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An analysis of the effects of suburban densification on vehicle use for shopping: Do existing residents respond to land-use changes in the same way as recent movers?

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ABSTRACT

Studies examining the influence of smart growth and compact development on travel behavior often focus on a limited subgroup of the population: those who have recently moved from one neighborhood to another. Despite the substantial proportion of existing residents in the population, their responses to land-use changes have not been thoroughly studied. To address this gap in the literature, this study compares two groups of suburban residents in the Atlanta metropolitan area: a treatment group whose neighborhoods experienced increases in density, land-use mix, and street connectivity and a control group whose neighborhoods did not experience such land-use changes. After correcting for self-selection, this study reveals that residents in the treatment group who relocated to suburban neighborhoods before land-use changes drove more miles for household maintenance activities than their control group counterparts in other suburban neighborhoods. The same households, however, drove substantially less for subsistence activities (e.g., commutes to school and work), which more than compensates for the moderate increase in vehicle miles traveled for household maintenance. These findings suggest that increased residential density and land-use mix in older suburbs contributes to a reduction in automobile vehicle miles traveled.

1. Introduction

Transportation scholars have found that land-use characteristics are closely related to travel behaviors. That is, those who live in dense neighborhoods with mixed land uses and pedestrian-friendly streets tend to drive less and walk, bike, and use public transit more (Badoe and Miller, 2000; Boarnet and Crane, 2001; Cervero and Duncan, 2003; Crane, 2000; Crane and Crepeau, 1998; Ewing and Cervero, 2001, 2010; Frank et al., 2006; Handy et al., 2005; Heath et al., 2006; Henderson and Bialeschki, 2005). However, we know far less about how travel behaviors *change* when land-use interventions are implemented (Cao and Chatman, 2016). In other words, if neighborhoods are densified and new types of land uses are allowed, do existing residents change their travel behavior? We contrast existing residents with new residents who have relocated to a neighborhood that differs substantially from their previous one and experience different land-use patterns after relocation, or *recent movers* (Krizek, 2003b). As existing residents do not experience local land-use changes in the same way as recent movers, their behavioral responses might also differ from those of recent movers.

Since existing residents constitute a substantial proportion of the metropolitan population in the United States, their travel responses to land-use investments are important to an understanding of effective planning and policy. These residents are likely to respond to changes in urban form differently from recent movers for several reasons. First, compared to recent movers, who often relocate to substantially different environments from their previous ones, existing residents experience *incremental* urban-form changes, so they may not notice or consider such slow or gradual changes as relevant to their lifestyles. Second, travel behavior researchers have noted that habits constitute a strong force that determines the everyday choices of travel modes (Bamberg et al., 2003; Esser, 1993; Fujii and Kitamura, 2003; Gärling and Axhausen, 2003; Garvill et al., 2003). If people become accustomed to certain modes of travel, they are reluctant to adopt newly available alternatives (Fujii and Kitamura, 2003; Schlich and Axhausen, 2003). Thus, as long as changes in the local built environment are gradual and not disruptive, existing residents may not appreciate them in the same way as recent movers, who are likely to search for information about available travel options in unbiased ways immediately after relocation (Verplanken and Wood, 2006). Another reason existing residents and

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movers respond to urban form changes differently is that under certain conditions, existing residents might be affected by physical changes in and around their neighborhoods resulting from the "cumulative effects" of gradual changes. That is, once changes exceed a minimum threshold, people are no longer able to ignore them (Chen and Chen, 2009; Coombs et al., 1970). In such cases, despite habits and routines, existing residents may be more likely to learn about new travel options that were not previously feasible but that have become available in their neighborhoods. In addition, when existing residents interact with their "new" neighbors—those who have recently moved in and who are taking advantage of new travel options—existing residents may experience a "learning process" that compels them to reevaluate their previous habits and adjust their routines (Scheiner and Holz-Rau, 2013a; Verplanken and Wood, 2006). In brief, although existing residents may not always respond to changes in land-use patterns that are *incremental*, under certain circumstances, they more than likely do. Therefore, additional studies about changes in the travel behaviors of existing residents in response to land-use interventions are warranted.

Until now, studies have not devoted much attention to exploring the land-use and travel interaction of existing residents. Thus, we address this research gap with a treatment-control framework and rigorous methods that transportation researchers have not frequently employed. While previous researchers have analyzed panel, repeated cross-sectional, or retrospective one-off survey datasets (Van de Coevering et al., 2015), we wish to acquire insights into policy and intervention by employing a conventional regional household travel diary with external datasets and plausible assumptions.

2. Changes in travel behavior from a longitudinal perspective

Because of the paucity of studies focusing specifically on the travel behavior of existing residents, we selectively review three groups of studies tangentially related to this topic. From these studies, we analyzed travel behavior *changes* associated with land-use attributes from a *longitudinal* perspective.

2.1. Studies examining whether changes in land-use patterns cause variation in travel behavior

Transportation scholars have found that most land-use characteristics (e.g., 5D-density, diversity, design, distance to transit, and destination access) (Ewing and Cervero, 2010) are significantly correlated with various measures of travel behavior (Badoe and Miller, 2000; Boarnet and Crane, 2001; Brownstone, 2008; Cervero and Duncan, 2003; Crane, 2000; Crane and Crepeau, 1998; Ewing and Cervero, 2001, 2010; Frank et al., 2006; Handy et al., 2002; Heath et al., 2006; Henderson and Bialeschki, 2005). Moreover, to make more robust causal claims, researchers have analyzed panel or retrospective cross-sectional datasets in which causality (e.g., changes in land use) occurs between observational waves or reference time points. For example, by analyzing the Puget Sound Transportation Panel (PSTP), one study (Krizek, 2003b) found that *movers* to neighborhoods with better accessibility reduced their number of vehicle miles traveled (VMT) after relocation. In their analysis of movers and non-movers in eight neighborhoods in the San Francisco Bay area, Cao and his colleagues found that differences between the perceived built environment of previous and current residences led to changes in auto ownership, vehicle miles driven, and the amount of walking (Cao et al., 2007a,b; Handy, 2005). However, these studies assumed that non-movers do not experience any changes in land-use attributes because the interval between waves or reference time points are too short for noticeable land-use changes to take place (e.g., a year). Thus, the causal mechanism underlying many of these studies appears to be more applicable to recent movers and less to existing residents. After all, unlike recent movers, who may explore every alternative immediately after relocation (i.e., learning about the new neighborhood), existing residents may have developed habits and routines over a long period of time, so they are less affected by gradual land-use changes in and around their neighborhoods.

2.2. Studies adopting the mobility biography framework

A group of scholars has analyzed movers and non-movers in panel datasets with a broader conceptual framework with the help of mobility biographies (Axhausen, 2008; Müggenburg et al., 2015; Scheiner and Holz-Rau, 2013b). Scholars adopting this framework have suggested that people do not always compare all feasible options for trip-making in their choice set before choosing the best one. Instead, they tend to develop habits and routines during an initial conscious planning and testing period, and afterward, they may decide to retain their habitual travel patterns unless they undergo an external shock. When such a shock takes place, individuals experience tension between their current travel behavior and a new circumstance, so they devote a conscious effort to developing a new set of habits and routines, sometimes with longer-term decisions (e.g., changes in vehicle ownership). Examples of these shocks are changes in household/family formation and composition, new school/workplace location, and changes in residential location that take place over the course of individual lives (Scheiner and Holz-Rau, 2013b).

To test this conceptual framework, most studies have analyzed panel datasets in which they have observed whether external shocks taking place in the previous wave account for changes in travel behavior in the next wave. These studies have revealed that besides changes in demographic and economic situations, residential relocation also affects travel behavior in various ways. Several have found that relocation to more suburban neighborhoods leads to the greater use of household vehicles, a higher share of commuting by car, a larger number of VMT, and lower multimodality (Beige and Axhausen, 2017; Clark et al., 2016; Dargay and Hanly, 2007; Oakil et al., 2014; Prillwitz et al., 2007; Scheiner et al., 2016; Scheiner and Holz-Rau, 2013a; Woldeamanuel et al., 2009). These studies, however, rarely controlled for residential self-selection, which may confound the claim of causality between new land-use attributes and changes in travel behavior. Additionally, these studies also assume that non-movers did not experience changes in urban-form attributes while they were observed in the panel.

2.3. Studies comparing travel behavior before and after specific land-use changes

Except for the initiation of public transit services (Brown and Werner, 2008; Ewing and Hamidi, 2014; Hong et al., 2016; Spears et al., 2016), noticeable urban form changes usually take place over a long time period. Thus, researchers often focus on the impact of a single *large* project on individuals in nearby neighborhoods. Lovejoy et al. (2013) compared shopping travel outcomes before and after the opening of the first big-box retailer in Davis, California, where residents had to travel a long distance from the city to reach a big-box retailer. They found that Davis households visited other shopping destinations less often, especially those outside downtown Davis and beyond Davis. Overall, the number of household shopping VMT to all types of destinations dropped by 20%. However, the authors analyzed only Davis residents, not others who resided outside the city boundary but who may have driven a longer distance to shop at the big-box retailer. In other words, the same change in land use may have prompted some residents to reduce vehicle use while inducing others to increase it, and its net effects for all affected households depended on local contexts (Boarnet et al., 2011). Moreover, even for those who are located closest to *new* dense, mixed-use, and pedestrian-friendly developments, closer proximity may not guarantee that they will travel to these new developments. For instance, one study (Handy and Clifton, 2001) found that as for shopping destination choice, the closer the nearest stores were to residents' homes, the more likely the residents of six neighborhoods in