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A literature review and research agenda

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Residential self-selection in the relationship between the built environment and travel behavior: A literature review and research agenda

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Abstract

This chapter gives an overview of the current debates on residential self-selection and presents a related research agenda. Here, we define residential self-selection as "the tendency of people to choose residential locations based on their travel abilities, needs and preferences." Debates relate to theory/causalities (including the role of attitudes), research methods, empirical findings (including the magnitude of the importance of residential self-selection for the influence of the built environment on travel behavior and the dominance of OECD (Organization for Economic Co-operation and Development) countries), and the implications for planning. The main contribution is

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in translating the current debates into a research agenda. Challenging avenues for future research are partly inspired by these debates, and include changing attitudes, qualitative research, multiple causal structures, extending the scope to other areas than residential areas, the existence of threshold values for the strength of preferences to be important for residential self-selection, the role of perceived accessibility, non-OECD countries, and planning implications.

Keywords: Land use, Residential choice, Travel choice, Selection bias, Attitudes, Causality

1. Introduction

Following Mokhtarian and Cao (2008, p. 205), residential self-selectin (RSS) refers to the tendency that people intentionally choose residential locations to meet their travel needs and preferences. For example, a person preferring to travel by train chooses a residential location close to a railway station. RSS studies assume that households can choose their residential location given their scarce financial resources. The level to which this is possible strongly varies geographically, because of varying housing market conditions for both owners and renters. Furthermore, it may be constrained by the availability of mobility instruments. For example, individuals who have no vehicles may have to live in the areas with transit services.

RSS generally results from socio-economic and demographic characteristics and attitudinal factors (Mokhtarian and Cao, 2008). Because almost all studies on the connection between the built environment (BE) and travel behavior control for the former, this chapter emphasizes attitude-induced RSS. The attitudinal factors mainly apply to travel and/or accessibility/residential preferences. In case of travel, the most common focus is on preferences for specific modes or travel behavior attitudes in general; in case of accessibility, researchers study attitudes toward having destination options nearby. People can self-select their place of residence for other reason than travel-related attitudes, such as preferences for specific environmental characteristics of neighborhoods. But only few studies have looked into this option to self-select, examples being Nijland et al. (2007) studying noise-related RSS, and Hamersma et al. (2017) studying environmental-quality related RSS. James et al. (2015) show that people can also self-select based on health-related characteristics, such as body mass index. We limit this chapter to travel attitudes and accessibility related RSS. Furthermore, we limit the chapter to RSS, and not to other forms of self-selection. As Van Wee (2009) argues, people can self-select in other respects, such as the place to work.

In addition RSS studies often emphasize the importance of addressing RSS because it does influence the impact of the BE on travel behavior. BE policies have often been advocated because of their potential role in reducing the negative impacts of travel behavior on the environment. So a better understanding of the impact of the BE on travel behavior needs to explicitly include the role of RSS in this impact. This better understanding is not only of interest scientifically because it informs us the causal relationship between the BE and travel behavior, but also for policy and planning: it makes clear how large the impact of BE policies on travel behavior is, after correcting for RSS. The pros and cons of options for BE policies depend on the impacts of these options on travel behavior and related externalities (noise, pollution, CO_2 emissions, road safety, etc.), and on possibilities for people to live in areas they prefer, both because of accessibility and travel options, but also because of preferences for the BE in general (livability, attractiveness). Because BE changes generally have long term impacts, it is very important that policy makers and planners are well informed about the implications of policy and planning options.

RSS has become a hot topic in the literature on the impact of the BE on travel behavior. A search on November 122,019 in SCOPUS on "residential self-selection" and "residential sorting" resulted in 167 hits and all but one papers were published since 2005. Sixteen of these papers were cited more than 100 times, and 24 papers were published in 2019 (including two papers formally published in 2020), showing that the research topic is very timely. Already as early as 2008 and 2009, two reviews of the RSS literature were published: one about methodologies (Mokhtarian and Cao, 2008), and one on empirical findings (Cao et al., 2009). The latter paper included 38 empirical studies, which showed how rapidly the literature had evolved.

Despite the high number of RSS papers, the debate on methodologies, findings, and implications is very lively, as expressed by a special issue in the *Journal of Transport and Land Use* (Cao, 2014). As discussed in Section 2, although earlier literature focuses on the question of RSS exists at all, and the extent to which it influences the impact of the BE on travel behavior, more recent literature discusses causal mechanism, dynamics in attitudes, more advanced research methodologies, and implications for policy and planning. Empirical research carried out so far is almost exclusively quantitative research (Næss, 2019). Summarizing the literature up till now, there is a general consensus on the existence of the phenomenon of RSS, and the facts that RSS influences the quantitative impacts of BE variables on travel behavior variables. In addition, there is a general

agreement on the preferred method to study quantitatively the magnitude of RSS, as well as the impact of RSS, via the BE, on travel behavior: longitudinal (panel based) studies. This contradicts the often cross-sectional studies published in the past 15 years. Nevertheless, Section 2 shows several topics are still open for debate, including causalities, methods, findings, and implications.

Because of uncertainty about the contribution of RSS in explaining the impact of the BE on travel behavior, as well as about the potential implications for policy, it is of paramount importance for both researchers and practitioners to better understand the phenomenon of RSS. The uncertainty mainly relates to the varying quantitative effects of BE variables on travel behavior indicators, such as mode choice and vehicle miles traveled (van Herick and Mokhtarian, 2020), and also on residential choice. Changes in travel behavior and residential choice do influence the environment and accessibility levels, and because of the uncertainties in residential choice and travel behavior, these influences are also uncertain. To the best of our knowledge, a comprehensive overview of current debates, linked to a research agenda, is lacking. Consequently, this chapter aims to contribute to this debate by (1) presenting an overview of the current debates, and (2) discussing avenues for future research in the area of RSS. The emphasis is on theoretical and methodological issues, not so much on the implications.

It is worth noting that Guan et al. (2020), a recent review, emphasizes the interaction between the BE and attitudes on travel behavior, the causal structure among RSS, the BE, and travel behavior, and measurement issues of BE variables and attitudes. Our literature study has a different structure and different focuses. It is conducted in a less traditional way (see Van Wee and Banister (2016) for the more general methodology of doing literature reviews). This chapter is more a discussion paper aiming to present a research agenda based on current debates, instead of a full fledge literature review paper on RSS. We searched for papers in SCOPUS using the string ("residential self-selection" OR "residential sorting"). We used SCOPUS because it is more inclusive than Web of Science (WoS). We realized that WoS includes more older papers. However, because the literature on RSS is quite recent, this feature of WoS is not important. Because we are interested in the current debates, we sorted based on date and started selecting the most recent papers. If still actual debates refer back to older papers, we included these older papers. This explains why the focus is mainly on papers published since 2014. After reading papers published between

2014 and (November 12) 2019, we experienced a saturation in the debate topics. Therefore, we aim to include all debates since Cao et al. (2009) but results reveal that papers published since 2014 probably cover all dominant topics that are still open for debate. The recommendations originate from analytical thinking and exchange of ideas between the authors of this chapter.

Section 2 summarizes dominant debates since Cao et al. (2009), followed by Section 3 presenting a research agenda.

2. The evolution of debates

This section summarizes the evolution of dominant debates during the past decade, mainly since 2014, without having the ambition to give a full overview of the debates. Science is all about theory, methods, and empirical knowledge, and debates first of all relate to these topics. A next debate concentrates around the implications of findings, and finally we discuss some specific other topics.

2.1 Theory/causality

A first debate focuses on the causal structure of attitudes (including travel attitudes and residential preferences), residential choice, and travel behavior. Cao et al. (2009) propose several alternative conceptualizations. For example, attitudes can be an antecedent for residential choice and travel behavior, but they can also be an intervening factor, so that causality runs from travel behavior via attitudes to residential choice, or vice versa. Attitudes can modify the influence of the BE, as shown by the studies on residential dissonance and travel behavior (Cao, 2015; De Vos et al., 2018; Kamruzzaman et al., 2013; Phani Kumar et al., 2018). Heinen et al. (2018) further add to those conceptualizations and reflect on the methodological implications.

Relationships among attitudes, residential choice, and travel behavior can be unidirectional (in both directions between any two of the three blocks) or bi-directional. Assuming only three (clusters of) variables, attitudes, residential choice, and travel behavior, in theory there are three relationships, and each can be unidirectional (in each direction), bi-directional, or absent, resulting in $3 \times 4 = 12$ conceptualizations. Some scholars also argue that RSS should be studied in the context of mobility biographies or using a life-oriented approach (Scheiner, 2014; Zhang, 2014; Zhao and Zhang, 2018). If other (clusters of) variables are included, such as

socio-economic and demographic variables, characteristics of the transport system or the land use system, life events, and other life domains, the number of theoretically possible conceptualizations increases rapidly. So far it is not fully clear which conceptualizations are more likely in general or in a specific case.

An important discussion with respect to causality relates to the static or dynamic nature of attitudes. A quite common assumption is that attitudes are stable, an assumption that has often been made in the context of the Theory of Planned Behavior (Ajzen, 1991), and if so, there is no "incoming arrow" to "attitudes" in causal models. But this does not have to be the case (De Vos et al., 2018; Gim, 2013): attitudes can change in general. Especially, they can be influenced by the BE, referred to as "environmental determinism" by Ewing et al. (2015) or "residential determination" by Lin et al. (2017). This topic has recently gained more attention in the literature (e.g., Farinloye et al., 2019; Kroesen, 2019; Van de Coevering et al., 2018; Wang and Lin, 2019), but it is still not well understood.

2.2 Methods

A second cluster of debates concentrates on the methods. Previous studies employ various approaches to identify and address RSS, including direct questioning, statistical control, instrument variables, sample selection models, propensity score matching, joint models, and longitudinal design (Cao et al., 2009; Mokhtarian and Cao, 2008). After reviewing the approaches, they conclude that longitudinal Structural Equation Models are the ideal methodology, one category being natural experiments (e.g., Boarnet et al., 2005; Zhang et al., 2017), and the other being panel studies on movers. Since then, several studies have applied the approach to analyze panel or quasi-longitudinal data of movers in the context of RSS (Cao and Ermagun, 2017; Wang and Lin, 2019). However, Heinen et al. (2018) argue that such studies still do not overcome all methodological issues of competitor methodologies, and suggest—as explained above—additional conceptualizations and "repeating analyses with and without individuals who relocated during the study, and with and without statistical controls for residential relocation" (p. 393). But such studies are not easy to conduct, because of problems in finding adequate data collection options, and because such studies are often data intensive (if attitudes are measured in an advanced way) and can result in high level (and selective) non-response.

Note that the debates on causalities and methods are related: the lack of understanding of causality is partly the result of a lack in longitudinal studies (Van de Coevering et al., 2018).

2.3 Empirical findings

A third debate focuses on the magnitude of the importance of RSS for travel behavior in general, as well as relative to the stand-alone impact of the BE on travel behavior (Mokhtarian and van Herick, 2016). Some studies find only few impacts, whereas other studies find the impact of RSS to strongly downplay the (independent) role of the BE (van Herick and Mokhtarian, 2020). In particular, they conclude, based on a review of 39 studies (and including 56 models) published before 2016, that of the total influence of the BE in these models 36–100% can be attributed to the BE itself. The variation partly comes from travel behavior outcomes being used (such as travel distance vs. travel time, cars vs. transit) (Cao and Fan, 2012). In theory RSS can occur based on travel attitudes and preferences in multiple ways. Mode choice is the most dominant travel behavior indicator, followed by vehicle miles traveled, whereas travel times, travel frequencies, and time of day choices are mentioned less frequently.

A quite common finding is that RSS is most important for people who prefer to travel by non-motorized transportation such as active travel, transit, and train (e.g., Ettema and Nieuwenhuis, 2017; Wolday et al., 2019). This is likely because the degree of RSS is influenced by "the supply of development alternative to conventional suburban neighborhoods" (Wolday et al., 2019, p. 88). Furthermore, if people self-select for travel-related reasons, this can be due to attitudes toward modes, but also because they do not like to travel at all, as shown by De Vos and Witlox (2016). The importance of RSS can also depend on the population of interest. Disadvantaged people and individuals in certain life courses can be more or less responsive to RSS than the general population (Cheng et al., 2019; Humphreys and Ahern, 2019). To conclude: the relative importance of RSS remains quite unclear.

A next empirical debate follows from the country focus: most studies on RSS focus on cities and regions in OECD countries, and there is much less evidence about the importance of RSS for the debate of the BE and travel behavior in other countries. Even within OECD countries, the importance of RSS varies. The effect of RSS appears stronger in the North America than in Europe (Gim, 2012; Næss, 2009; Wolday et al., 2019), probably

because the latter is more transit friendly and less sprawling than the former. Furthermore, Wang and Lin (2014) argue that the RSS phenomenon could be different in China because of the limited residential and travel choices and Chinese's unique preferences for land use and transportation system. Since then, we have seen a growing number of studies on China. For example, Cao and Yang (2017) explore RSS in Guangzhou, China, and indeed find RSS to also play a role in that city; Zhang et al. (2017) use a natural experiment to account for RSS effect on auto ownership and fuel consumption in Beijing. Studies from other non-OECD countries are limited, the Iranian study of Etminani-Ghasrodashti and Ardeshiri (2016) and the Vietnam study of Tran et al. (2016) being exceptions.

2.4 Implications

A next debate focuses on the implications of RSS for planning, see, for example, Næss (2014) and an associated commentary (Van Wee and Boarnet, 2014) in the aforementioned special issue (Cao, 2014). If the impact of the BE on travel behavior is partly due to RSS, the independent impact of the BE on travel behavior is likely to be overestimated, although underestimations are also possible (see Cao and Chatman, 2016; Kroesen and Chorus, 2018). On the other hand, Næss (2009, 2014) and Levine (1999) argue that the phenomenon of RSS itself shows that the BE has an impact on travel behavior. If people have preferences for specific modes and residential areas, they should be provided with the "right" environment, to allow them to travel by, for example, public transport or active modes, and to reduce travel by personal vehicles (Zhang and Zhang, 2018). Providing the "right" BE reduces residential dissonance (see, for example, De Vos et al., 2012; Frank et al., 2007; Huang et al., 2016). Linking this to the discussion on causal structures (see above), in this case the BE is an enabler for travel preferences.

Chatman (2014) argues that an accurate estimation of the BE effect on travel behavior by controlling for RSS may not be conducive to predicting the effect of certain land use and transportation policies. It depends on how people with certain attitudes respond to the changes in the BE. Furthermore, he contends that the research of land use and travel behavior should consider housing supply and market demand. A promise underlying the argument that enabling RSS may amplify the BE effect on travel behavior is that developments alternative to suburban neighborhoods

are undersupplied (Cao and Chatman, 2016). However, whether there is an undersupply of the alternative development is debatable (Cao, 2008; Levine and Inam, 2004).

2.5 Specific topics

Although most debates concentrate on the topics as discussed above, a few more debates, often discussed in one or a few papers but important to the RSS issue, have emerged. One debate focuses on the questions of "who decides with respect to residential choices," at least as far as related to RSS. It is generally assumed that the respondents being surveyed make such a decision, but Guan and Wang (2019) argue that such decisions are made at the household level. In particular, they find that husbands' attitudes are more important to residential choice whereas wives' attitudes have a larger effect on commuting distance in China. The discussion on this topic is still in its infancy.

It is also interesting to know how the size of a metropolitan area affects the degree of RSS. Most studies use the data from large metropolitan areas and find the prevalence of RSS. However, many medium and small metropolitan areas may not have large variations in the BE and do not experience severe traffic congestion. Therefore, there may be fewer motivations for RSS. Wolday et al. (2019) find that RSS is more pronounced in the larger Oslo metropolitan area than in the smaller Stavanger region, where transit supply is limited, even in central business districts. Moreover, in three small cities in Norway, travel-related attitudes have hardly any effect on car driving distance (Wolday, 2018). In rural Sichuan, China, travel attitudes have few effects on travel behavior and carbon emissions (Ao et al., 2019).

A next topic is travel satisfaction and the link with RSS. Ye and Titheridge (2017) explain that travel satisfaction can influence travel attitudes, which links this topic to the reverse causality debate. Cao and Ettema (2014) find that RSS has an important influence on satisfaction with travel and conclude that deploying rail transit will improve individuals' travel satisfaction, especially those who prefer transit. De Vos et al. (2016) find that travel satisfaction differs between people living in urban vs. suburban areas (and between consonants and dissonants). The link between RSS and travel satisfaction is also relevant for the RSS debate, because the expected utility at the time of making a decision, such as a residential move, does not have to match the experienced utility.

3. A research agenda

This section is limited to recommendations for future research that are not already extensively discussed in the literature. We therefore do, for example, not discuss the importance of longitudinal studies. The rationale for selecting the topics varies between the topics. Putting "changing attitudes" on the agenda directly follows from the importance of attitudes as discussed above. The plea for qualitative studies is a reaction to the quantitative focus of almost all research done in this area, whereas we still poorly understand the motivations and mechanisms for people to self-select in specific neighborhoods or neighborhood types. The topic of causal structures follows from the fact that previous research is inconclusive with respect to the causal structures linking RSS, travel behavior, and BE variables. The topics discussed under the umbrella of "extending the empirical focus" result from overviewing the literature published until now, and analytical thinking. Recommending research on the link with planners and policy makers originates from the fact that the RSS debate is generally put in a context of the relevance or not of implementing BE concepts to influence travel behavior.

3.1 Changing attitudes

In line with others, such as Bruns and Matthes (2019), we recommend more research into the area of attitude changes, both in general as well as with respect to those initiated by the BE. Due to the exposure to a new residential environment and travel options, people might change their attitudes (Kroesen, 2019; Kroesen and Chorus, 2018), but attitudes can also change for other reasons, such as changing environmental awareness. If attitudes change due to the BE, the impact of the BE on travel behavior might be underestimated compared to results derived assuming attitudes to be constant (see for further discussion Chatman, 2009, Kroesen and Chorus, 2018, and Næss, 2014), making it a very relevant topic for understanding the impact of the BE on travel behavior. The process of attitude change is still poorly understood (Van Wee et al., 2019). Longitudinal studies might reveal attitude changes, but if these changes are not explicitly included, the role attitudes play in models might depend on the moment of measuring attitudes in these studies. Moreover, attitude change can influence results of cross-sectional studies. For example, if attitudes change

after a move, measuring attitudes after that move do not reflect the attitudes at the moment the decision for the residential choice was made (Guan et al., 2020).

Attitudes changes are relevant for causal structures: BE impacts on attitudes can explicitly be modeled. Latent class transition models (see Van de Coevering et al., 2018) can reveal groups of people that change attitudes over time. In other words, such models allow researchers to assess changes in attitudes based on unknown characteristics of the persons or households, and these attitude changes can next be included in models linking RSS, the BE and travel behavior.

3.2 Qualitative studies

In line with some scholars (e.g., Bruns and Matthes, 2019; Farinloye et al., 2019; Næss, 2015), we recommend to take a step back from the many quantitative studies, and do some qualitative research, like in-depth interviews or focus group meetings. As topics to study we see several avenues. First of all qualitative studies allow researchers to better understand the motivations of people to self-select or not (at least because of travel/accessibility preferences and attitudes, maybe also for other reasons). Researchers can explicitly ask if and how travel-related attitudes played a role in people's residential choice. Secondly such research can study the role of restrictions to be able to choose the preferred residential location, housing market restrictions and financial restrictions being two important candidate types of restrictions. Thirdly such research could focus on the inclusion of people who make the decisions (individual, individual and partner), and secondary players who influence their decisions (children living with their parents or not (anymore), other family, members and even employers—note that some employers force people, like nurses, to live not too far from the working location.[a] Fourthly such research could explore changes in attitudes, as discussed above. When and how did people's attitudes change, which factors played a role, to what extent did the BE play a role, were some factors related or not?

A fifth topic is the spatial scale at which people self-select. People can decide to self-select, but the question is: at which spatial scale? They might

[a] This, for examples applies to many nurses in the Netherlands—they should live close to work to be able to be at work within a short time period. The current Minister of Housing argued that for that reason nurses should be given priority in the allocation of social housing in Amsterdam—see https://www.nursing.nl/verpleegkundigen-moeten-voorrang-krijgen-op-sociale-huurwoningen/

self-select in a specific neighborhood (type) but also more specifically in a smaller part of a neighborhood. For example, if they want shops to be nearby because they prefer to walk to shops, not the full neighborhood might be the level to self-select, but only a part of it, the part near shops. But it could also be that they self-select at the level of the city as a whole. They might, for example, prefer to live somewhere in a medium sized city without specific preferences for locations within that city. We expect the spatial scale of RSS to be strongly correlated to the motivations to self-select. If people primarily self-select based on a commuting mode choice preference for rail, they probably search for a dwelling at a reasonable distance from a station. But if they self-select because they prefer to walk or cycle to destinations like shops, medical and other services, restaurants etc., they probably select specific neighborhoods. Then the answers to this question can help policymakers identify appropriate geographical scales for planning interventions.

Wolday et al. (2019) is an example of qualitative research in the area of RSS. They find that although all interviewees value good accessibility, suburbanites appreciate the supportive environment for children and affordability more than accessibility. This study shows the interplay of travel-related motivations, housing and financial restrictions, and secondary household members in residential location decisions.

Despite the inherent limitations of qualitative research, especially with respect to representativeness, forms of bias, and resulting in qualitative outcomes only, such research could be an important step, and the limitations could at least partly be addressed in follow-up quantitative research. The strong focus on quantitative research so far is understandable because of the link with the debate of the BE and travel behavior: RSS can help quantify the independent effect of the BE, an important component of travel demand forecasting models. But we argue that the RSS mechanisms at the individual or household level are still poorly understood, and deserve more attention. The results of qualitative analyses can be used either to formulate hypotheses tested by quantitative studies, or to explain the underlying reasons for the observed relationships between the BE and travel behavior in quantitative studies (e.g., Wolday et al., 2018).

3.3 Multiple causal structures

In line with the discussion on causalities, we argue that there is not one "best" causal structure, but there could be multiple. The reasons is the

heterogeneity between people and households—see Cao and Chatman (2016), Jarass and Scheiner (2018), and Kim and Mokhtarian (2018). The challenge then is to find out which causal structure applies to which people or households. Methods to study this heterogeneity and the causal structures that apply to link the BE, RSS, travel behavior, attitudes and socio-demographic variables first should have data for at least two moments in time to allow for the exploration of causalities. In addition they should be able to identify (groups of) people for which different causalities apply. One option is Latent Class Transition Modeling. Classes then related to the causal structures that apply. Kim and Mokhtarian (2018) also discuss the strengths of Latent Class models (LCM) for RSS research, but do not link the discussion to the existence of multiple causal structures.

3.4 Extending the empirical focus

A first topic in this category is travel behavior at other places than in the residential area, to the best of our knowledge an almost completely overlooked topic. For example, people who start walking or cycling more in their residential area might also walk or cycle more as a form of egress transport, from a station to their workplace. They might even decide to travel by train (as opposed to driving) because of the increased perceived attractiveness of egress travel (walk or cycle as opposed to bus, tram or metro). Or at a holiday destination they could also adapt their travel mode to what they are used, and they might even chose for other holiday destinations because of the preferences for travel and options available at the destinations. Researchers could, for example, match residential neighborhoods and travel behavior that originates at the neighborhoods and figure out the extent to which RSS translates into the behavior outside of the neighborhoods.

Next we highlight the potential threshold effect of RSS, referring to the fact that preferences or attitudes should have a certain minimum level of importance to play a role in residential choice (Galster, 2018). A qualitative analysis shows that although both urban residents and suburbanites appreciate transit accessibility and proximity to facilities, RSS will be limited to only those who have strong preferences for these attributes (Wolday et al., 2019). This makes sense because households often face various constraints in residential location choice and are unable to exercise their travel-related preferences. However, it is unclear how strong these preferences should be to make people self-select them based on these

preferences? Overall, we need to examine the non-linear and synergistic effects of RSS and the BE on travel behavior. Gradient boosting decision trees is a candidate analysis approach (Ding et al., 2018).

Furthermore, the debate on RSS can be linked to the debate on perceived accessibility—for travel behavior, experienced constraints for activity participation and appreciation of levels of accessibility, perceived accessibility is what matters, e.g., expressed as perceptions of travel times (or generalized transport costs) to relevant destinations—see, for example, Lättman et al. (2016), Lättman et al. (2018), and Liu et al. (2018). Accessibility research generally studies measured levels of accessibility, based on characteristics of the land use and the transport system, and sometimes on characteristics and restrictions/constraints of people and availability of services (e.g., opening hours of kindergartens). Linking accessibility to RSS, it is important to realize that what matters for RSS are perceived levels of accessibility (by available and preferred transport modes), and secondly, changed attitudes because of the exposure to a new or changed BE can influence the perceptions of accessibility. A more general question is how to handle the relationship between objective-measured BE characteristics and their subjective measures. Previous studies often include both of them in a single-equation model, by treating them exchangeable and overlooking their intrinsic connections (e.g., Handy et al., 2006; Spears et al., 2013). However, environmental psychology suggests that subjective BE characteristics should mediate the corresponding objective characteristics and travel behavior (Ma and Cao, 2017; Ma et al., 2014; Mehrabian and Russell, 1974).

Finally, we emphasize the importance of geographical context. As argued above, most studies on RSS focus on OECD countries, or China, leaving many options to study the relationship among RSS, the BE, and travel behavior in other countries and regions. And even within the OECD (between and within countries) or China, a lot of heterogeneity could influence study results. Candidate factors for this heterogeneity could be the availability of high quality infrastructure for active modes, the social status of specific transport modes and the importance of this status for attitudes and choices, housing market characteristics and the level of freedom to make a residential choice, and (perceived) restrictions to mode choice likely due to perceived social safety of women in some countries and times of day or the fact that until recently women were not allowed to drive a car in Saudi Arabia. For example, the options to self-select one's residence depends on the availability of houses within the budget to rent

or buy, at the neighborhoods or neighborhood types preferred. Availability of neighborhood types and house types depend on (past) land use policies, and (the absence of) regulations with respect to the housing market. Both land use policies and such regulations vary widely across the globe. Not only are RSS studies in other than mainstream countries recommended, so are cross-country and cross-culture comparisons because these can help validate the generalizability of the findings of RSS studies. Because experiences in OECD countries cannot a priori be transferred to developing countries, research in these countries is very important. Many of these countries face rapid population growth and increasing shares of the population living in urban areas. Consequently they are currently developing their land use and transportation system, and early interventions to facilitate RSS can help achieve the goal of sustainable transportation (Cervero, 2013).

3.5 Implications

In line with the debate for planning as discussed above, we recommend more research into the importance of findings for planners and policy makers in general but also into options to strengthen the impact of the BE on travel behavior. Moreover, an important topic is to study how to reach planners so that they are aware of the relevance of RSS studies, and how to translate the findings in such a way that planners can include the findings in their planning activities.

4. Concluding remarks

In this chapter, we show several avenues for future research. Not all topics are of equal importance. Departing from the fact that, as explained in the introduction, a better understanding of the impact of the BE on travel behavior needs to explicitly include the role of RSS in this impact. We think that three topics are most important. The first one is the qualitative studies as suggested above, and the second topic is studies exploring which causal structures apply to which persons or households (probably via the latent class models). Thirdly, and as a specific case of the second topic, a better understanding of if, how and for whom attitude changes apply, deserves more attention, especially because if attitudes changes due to a changing BE, the impact of the BE could be underestimated, not overestimated, as often argued in the RSS debate. Especially longitudinal studies that include (changing) attitudes seem promising.

Our chapter does not only aim to be relevant for researchers, but also for practice. If researchers are better able to quantitatively estimate the effects of candidate BE policies, planners and policy makers can be better informed about the travel behavior, residential choice, and other policy relevant effects (accessibility, environment) of such policies. In addition, providing information (documents, videos, …) about best practices with respect to BE policies could be helpful to bring BE policies under the attention of planners and policy makers. Such information could show the BE changes and their impacts on residential choice, travel behavior and policy relevant effects, plus the mechanisms explaining such impacts (such as direct travel behavior changes, but also attitude changes after relocations).

To conclude: now that for about a decade and a half, RSS has been studied and debated frequently, it is time for a next generation of studies.

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