in a *new development area* (with only little development). This road has no impact on the local population since the area is still (partly) uninhabited. Road building (of adjustment) in such area is, however, not without consequences on households' location behaviour. When choosing a residential location, actors evaluate the costs and the benefits associated with this road and will take that into account into their location decision.

These observations justify the need to not only include the positive effects of transport (i.e. accessibility improvement) but also the negative ones into the location decisions of households and in infrastructure project appraisals.

4.2. Influence of negative road externalities on residential location choice

The negative externalities of a road and their influence on households' location decisions have attracted some attention in scientific literature (see, for instance, Wilhelmsson, 2000; Arsenio, 2006). However, this is in particular true for the impacts of noise (and to a lesser extent, air pollution) in economic assessment studies. Other externalities such as barrier effects, visual impacts, vibrations, etc. seem to have generated less interest.

There are basically two ways of measuring the (individual) valuation of non-tradable goods: damage valuing and costs avoidance. *Damage valuing* is based on the willingness to pay (WTP) of individuals for a particular good (in this situation the WTP to reduce

external effects associated to a road). People's WTP can be derived using revealed or stated preference techniques. The second approach (i.e. *avoidance of costs*) does not attempt to estimate the value *per se*, but focuses on the (collective) costs necessary to achieve a certain reduction of the external effect of not exceeding a previously stated norm. Examples of such norms are the standards for noise pollution or international agreements on CO_2 emissions (e.g. Nijland and van Wee, 2008; Eijgenraam et al, 2000). Reviews of the diverse techniques used to evaluate the external effects generated by road traffic can be found in Maibach et al. (2008) and Bateman et al. (2001).

Although results are slightly influenced by the applied assessment method, it appears that, in general, negative externalities of road traffic significantly influence households' location decisions and the residential satisfaction level. Households are even willing to pay a considerable amount of money to reduce these nuisances (see, for example, Wilhelmsson, 2000; Arsenio, 2006; Garrod and al, 2002). Moreover, WTP seems to vary according to households' characteristics. In that respect, household composition and income level appear to be amongst the principal explanatory variables (e.g. Arsenio, 2006).

A drawback of all studies mentioned is that they mainly focus on the negative side effects generated by a road and its users, but (often) fail to take into account the positive ones such travel time gains. Without including accessibility-related variables in location models, these studies might misinterpret the influence that noise, air quality, visual impact, etc. have on the location decisions of households and vice versa (see, for example, Theebe, 2004; Harrison and Rubinfeld, 1978; Bateman et al., 2001).

4.3. Combined impact of both positive and negative effects of a road on residential location choices of households

Some studies have simultaneously included the positive and negative effects related to transport activities into their location models. In addition to variables related to the environment, housing and/or neighbourhood qualities they also include accessibility characteristics. Generally speaking, these studies have found that both environmental and accessibility-related variables significantly influence households' location choice/preferences[1], regardless of the study area and the method used (see, for instance, Harrison and Rubinfeld, 1978; Theebe, 2004; Bateman et al, 2001; Wardman and Bristow, 2004; Andersson et al, 2008; Ortuzar and Rodriguez, 2002). Moreover, all variables in their estimated models have the expected sign, i.e. a negative coefficient for noise, air pollution, and travel time/distance. This means that households prefer to live close to a highway to benefit from a high(er) accessibility, but do not want to suffer from the nuisances associated with it. It, therefore, seems to be the case that in the location choice process, households accept a lower accessibility (i.e. live further away from a road) in order to reduce the nuisances caused by this road (e.g. noise, air pollution, etc). This also reflects itself in property values as underlined by Bateman et al. (2001). They found a complex relationship between property values and proximity to different facilities (e.g. road proximity), regarding the costs and benefits associated to these facilities. This

[1] Excepted for the variable "distance to train station" in Andersson et al (2008), and "travel time by bus" in Wardman et al (2004)

relationship results in an inverted U-shape. Property prices close to these facilities are relatively low, due to the relative large nuisances associated to these facilities. Moving away from these facilities, property prices initially rise, reach an optimum and then fall as the disamenity of travelling over longer distances to facilities increases. This observation is in line with the earlier presented theoretical model proposed by Vlek (see Fig.3, section 4.1).

5. Conclusions

On the basis of a desk research, this paper aimed to provide some insight into how households trade-off positive effects of road infrastructure (i.e. accessibility gains) and its negative externalities (e.g., noise nuisance, air pollution) in their residential location decisions. We firstly focused on studies that examined the influence of accessibility on location choices. Generally speaking, the empirical-based studies have found that accessibility (often defined as trip impedance to a certain activity location) indeed has an influence on residential location decisions of households but that socio-economics (e.g., household income, life stage) and house/location related variables seem to be more influential. However, some factors seem to complicate an easy conclusion regarding the exact influence of improved accessibility, such as the definition of accessibility, the type of respondents taken into account and/or the current level of service in an area. Moreover, many studies do not make a distinction between the decision to relocate and the final choice of the new residence. Yet, accessibility may play a role in both phases.

Whereas new or adjusted infrastructure has, generally speaking, a positive effect on accessibility, it may also go hand in hand with negative externalities such as air pollution, noise nuisance, destruction of landscape. These positive and negative effects are particularly strong adjacent to the road and may gradually decrease with distance (i.e. network distance in the case of accessibility; air line distance regarding external effects). The available studies indicate that households trade-off these positive and negative effects of infrastructure. In the location choice process, households seem to accept a lower accessibility (i.e. live further away from a road) in order to reduce the nuisances caused by this road (e.g. noise, air pollution, etc). This may also reflect itself in property values.

Generally speaking, there are some methodological difficulties that have to be overcome in order to gain a realistic insight into location trade-offs near (new) road infrastructure. Studies that intend to explore such trade-offs often use stated preference techniques. Respondents are, for instance, presented with (often two or more) location alternatives consisting of several variables (e.g., type of house, accessibility factors, negative externalities) with different values, and, are subsequently asked to choose their preferred alternative. Reliability of results, however, largely depends on the perceived realism of the experiment. In the situation at hand, difficulties on the one hand relate to the number of variables that can be taken along in the experiment (i.e., with respect to respondent judgement abilities) , and, on the other hand relate to the operationalization of some of the positive effects and negative externalities associated with road infrastructure. Regarding the latter, it is hard to get reliable respondent judgements regarding aspects such as air pollution and noise nuisance and their influence on location decisions. Can people, for instance, imagine the consequences of air pollution, which can hardly be seen visually and which only impact human health on the long term?

If it were possible to realistically measure the trade-offs between positive effects and negative externalities within a broader context of residential location decisions, it might benefit the current road infrastructure planning practice. By including micro-level insights into the area-oriented planning approach, actors living in the neighbourhood may more easily accept plans, which may lead to fewer delays. Furthermore, more insight into the willingness to pay of certain groups for living at certain types of locations may possibly assist planners in deciding where different types of housing lead to the highest satisfaction and economic benefit. Moreover, these kinds of analyses may also give insight into how (positive) mitigation measures might overcome opposition and make plans acceptable. For instance, a highway may be made more acceptable when people can also access it close to where they live. However, including too many different demands and opinions also makes planning more complex and less feasible. A better approach may be to try to derive some 'common rules' that apply to certain groups of people. This can also be regarded as a sort of meso-approach. Its advantage is that planning may be improved by taking more account of group preferences and will not loose track due to complexity. The conclusion, therefore, may be that in order to optimize the potentials of area-oriented planning approaches to road infrastructure planning it is important to do more in the sense of including characteristics (demand, wishes, perceptions) of important household 'groups' into the planning phase. This may increase the effectiveness of planning. However, some aspects remain project-specific which makes a situation-specific approach to planning also inevitable.

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