Transportation Research Part A 80 (2015) 277–287

Contents lists available at ScienceDirect

Transportation Research Part A

journal homepage: www.elsevier.com/locate/tra

The impact of transit station areas on the travel behaviors of workers in Denver, Colorado

Gregory J. Kwoka, E. Eric Boschmann *, Andrew R. Goetz

Department of Geography and the Environment, University of Denver, 2050 E. Iliff Ave., Denver, CO 80208, United States

ARTICLE INFO

Article history:
Received 29 July 2014
Received in revised form 28 July 2015
Accepted 10 August 2015
Available online 2 September 2015

Keywords:
Light rail
Transit
Travel behaviors
Workplace
Sustainable transportation
Denver

ABSTRACT

Transit development is one planning strategy that seeks to partially overcome limitations of low-density single use car oriented development styles. While many studies focus on how residential proximity to transit influences the travel behaviors of individuals, the effect of workplace proximity to transit is less understood. This paper asks, does *working* near a light rail transit station influence the travel behaviors of workers differently than workers *living* near a station? We begin by examining workers' commute mode based on their residential and workplace proximity to transit station areas. Next, we analyze the ways in which personal travel behaviors differ between those who drive to work and those who do not. The data came from a 2009 travel behavior survey in the Denver, Colorado metropolitan area, which contains 8000 households, 16,000 individuals, and nearly 80,000 trips. We measure sustainable travel behaviors as reduced mileage, reduced number of trips, and increased use of non-car transportation. The results of this study indicate that living near a transit station area by itself does not increase the likelihood of using non-car modes for work commutes. But if the destination (work) is near a transit station area, persons are less likely to drive a car to work. People who both live and work in a transit station area are less likely to use a car and more likely to take non-car modes for both work and non-work (personal) trips. Especially for persons who work near a transit station area, the measures of personal trips and distances show a higher level of mobility for non-car commuters than car commuters – that is, more trips and more distant trips. The use of non-car modes for personal trips is most likely to occur by non-car commuters, regardless of their transit station area relationship.

1. Introduction and background

When considering cities, sustainability, and climate change, urban transportation and the use of private automobiles plays a fundamental role in terms of energy consumption and greenhouse gas emissions. While technological advancements such as hybrid cars offer solutions of reducing pollution and energy consumption, a more fundamental shift may come through behavioral changes, including a reduction in the need to travel (particularly by car), increased use of public transport (as well as walking and cycling), and a reduction in travel distances (Cervero and Murakami, 2010; Banister, 2011; Chatman, 2013). Given the urban forms commonly characterized by low density, sprawling, automobile-oriented development, many

* Corresponding author. Tel.: +1 303 871 2654.
E-mail addresses: gkwoka2@gmail.com (G.J. Kwoka), eric.boschmann@du.edu (E.E. Boschmann), andrew.goetz@du.edu (A.R. Goetz).

http://dx.doi.org/10.1016/j.tra.2015.08.004
0965-8564/

U.S. cities face challenges in shifting travel behaviors due to the lack of infrastructure that facilitates nearby and non-car travel.

Transit development is one planning strategy that seeks to partially overcome these limitations of low-density single use car oriented development styles. For example, transit oriented developments (TODs) are high density development projects with mixed land uses (including housing, retail, services, and jobs), access to transit (bus or rail), a high level of walkability, and design principles that emphasize pedestrians over automobiles (Calthorpe, 1993; Ratner and Goetz, 2013). Their objective is to create an urban space that increases overall livability and quality of life. Indeed, TOD has gained support by planners and policymakers for its potential to address many issues associated with unsustainable transportation systems. Specifically, the level of interest in transit oriented developments in the U.S. has been spurred by traffic congestion growth, distaste for suburban-style development, new desires for urban walkable lifestyles, costs of private transportation, and increases in integrating environmental and sustainability consciousness with lifestyle choices (Ratner and Goetz, 2013). Demographic projections further suggest public demand for such developments will become greater in the future (Myers and Gearin, 2001).

A key concern of urban and transportation planning research is how urban form, including new transit corridors, transit station areas, or TODs, influences travel behaviors. While the study of the relationships between built environment and travel behaviors is not new (Ewing and Cervero, 2001, 2010; Guo and Chen, 2007; Boarnet, 2011), it has taken on greater emphasis recently within the context of sustainability and sustainable urbanism (Guo and Chen, 2007; Cervero, 2009; Chatman, 2013). The extensive body of literature examines whether different arrangements of the built environment (e.g. high or low density, balance of jobs and housing, land uses) affect travel behaviors of people, particularly looking for reductions in automobile usage and associated environmental and social impacts. Most commonly, changes in travel behaviors are measured using a variety of metrics, including trip frequency, trip length, or mode choice. For example, does residence in one type of built environment foster changes and reductions in these measures? However, self-selection bias suggests peoples' residential choice is influenced by their preferences in travel and commuting (Guo and Chen, 2007; Olaru et al., 2011), thus it becomes difficult to disentangle the effects of the built environment on travel.

While transit development may seek to increase transit usage as a planning objective, some research shows that transit station areas attract residents for a variety of reasons and that close proximity to transit does not measure highly. For example, TODs tend to attract smaller households without children, who make residential choices based on housing quality and type, cost, and neighborhood quality (Lund et al., 2004; Lund, 2006; Dill, 2008). Furthermore, this same research indicates most TOD residents are not transit dependent but in fact still own cars, and are not as motivated by access to transit as would be expected (see also Chatman, 2013). Rather, TODs attract persons seeking shorter non-work trip destinations whether by car or walking, not necessarily by transit. These findings support early skepticism that TODs and neo-traditional neighborhoods do in fact reduce travel distances or increase transit usage among residents (Gordon and Richardson, 1997). And despite the growth of residential TODs, a large citizenry maintains a preference for 'ideal' residential neighborhoods of low density single family suburban living (Loukaitou-Sideris, 2010).

Despite the growth of residential lifestyles in New Urbanist style developments such as TODs, the arguments above suggest living preferences are not necessarily motivated by proximity to transit. To date, studies conducted on TODs' ability to influence travel behavior have shown mixed results. According to a study of TOD impacts on transit ridership in California by Lund et al. (2006), TODs do confer meaningful ridership benefits, but complementary policies and programs may be necessary before hoped-for ridership gains can be met. Cervero (2007) acknowledges that transit oriented development produces an appreciable ridership bonus in California, but it is largely due to residential self-selection and employer policies that reduce free parking and automobile subsidies. Dill (2008) found that residents of surveyed TODs in Portland are not transit dependent, although they did commute by transit at a significantly higher rate than residents citywide. Cao and Schoner (2014) show that the Hiawatha light rail transit (LRT) line in Minneapolis promoted transit use of residents who had lived in the corridor before its opening, but that residents who moved to the corridor after its opening use transit with the same frequency as new residents in comparable urban corridors without LRT. This literature suggests that TOD area residents generally tend to use transit more than residents outside of TOD areas, but that this relationship is not always conclusive, and the reasons for higher transit use include other factors such as supportive policies.

To increase ridership, one key objective in urban transportation planning is to make transit more accessible to residents. However, new research proposes that transit stations located near workplaces are more effective than stations near residences (Tsai, 2009), thus arguing for a stronger emphasis upon the non-residential components of transit developments, particularly retail and employment. This is particularly evident as most transit trips are work or school related (Kim et al., 2007). For example, in California TODs, a sizable 26.5% of *work* trips for TOD residents were made by bus or rail, whereas only 8.1% of home based *non work* trips were made by bus or rail (Gard, 2007). In Chicago, Lindsey et al. (2010) found that a large percentage of trips that originate from households close to transit also terminate at work destinations close to transit. The success of transit in Stockholm, Sweden suggests that a key design principle is to distribute industry and offices roughly in proportion to residential population, i.e. to achieve a jobs-to housing balance (Cervero, 1996). In the U.S., high density development of both jobs and housing along rail lines, however, is important for influencing travel behaviors from the *residential* side of transit development. This is particularly true along the Arlington (VA) Metrorail corridor, where residents are twice as likely to commute by transit than residents outside the corridor, and every 100,000 square feet of added office and retail floor space increases average daily boardings by nearly 50 (Cervero, 2009). For San Francisco's BART transit