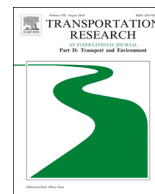


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Transportation Research Part D

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

Examining the role of trip destination and neighborhood attributes in shaping environmental influences on children's route choice

Mika R. Moran^{a,*}, Daniel A. Rodríguez^b, Jason Corburn^b^a Faculty of Architecture and Town Planning, Technion – Israel Institute of Technology, Technion City, Haifa 320003, Israel^b Department of City and Regional Planning, University of California Berkeley, Berkeley, CA 94720, USA

ARTICLE INFO

Keywords:

Route choice
Walkability
Children
Walking for transport

ABSTRACT

Routes are a common way through which child pedestrians experience the built environment. However, empirical evidence on route-scale environmental influences on children's walking are scarce and mainly concern home-school itineraries. To address this gap, this study aims to identify environmental influences on children's route choice, and to explore how these may vary by trip destination and neighborhood type. One hundred and seven children (10–12 year old) living in inner-city and clustered suburban neighborhoods in Rishon LeZion, Israel participated in the study. Participants were instructed to draw the routes along which they regularly walk from their home to four destinations: School, public facility, retail and park. We then compared the attributes of the built environment for the walking trips reported, relative to the trips that would have taken the shortest path along the street, path, and alley network for each origin-destination pair using conditional logistic regression, while adjusting for the correlation across choices, route length, and individual characteristics. Comparisons of chosen and non-chosen routes suggest that routes with fewer intersections are more likely to be selected, if they have fewer intersections but more compact urban form along the route. The ratio of built-to-lot area and distance remained significant, but residential land uses and the walkability index were differentially associated with route choice when analyses were stratified by destination and neighborhood type. Being the first study to explore route choice by both location and destination and given that environmental influences on walking are context specific, this study provides valuable insights on environment-behavior interactions.

1. Introduction

In recent decades, the adverse health effects of sedentary life-style (Biswas et al., 2015) along with the negative environmental impact of increasing car use (Frank et al., 2003) has led to intensive investment in active mobility as part of a wider urban health agenda (Corburn et al., 2004). Amongst the various types of active mobility, walking may be the easiest to adopt and adhere to, as it has zero cost and requires no special skills or equipment. Walking for transport has positive health impacts throughout the lifespan (Scheepers et al., 2014) and especially during childhood, given the high and rising prevalence of childhood overweight and obesity worldwide (Gupta et al., 2012; Lobstein et al., 2004). Replacing car-trips with walking is highly beneficial for children because it decreases car-pedestrian conflicts (Lyon and Persaud, 2002) as well as traffic-related pollution, to which children are highly sensitive (Jerrett et al., 2008; Schwartz, 2004). Furthermore, children's walking contributes to their socio-emotional development by positively

* Corresponding author at: The Faculty of Architecture and Town Planning, Technion – Israel Institute of Technology, Haifa 32000, Israel.
E-mail addresses: moran.mika@gmail.com (M.R. Moran), danrod@berkeley.edu (D.A. Rodríguez), jcorburn@berkeley.edu (J. Corburn).

<https://doi.org/10.1016/j.trd.2018.08.001>

affecting their independence and improving self-image and social ties (Kingham and Ussher, 2007).

Despite its clear benefits, children's active mobility and walking for transport has been decreasing over the years throughout the world. In the USA between 1969 and 2009, the percent of children walking or biking to school dropped from 40.7% to 12.7% (McDonald et al., 2011). In Australia, the percent of children who walked to school dropped from 57.7% in 1971 to 25.5% in 1999–2003 (Van der Ploeg et al., 2008). These trends have been attributed to various factors, such as: increased car reliance, low access to schools, and low-density suburban development (Frank et al., 2003).

Neighborhood characteristics play an important role in enhancing active mobility. Accumulating empirical evidence supports the role of the physical environment in enhancing active mobility and transportation walking in particular (Saelens and Handy, 2008; Sallis et al., 2012). Walking was found to be more common in inner-cities compared to suburban neighborhoods (Khattak and Rodríguez, 2005). Among general populations as well as among children, walking has been linked to high walkability (Owen et al., 2007) and other walkability-related characteristics, such as street connectivity (Giles-Corti et al., 2011; Sugiyama et al., 2012), residential density (Carlson et al., 2014), land-use mix/access to destinations (Koohsari et al., 2014; Lee and Moudon, 2006) and sidewalks (Boarnet et al., 2005; Sugiyama et al., 2012).

In addition to neighborhood characteristics, routes attributes play an important role in shaping pedestrians' experience. However, to date, most of studies have focused on neighborhood influences on walking (whether by using external aerial units or home-based buffers) and only recently studies have begun to focus on more micro-scale environmental influences. Amongst these, some studies focused on the actual routes taken by individuals (henceforth: chosen routes) by employing quantitative (Millward et al., 2013), qualitative (Carroll et al., 2015; Van Cauwenberg et al., 2012) or mixed methodologies (Moran et al., 2017). Other studies relied on proxy measures of journeys, consisting of modelled routes that represent the shortest/most direct street-network itinerary between predetermined destinations (e.g., Dalton et al., 2015; Karusisi et al., 2014). While modelled routes were found to be reliable proxy measures (Duncan and Mummary, 2007), the study of chosen routes is essential to the understanding of environment-behavior associations. Ultimately, comparing chosen and non-chosen routes provides valuable insights on environment-behavior interactions and route-choice considerations. This type of comparison has been increasingly used in route choice modelling studies (e.g., Buliung et al., 2013; Harrison et al., 2014; Rodríguez et al., 2015; Tribby et al., 2017; Winter et al., 2010) not only because of its potential to partially overcome concerns about self-selection, but also because of its intuitive appeal, as routes are the way through which pedestrians' experience and relate to the built environment.

Results of studies on route decisions support and further extend previous work by that was largely done at the neighborhood level. Specifically, routes were found more likely to be used if the environment along them was characterized by high levels of density (Dalton et al., 2015; Larsen et al., 2012), access to destinations (Gallimore et al., 2011; Rodríguez et al., 2015) and aesthetics (Dessing et al., 2016). However, route-level studies have also revealed new environmental features related to walking that were less reported at the neighborhood level, such as urban waterscape (Dessing et al., 2016; Moran et al., 2017), openness of streetscapes (Van Cauwenberg et al., 2012), and traffic control features (Rodríguez et al., 2015).

To summarize, attributes of the built environment measured at the neighborhood and route levels have been associated with walking behaviors. However, the vast majority of previous studies have focused on either neighborhoods or routes but haven't examined the synergistic effect between both. Walkable routes in a sea of suburbs are likely to influence behaviors differently than similar routes in a similarly walkable environment. These interactions are important, as they provide cues to pedestrians about the feasibility of reaching other potential destinations through trip chaining, and of using different routes to reach desired destinations. Furthermore, most studies examining route choices have focused on trips to prominent destinations (e.g., home to work, or for children, home to school trips), even though these remain a minority of trips undertaken during a given day and thus fail to represent other routine/discretionary trips that may occur. Given the expectations and emerging evidence that environmental influences on physical activity are likely to be context-specific (Saelens and Handy, 2008; Giles Corti et al., 2005), it is reasonable to expect that route-choice considerations may also vary by context (trips location and purpose). The current study fills this gap in the literature by investigating associations between the built environment and children's route choices, while addressing differences in location and neighborhood characteristics (inner-city vs clustered suburban neighborhoods) and destinations (school, public facility, park, retail). The main questions posed in this research are: What are the associations between route-level environmental attributes and children's route choice? and - Do these associations vary by the journey's destination and general location?

2. Methodology

2.1. Study area and participants

The study was conducted in the city of Rishon LeZion, the fourth largest city in Israel (243,323 inhabitants), located along the central Israeli Coastline plain, 12 km south of Tel Aviv. Two distinct urban areas were selected, broadly characterized by high built footprint, land-use mix and grid street network (henceforth: *Inner-city*), and by the presence of high rises with undeveloped and parking spaces surrounding them, resulting in a low built footprint, segregated land uses and limited street connectivity (henceforth: *Suburban*). The two areas were also chosen so as to have similar socio-economic indicators. For sampling purposes, five neighborhoods were chosen, of which two neighborhoods were located in the inner-city and three were located in the suburban area. A figure ground map of the study area (Fig. 1) shows differences between the inner-city and suburban areas. These differences can also be seen

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