What Makes a Pedestrian and Cycling Friendly Environment?

Study Methods and Empirical Evidence

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In this seminar, we have already talked about how built environment affects travel behavior, and the potential challenges of tackling the bias of modeling the relationship between them. Cervero and Kockelman (1997) defined built environment as "the physical features of the urban landscape that collectively define the urban realm, which may be as modest as a sidewalk, or an in-neighborhood retail shop, or as large as a new town." Out of the many facets of built environment, today I would like to just focus on the aspect of environment that affects pedestrian and cycling travel behavior. This discussion includes three main issues:

(1) What characteristics construct a better pedestrian and cycling environment?
(2) What are the available tools to measure it, and the pros and cons of these tools.
(3) Is Walk Score a good way to capture walkability?

Introduction to the theory of smart growth, new urbanism, and TOD

In response to auto-oriented urban and transportation planning that had dominated America since the end of WWII, the concept of "smart growth" has emerged in the last two decades. Smart growth means building urban, suburban, and rural communities with housing and transportation choices near jobs, shops, and schools. In addition to its effects on people's travel choices, advocates of smart growth argue that it would support the existing communities, lessen municipalities' fiscal burden, improve the value of the communities, and provide communities with higher quality of living.

Taking a step further, the concept of "new urbanism" broadens the concept of smart growth, and stresses the importance of improving the quality and utility of pedestrian travel in a community. New urbanism has several design/planning guidelines such as high walkability, mixed-use and diversity, and traditional neighborhood structure.

Another important concept related to new urbanism is Transit Oriented Development (TOD), which further describes the importance of letting transit station be the prominent center of a community. High density and quality development should be located near the transit station, so that those who take transit as a commute mode would benefit from satisfying their daily needs. Because pedestrian is the main character in transit use, providing safe, easy access from home to transit station is also an important guideline. These guidelines help to increase transit usage, reducing auto travel at community level as well as regional level. If people are used to get around their community on foot or by bike, and reach farther
destinations by transit, it further reduces the incentives for the urban areas to sprawl, which we all know causes many environmental, transportation, and even health problems.

**Assessing and providing pedestrian-friendly environment**

The common theme of the abovementioned concepts is to reduce vehicular traffic and encourage pedestrian travel. This leads us to focus on the importance of measuring pedestrian environment - What makes pedestrian environment better, and as an extension, cycling environment, since bike has emerged recently as an important alternative to motorized mode and as a way to improve users' mobility. First of all, street connectivity is a crucial component in community design. Street networks that are more grid-like are preferred over networks that have plenty of cul-de-sacs and long blocks, thus increasing distance between destinations. Since the travel speed of pedestrian and bike is noticeably lower than that of vehicle, bad connectivity discourages pedestrian and bike travel much more than vehicular travel.

Measures of connectivity can be useful in two areas: (1) study on the relationship between travel behavior and urban form; and (2) public policy establishing performance standards for new and/or existing development (Dill, 2004). In Dill's paper, she tried to enumerate all common measures of network connectivity, such as intersection density, link-node ratio, and block size. She explains in detail the method to calculate each measure, and applies a case study in Portland, OR to see the statistical relationship among these measures.

Marshall and Garrick (2010) further investigated the effect of street network design on walking and biking by comparing 24 Californian cities in their paper. By classifying the citywide street network and other connectivity measures as independent variables, using logit model, they found that all three fundamental characteristics of a street network - street connectivity, street network density, and street patterns - are statistically significant in affecting the choice to drive, walk, bike, or take transit.

After writing the famous 3Ds (density, diversity, and design) paper with Kockelman, Cervero continued to probe into the effect of 3Ds on walking and bicycling (Cervero and Duncan, 2003). In this paper, they used 2000 Bay Area Travel Survey which contains data from 15,066 randomly selected households in 9 counties. They imposed 1-mile around each surveyee's both origin and destination as the walkable distance, and 5-min as the bikable distance, and measured the built environment within the boundaries of origin and destination on which they regress households' mode choice. They also used factor analysis to reduce variables and reduce potential multicollinearity. They found that land-use diversity factor at the origin is significant in explaining households' tendency to walk, which confirms at least partially to the assumption of new urbanism. Although the result indicates that the "design" factor is not significant in both walking model (tendency to walk) and bicycling model, according to the p-value, pedestrian/bike friendly factor affects tendency to bike more than walk.

**Walk score as a proxy for walking accessibility**

Walk score is a unique way of capturing the walkability around a particular location (origin). It includes three facets: (1) Walking routes and distances to amenities; (2) Road connectivity metrics such as density
and block length; and (3) Scores for individual amenity categories. There are different weights given to different types of amenities, and the distance decay function is used to capture the friction of distance between the origin and the destination amenity. Intersection density and average block length are included as the pedestrian friendliness metrics. It is a unique approach to combine accessibility (the level of opportunities within a distance) and pedestrian friendliness in a single measure (score). Further studies may be conducted to see its effectiveness in predicting people's travel behavior.

**Relationship between bike lane/path, built environment and cycling level**

In addition to walking, cycling can be considered an important feeder mode to transit (Martens, 2004); therefore, to implement TOD, bicycling environment cannot be neglected. Buehler and Pucher (2012) analyzed the link between bike lane/path and bike commute behavior. After taking several control variables into account, they found that both bike lane and bike path variables are significant in explaining bike commute ratio and counts, and several significant control variables are also significant. This result further parallels the aforementioned studies on the impact of mixed-use and street network connectivity on pedestrian travel.

**Closing remarks**

The relationship between built environment and travel behavior is an interesting topic to deal with. There exists no absolute answer to the request, and the selection of measures as well as variables needs caution: The inclusion of the variables may cause some issues, such as the multicollinearity between the independent variables and the endogeneity between dependent variables and certain independent variables. One must be careful when statistically modeling the relationship and interpreting the results. Also, a lot of modeling challenge is due to the limitation of available data. We have to choose the appropriate tools to match up with the data instead of theoretically devised a sound model before placing the data in. Nevertheless, the study results are still valuable for planners and policy makers to reduce auto dependence and promote walking and cycling.

**Discussion questions**

1. In the required reading "Measuring Network Connectivity for Bicycling and Walking" by Dill, which method of capturing "street connectivity" do you think is most explanatory? In different types of neighborhood, is it arguable that the appropriate types of measures would be different?

2. What are the pros and cons of using Walk Score as a proxy for walking accessibility?

3. What do you think are the important variables that may affect people's tendency to walk but are not easily measurable?
Required Readings

3. Walk Score Methodology

Other Readings