Student essay: Built environment and self-selection of residential location in the context of US-American cities

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Abstract

Urban environments currently experience radical transformation processes – from the ones related to growing population to sustainable city transitions. Therefore, they are in the center of public attention in enabling more just and sustainable community spaces. Although research has been conducted for several decades, it remains unclear what constitutes systemic change. However, factors found to be some of those constitutional factors are self-selection of the living location and the surrounding built environment. Hence, this paper aims to explore the relationship between travel behavior, the built environment and self-selection. Considering available literature reviews and meta-analyses, the examination focuses on the living context in the US. It was found that all the influencing parameters are highly intertwined, thus making disaggregation difficult and showing the importance of multidimensional assessments of urban environments. Nonetheless, gaps remain regarding the elimination of research biases, and furthermore, considering the characteristics of various methodologies.

1. Introduction

When designing policies to address behavioral changes towards more sustainable travel patterns, systemic approaches are necessarily needed. To understand the interrelations, scientific research is evaluating the question whether people choose their living location according to their travel preferences, respectively called self-selection,

or whether the opposite is the case and the conditions in the built environment have a greater impact on how the travel behavior is shaped. This paper collects approaches pursued in a chronological overview on what the relationship between travel behavior, the built environment and self-selection is found to be in the US-American context.

The discussion around the role of self-selection and the built environment on travel behavior has originated in the late 20th century by the researchers Mokhtarian and Handy. The underlying research scope was analyzing to what extent attitudinal factors influence travel decisions and therefore, understanding the significance of land-use policies and changes in the built environment (Kitamura et al., 1997). The remainder of this paper aims at answering this research question and is structured as follows. Firstly, initial approaches are illustrated providing a starting point on the interaction between the built environment and travel patterns, suggesting the importance of other attitudinal factors (Kitamura et al., 1997). Secondly, the weaknesses of the initial research focusing on travel behavior are highlighted, addressed by a microeconomics approach (Boarnet & Crane, 2001), and the importance of causal inference is provided (Bagley & Mokhtarian, 2002; Handy et al., 2005; Handy et al., 2006). Thirdly, further aspects influencing the interrelations are added by elaborating on one hand, how well individual preferences match general residential location preferences and the effect on travel behavior (Schwanen & Mokhtarian, 2005); on the other hand, how there is a different significance for either utilitarian or strolling walking trips (Cao et al., 2006). Fourthly, a generalized view collects several foregone research to elaborate characteristics, strengths, and shortcomings of the various methodologies used (Cao et al., 2009; Ewing & Cervero, 2010). Lastly, a large-scale US neighborhoods structure analysis is provided, reevaluating and rounding off the debate on the effect of self-selection on travel behavior (Voulgaris et al., 2017).

2. Discussing the impact of Self-selection

2.1 The first scientific approaches

Self-selection in transportation describes the behavioral characteristics of people choosing their residential location according to their preferred travel mode choices and vice versa. However, this interrelation is not trivial and content of a vivant scientific debate. Especially the debate in regard of interaction of land use planning decisions and individuals' travel behavior in regard of self-selection of residential location was mainly initiated by the researchers' team around Mokhtarian et al. (1997) – a leading character in this academic debate – in the US around the end of the 20th century. Their research is intended to examine the effectiveness and desirability of land use policy planning to manage travel choices.

However, a further distinction between the influence of self-selection or characteristics of the built environment have initially not been executed within this approach. Stated preference surveys in five neighborhoods in the San Francisco Bay area revealed a significant relevance of built environment on the modal split in a region when socio-economic neighborhood characteristics are also accounted for. Such factors comprised parking availability and the proximity to a bus stop, as being positively associated with automobile trips, and sidewalk availability and high-density urban structure that are positively associated with non-motorized trips.

The special characteristic of this initial paper is the two-folded methodological approach: on one hand, a linear regression between socio-economic and neighborhood characteristics and the number and proportion of trips was executed; on the other hand, 39 attitude statements, compiled in the categories "pro-environment, pro-transit, suburbanite, automotive mobility, time pressure, urban villager, TCM, and workaholic" (Kitamura et al, 1997). Relative assessments of the very same attitude statements revealed that they strongly impact on travel decisions, exceeding the influence of the built environment.

Therefore, the author team concludes that policies aiming for increased urban density and land use mixture might fail when attributional changes are not also accounted for. Indeed, this analysis lacks the influence of land use policies on travel attitudes which created the starting point for the upcoming and ongoing research activity about self-selection and the importance of the built environment. Also, it requires further elaboration how other influences form attitude, i.e., the choice of job location, residence, and vehicle ownership.

2.2 From economic examinations to the question of causality

The consecutive research (Boarnet & Crane, 2001) aimed to address the previously described weaknesses with an economic approach. As the absence of systematic examination of the travel behavior was identified to cause a structural bias of outcomes, this research paper used the microeconomic theory of demand to classify the correlation between land use, transportation, and behavior empirically. Therefore, the connection of design principles with perceived prices helps as a systemic framework. In addition to the examinations of Kitamura et al. (1997) they also emphasized the importance of geographical scales as they were found to majorly impact on the link between urban planning & design and travel behavior. The answer to the question whether the underlying correlation, i.e., the influence of design choices on individuals' travel decisions, also comprises a causal relationship cannot be clearly verified with the result of the given analyses.

Indeed, the complexity of interrelations and the fact that how a study is constructed severely prepossesses the outcomes obliterates the clarity of cause-effect-relationships. This perception inaugurated a continuing series of research studies that strived for elaborating the

correlation-causality distinction. Based on the findings and identified weaknesses of the forgone works (Kitamura, Mokhtarian, & Laidet, 1997; Boarnet & Crane, 2001), the influence of predisposed attitude settings on residential location, respectively the self-selection phenomenon, and on individual's travel behavior was aimed for to be analyzed by Bagley & Mokhtarian (2002). The question raised was explicitly whether the correlation that was determined in the previous research (Kitamura, Mokhtarian, & Laidet, 1997) is significantly based on a causal linkage. The authors (1997) therefore developed a structural equation model (SEM) featuring similar data from the San Francisco Bay area as the first research did (Kitamura, Mokhtarian, & Laidet, 1997). To account for various dimensions of the attitudinal prepositions, this model included measures regarding attitudes and lifestyle apart from measures of residential type, travel demand, and job location (Bagley & Mokhtarian, 2002).

It was found that the prepositional factors have the strongest impact on the travel demand whereas the impact of residential type was marginal. Thus, a direct causation between planning & design in land use and individuals' travel behavior couldn't be concluded. When attitudinal, socio-demographic and lifestyle variables are considered, neighborhood type is rarely affecting the travel decisions. Vice versa, there was some evidence for travel behavior affirming travel attitudes. The higher the vehicle-miles travelled (VMT) – a target variable of elaboration to evaluate the proportion of motorized trips – were determined, the more people developed a pro-driving attitude and the more they disfavored living in high density areas. Nevertheless, Bagley and Mokhtarian (2002) evaluated it as improbable that only attitude-based self-selection explains the findings; only the pace of behavioral adaptations could not be accounted for in the paper.

This is the result of a limited number of tested data, the focus on individual's instead of household data leading to missing account for interactions and system dynamics, as well as the systematic bias of the

study's methodology resulting in possible overlooking of explanatory variably; a setting as already described by Boarnet & Crane (2001).

Acknowledging the unclear role of the built environment, and whether there is solely a correlation between the built environment and travel behavior, a further study aimed at testing for a causal inference between these two dimensions was conducted. The aim was to see if self-selection is the dimension affecting the correlation between these; hence, examining a causal inference between the built environment and travel behavior, in this case referring to walking (Handy et al., 2005; Handy et al., 2006). Given a quasi-longitudinal study design within eight different neighborhoods in Northern California, the aim was to understand if a change in the built environment, having a positive effect on walking, leads to more walking.

The findings show the existence of a causation between these two dimensions; thus, it is argued that the built environment has a causal effect on walking. Changes in the built environment are clustered into five different dimensions, namely increasing (1) accessibility, (2) physical activity options, (3) safety, (4) attractiveness, and (5) socializing. Despite this clustering, it is not clear which of these dimensions should be emphasized more, or which distinct package of these dimensions has the greatest impact, given that all five dimensions are mostly integrated within an urban environment and data aggregation is difficult to achieve.

However, one clear recommendation is how these findings can be integrated in policies in promoting more walkability: thus, also increasing walking. The policies are divided into new development projects and into existing environments, given that creating change in the existing environment is increasingly challenging. On the one hand, for new development projects planners should ensure to increase accessibility through proximity-based zoning and to integrate efficient infrastructure for walking and biking. On the other hand, regarding

existing environments, planners should ensure to protect traditional neighborhood structures, increase their efforts to decrease the ridership of private vehicles on streets through traffic calming initiatives, and promote investments into walking and biking infrastructure. Additionally, the qualities of the built environment cannot be neglected, e.g., improving the safety within neighborhoods through improved street lighting, or establishing socializing events aiming at promoting walking.

Finally, it is vital to understand that the changes in the built environment need to be vast, as otherwise, no significant increase in and the benefits of walking can be reaped. Moreover, walking in general is in decline within the US and even if changes in the built environment may therefore not increase walking, they are important in moderating this decline, and as every resident being able to walk substantially increases the benefit of society, every investment in these policies is justified.

2.3 Residents' characteristics and the importance of trip purpose

Given the complex and adequately not easily definable role of self-selection and the built environment, moreover, given the difficulties in determining each individual significant contribution towards travel behavior, further research was conducted, trying to split these attributes into different parts. Schwanen & Mokhtarian (2005) aimed for determine to what extent peoples' travel behavior shapes according to the mobility conditions they find in their residential proximity – referred to as consonance – or whether they do not comply with the circumstances of their built environment – considered as dissonance.

Consonant residents are described as sharing the same travel attitudes as predominantly is the case within their area of residence. On the other hand, dissonant residents' travel attitudes are not in line with

other residents within their residential proximity, hence appearing mismatched when comparing their travel behavior and residential location. The area of study is San Francisco and its surrounding suburban communities, and this entails that within urban environments (referred to urbanites) there is a higher share of public transit and active mobility. On the contrary, in suburban environments (referred to as suburbanites) there is a different modal split consisting of higher private vehicle ridership (and vice versa).

The findings of this analysis show how the individual commute choice; hence, the focus of this study lies on work-related travel, differs between consonant and dissonant individuals. It is shown that consonant residents within an urban environment travel less by private vehicle, thus more by public transport and active mobility, compared to dissonant urban residents. In addition, consonant residents within a suburban environment travel more by private vehicle, thus less by public transport and active mobility, compared to dissonant suburban residents. Another important finding is, despite their being an effect of dissonance on both suburban and urban residents, the strength of this effect differs between the two residential forms. For suburban environments the effect of dissonance is much weaker, arguing that even if residents would prefer increasingly using public transport and/or reaching their destination by active mobility, the built environment is preventing these residents from taking this decision. It is therefore argued that for suburban environments the built environment is a more limiting factor for its residents to use more sustainable modes of transport and has a greater effect than their travel preferences. Regarding urban environments, the effect of dissonance on the travel behavior is greater, suggesting that the role of the built environment and travel preferences are more balanced. This means that residents in urban environments have more options to use a more sustainable mode of transport, however, the higher the degree of dissonance, so the ones who prefer to commute by private

vehicle within urban environments, are not constrained in their options and can rather freely do so.

Furthermore, Cao et al. (2006) focused on determining the relationship of self-selection and the built environment and the effect on walking for two different purposes, namely (1) for utilitarian trips, and (2) for strolling trips. Utilitarian walking trips are described as purpose-driven, which means that these types of trips could be based, e.g., on buying groceries. Strolling trips are described as leisure trips, so they do not have a clear purpose, e.g., taking a walk around the neighborhood. When taking a closer look at how self-selection affects both walking types, the evidence suggests that both are impacted, however, it is shown to have a greater effect on utilitarian trips. Given this finding, the degree of human change by redesigning the built environment for residential areas that prefer to use their private vehicle, might not have a significant influence in increasing walking for this purpose. Regarding the role of the built environment, again an effect on both walking types can be seen, nonetheless, different aspects are separately important to consider. For utilitarian trips, the aspects of the built environment at the destination, and for strolling trips, the perception of the built environment within their own neighborhood are more important.

This finding highlights the importance of the built environment not only at origin-level, with a greater focus on strolling trips, but also at destination-level, which holds to be especially true for utilitarian trips. In addition to these findings, another important aspect of the built environment, which affects the general frequency of walking trips for utilitarian purposes, is the distance to utilities, such as grocery stores, which is again influenced by how the built environment allows a walkable street grid. Thus, accessibility in general influences residents' decision in walking more frequently for utilitarian purposes.

Furthermore, another important factor for both walking purposes is perception and appearance of the built environment with a focus on

traffic related issues. The higher the degree of traffic-calmness, the higher the frequency of walking for both types. Thus, policies should aim at decreasing mobility to favor more walking within residential and commercial areas. Another important finding is how in general, more trips account for strolling purposes, despite the general assumption that trips tend to have a purpose.

2.4 Connecting the dots

All the forgone analyses were focusing on one special methodology and using various differing approaches to evaluate the land use transportation behavior linkage. As there was a growing base of academic findings, consecutive research was able to collect the different angles and to sustain the broad examination in reviews and meta-analyses (Cao et al., 2009; Ewing & Cervero, 2010). Cao et al. (2009) accomplished a review of 38 empirical papers, analyzed and structured their data and compared them, as well as methodologies, outcomes, and strength and shortcomings. Remarkable is the variety of nine methods including statistical control, joint discrete models, or SEM (Bagley & Mokhtarian, 2002) and (quasi-) longitudinal design (Handy et al., 2005) as in the earlier described sections. On this level, a thorough investigation whether built environment accounts for causal changes in travel behavior or is just an association could be executed.

Contrasting to the previous findings and according to some predictions (Bagley & Mokhtarian, 2002) there is a significant influence of land use configurations when self-selection is also considered as an affecting component. However, not all included studies showed a clear causality, and when it comes to quantification, only eight of the examined papers showed a stronger impact of built environment. Due to the wholistic approach, the review paper (Cao et al., 2009) could assess the suitability of various methodologies, too. Whereas statistical methods are found to fit best to the objective of verifying correlations, one method stood out by combining strength

adequately: Longitudinal structural equation modelling (SEM) can both account for attitudinal affection as well as various dimensions of causation. Furthermore, the scope of future research was defined as executing natural experiments and panel studies of residents that move from one neighborhood to another, or of observable adjustments in the built environment to study long term effects and adjustability of travel behavior attitudes.

A similar level of investigation was realized by the meta-analysis of Ewing & Cervero (2010). Apart from only collecting outcomes of the forgone papers, this work also updates the findings, elaborates weaknesses in methods and subjoins additional perceptions. This is done by developing elasticities for the individual results of the studies and aggregating them to weighted averages. This results in a vast overview of influences on the different travel modes walking, motorized travel, and transit use. Respectively, all the parameters influencing travel behavior have been identified to cohere inelastically. Confirming the results of Cao et al. (2009), the effect of built environment adjustments is severe, especially in combination of various variables.

Furthermore, the paper (Ewing & Cervero, 2010) features the 5-D principles of transit-oriented development comprising design, diversity in land-use, destination accessibility, density, and distance to transit. In detail, it was found that the factors that mostly affect the transport made by motorized vehicles include destination accessibility, followed by density – a parameter that usually, structurally accounts for higher land-use diversity and increased accessibility, too – and design parameters, such as intersection configuration and block size. Contrasting to commonly assumed perceptions, population and job density are not strongly involved in travel behavior choices.

Similar findings regarding the walking trips have been concluded: Land use diversity, i.e., a well balance between job and housing

locations, design factors regarding intersection configuration and the proximity of transit stops can foster active walking behavior. Finally, promoting good stop accessibility was also found to support transit ridership. According to common practices of transit operators, a quarter mile to most residents is critical. Subsequently, high intersection density as well as well-connected streets show another important factor on the choice towards transit travels. Despite assumed prospects, population and job densities are showing low elasticities.

In summary, this has been observed across all the travel modes. Generally, measures of density are often included in the other principles and therefore show a low discrete steering capacity. In reverse conclusion, developments in urban environments of whatever kind are probably more effective to address modal changes than well-designed land use configurations in remote areas. Eventually, destination accessibility is most influential on changes in travel behavior. These elaborations exceed the outcomes of the associated research and add a new perspective.

2.5 How free are Americans in terms of self-selection?

In the final paper by Voulgaris et al. (2017), which we have included in our essay is a large-scale analysis within the US, clustering different built environment variables, providing topological data on neighborhood structures, and enabling to evaluate travel behavior. It is found that there is generally little variation in the number of trips in different neighborhood structures, however, the variation in vehicle miles travelled and the mode choice is substantial. The variation is the most severe when comparing newly rural developed, where private vehicles account for more than 75% if the modal split, with old urban environments, as for rural areas there is the highest share in vehicle miles travelled and the lowest share in total transit trips.

However, solely old urban environments appear to significantly differ in terms of travel behavior and the built environment from all other urban environments, with the highest reliance on transit-based trips and the lowest reliance on private vehicle. Despite old urban environments accounting for only 4% of the total population, compared to 27% of the population living in newly rural developed environments, its residents account for 33% of all transit-based trips within the US and it is the only neighborhood structure with a public vehicle ridership lower than 75% of all trips. Given this low share of the population living in these kinds of environments, the question concerning the role of self-selection becomes gradually more unclear and foggier, as it becomes clear that there is a low opportunity in choosing to reside in these old urban environments.

In addition, recognizing again the low variation across all other neighborhood structures, it is evident that minor changes in the built environment, moreover, only touching across single dimensions, are not significant in changing human travel behavior, and that only positive change can be created, when increasing the number of old urban neighborhoods.

However, as concluded by the authors, "old urban neighborhoods, and the travel they engender, would seem to be outliers in every sense of the word." (Voulgaris et al., 2017).

3. Discussion

From the initial intention to evaluate the influence of land-use policies and attitudinal perceptions on travel behavior, the importance of self-selection was elaborated. Indeed, it was unclear to what extent individual attitudes moderate the effect of the built environment on travel behavior. Whereas some research defined a direct causal inference between the built environment and travel behavior, other research highlights the significance of self-selection.

On one hand, the research comes across various dimensions within the built environment that need to be addressed to nudge people in decreasing their share of private motorized trips. On the other hand, self-selection, in terms of attitudinal preferences, also has a significant impact on different walking purposes and the share of private motorized trips and transit trips. Subsequently, deriving one generalized conclusion seems inadequate, as the urban structure is highly complex and will not fit into one model. Hence, it is unfeasible to derive one distinct answer with the aim of answering the given research question. From this, however, we can see how human behavior, known as not being fully rationale, is not easy to predict given the dynamic interaction of individuals in a complex system. Disaggregating parts of human behavior from sub-systems only successively allows confirming that, as is the case for urban transport, the system is highly integrated. Past clustering of expert knowledge in specialist silos is not suitable in addressing the challenges of the 21st century.

Nonetheless, given the focus on US neighborhood structures, it appears to be naïve to disregard the substantial supply and demand gap for other modes of transport besides one's own private motorized vehicle. Whilst people within the US would prefer active mobility or transit usage, the supply of these modes of transport is inadequate and it appears that only the smallest share of the population essentially has the opportunity choosing for themselves which mode of transport they want to rely on.

In addition, we believe that this raises additional concerns over justice in transportation, as these areas are not made accessible to all members of the society especially focusing on most vulnerable groups, e.g., children, elderly, or disabled persons. This accessibility is further diminished by the already high but still increasing real-estate prices leading to the requirement of a market intervention. One intervention aiming at establishing the deepest leverage point for

systemic change could address the neighborhood types with the most significant attitudinal factors promoting private motorized travel behavior. Nevertheless, intervening on the level of individual attitude formation can be perceived as a severe limitation of the personal right concerning the freedom of choices. Thus, individual freedom must be weighed against the higher goal of achieving societal benefits. The remaining question refers to the responsibility of a reflective urban planner also considering the role of local politicians balancing the public discussion of societal goals, individual rights, and the interest of various stakeholders.

Given the various research methodologies used, we still believe that this pool of knowledge would benefit greatly from additional studies. Given that most empirical studies relied on surveys, one highly recommended research topic is investigating actual change in the built environment and assessing the effects both from a short- and long-term perspective. This allows to better observe the change in human behavior, moreover, it will allow to experiment in building a possible right package regarding the dimensions of the built environment within that study area. Another way to observe these attitudinal adjustments is to focus on residents moving from one neighborhood type to another, most likely leading to an alignment of individual travel behavior. Nonetheless, even in these studies generalization will be difficult to achieve, and it should be acknowledged how also these study findings will only serve as snapshots for a distinct neighborhood structure, which again is dynamic in nature and highly integrated within its surrounding system.

Finally, considering the scope of this paper focusing on the US context, this examination fails to formulate generalized findings in other, respectively in a European context. This is based on fundamental differences in the built environment and attitudinal factors including the value of societal goals. Indeed, this can be the subject of an additional elaboration in the future.

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