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New light rail transit and active travel: A longitudinal study

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ABSTRACT

We use panel data to investigate the before-and-after impact of a new light rail transit line on active travel behavior. Participants were divided into a treatment group and a control group (residing <½ mile and >½ mile from a new light rail transit station, respectively). Self-reported walking ($n = 204$) and accelerometer-measured physical activity ($n = 73$) were obtained for both groups before and after the new light rail transit opened. This is the first application of an experimental-control group study design around light rail in California, and one of the first in the U.S. Our panel design provides an opportunity for stronger causal inference than is possible in the much more common study designs that use cross-sectional data. It also provides an opportunity to examine how an individual's previous activity behavior influences the role that new light rail transit access plays in promoting active travel behavior. The results show that, when not controlling for subject's before-opening walking or physical activity, there was no significant relationship between treatment group status and after-opening walking or physical activity. However, when controlling for an interaction between baseline walking/physical activity and treatment group membership, we found that living within a half-mile of a transit station was associated with an increase in walking and physical activity for participants who previously had low walking and physical activity levels. The results were opposite for participants with previously high walking and physical activity levels. Future policy and research should consider the possibility that sedentary populations may be more responsive to new transit investments, and more targeted "soft" approaches in transit service would be needed to encourage people to make healthy travel choices.

1. Introduction

A sedentary lifestyle is a growing concern in the United States. It is a major risk factor for obesity and a variety of chronic diseases, such as coronary heart disease, type 2 diabetes, and breast and colon cancers (Lee et al., 2012; WHO, 2009). However, the share of adults and children engaged in physically active travel for both work and leisure has declined sharply over the past decades in the United States (Bassett et al., 2008; Brownson et al., 2005). Recognizing this problem with sedentary lifestyle, public health and urban planning researchers have turned to the potential role of the built environment to change behavior and create a pathway to a physically active lifestyle (Brownson et al., 2009; Frank et al., 2006). This new line of research focusing on the potential role of the built environment in promoting active travel behavior has had a profound

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influence on the current research and practice in urban planning and transportation (Badland and Schofield, 2005; Bors et al., 2009; Sallis et al., 2004).

One area that is receiving increasing attention is the role of public transit in promoting more active and healthy travel choices (Morency et al., 2011; Stokes et al., 2008). In recent years, many local and regional governments have built new transit systems, and an increasingly common secondary justification for those systems is the promotion of active lifestyles (US DOT, 2014; Zheng, 2008). Previous research has found a positive association between frequent transit use and moderate physical activity (Besser and Dannenberg, 2005; Lachapelle et al., 2011; Rissel et al., 2012). Living close to a transit station was also found to increase the odds of utilitarian walking (McCormack et al., 2008). However, these studies were based on cross-sectional data, showing only a correlation with the observed relationships. Because of the cross-sectional nature of most studies, it is still unclear whether changes in the built environment through new transit investments can lead to a meaningful behavioral change (Bauman et al., 2002).

We fill a gap in the literature by presenting results from one of the first longitudinal studies of travel behavior change before and after the construction of a new light rail line. Our longitudinal study design allows stronger causal inference than cross-sectional data. Our research examines the role of an individual's previous walking and physical activity levels in influencing the "treatment effect" of new light rail transit on after-opening walking and physical activity. The use of past behavior in a longitudinal study of the impact of new light rail is novel in the literature. In addition, we use more robust measurement of active travel behavior – self-reported walking and accelerometer-based physical activity, and our findings are similar for both measures.

2. Literature review

Previous research on the impacts of transit investments suggest that transit is positively associated with active travel behavior (Besser and Dannenberg, 2005; Lachapelle and Noland, 2012; Rissel et al., 2012). However, most research in this area consists of cross sectional studies, making it difficult to assess causal relationships. Longitudinal studies can provide stronger evidence on the impacts of new transit investments and overcome concerns about the influence of residential selection on travel behavior (Cao et al., 2006). However, longitudinal evaluations of the travel impacts associated with new light rail transit are still rare. To our knowledge, only two studies have longitudinally examined the effects of a new light rail transit line on active travel behavior. Brown and Werner (2008, 2007) used a pre-post study design to examine the impact of a new light rail line on 51 residents in Salt Lake City, Utah. They found that using the new transit service was associated with an increase in moderate physical activity, but no statistically significant association was found between proximity to the transit stations and physical activity. Using longitudinal samples from Charlotte, North Carolina, MacDonald et al. (2010) found a strong association between light rail use and body mass index (BMI) and obesity. However, they found only a marginally significant association between light rail use and the odds of meeting recommended physical activity. The results from the previous studies suggest that light rail transit may help overcome some of the barriers to engage in active travel, but it is still unclear whether exposure to new transit service has any meaningful impacts on residents' active travel behavior. We contribute to the literature by extending the scope of longitudinal, pre-post studies of new light rail with our case in Los Angeles.

Drawing from a more general literature on the relationship between the built environment and physical activity, researchers have studied a broad range of factors influencing physical activity, including social and physical environments as well as individual psychological factors, such as environmental perceptions and cognitive behavioral attributes (Carlson et al., 2012; Handy et al., 2002; Kerr et al., 2010; McNeill et al., 2006; Saelens et al., 2003; Timperio et al., 2006). Over the past several decades, behavioral change models, such as the health belief model (HBM) and the theory of planned behavior (TPB), have gained popularity in physical activity research and practice (Glanz et al., 2008; King et al., 2002). Among the most prominent theory in the context of the built environment and physical activity is the ecological model which encompasses interpersonal, social, and physical dimensions of activity promotion (Sallis et al., 2006). This model has been widely used by urban planners and policy makers because it enables integration of existing land use and transportation policies into physical activity promotion, contributing toward creating more sustainable and healthier lifestyles (Bauman et al., 2002; Pickett and Pearl, 2001; Sallis et al., 2006).

Despite much work on theory development, there has been a lack of clarity and consensus in our understanding of potential mechanisms of physical activity change (King et al., 2002). One particular area that has received relatively little attention in the active transportation field is the role of past behavior, although it has been a subject of rigorous research in other arenas. Past behavior has been actively discussed among researchers studying the theory of reasoned action (TRA), theory of planned behavior (TPB), and habitual travel behavior (Ajzen and Fishbein, 1980; Ajzen, 1991; Gärling and Axhausen, 2003). Previous studies have consistently found an independent influence of the frequency of past behavior across a range of behaviors, such as drug use, school attendance, television watching, and recycling behavior (Bentler and Speckart, 1979; Fredricks and Dossett, 1983; Ouellette and Wood, 1998). In particular, past physical activity behavior has been found to influence habit formation, and thus influence intentions to engage in later physical activity (Aarts et al., 1997; Hagger, 2001). Although there is an on-going debate whether past behavior can directly predict later behavior (Ajzen, 2002), studies have consistently found that past behavior has a significant residual effect beyond cognitive behavioral constructs (e.g. intentions and perceived behavioral control) while improving model performance and predictability (Bamberg et al.,