Cycling in Cities:
Using GIS to study how the built environment influences active transportation

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Abstract

While there is a body of evidence for a link between the built environment and physical activity patterns, there has been little research to date focused on specifically cycling for transportation. My study will use GIS to link spatial data with travel data collected in a recent Ridership Survey in the Greater Vancouver Region, to determine which objective measures of the built environment are associated with a higher likelihood of making a trip by bicycle. The project faces challenges in terms of identifying suitable buffering methods and deriving appropriate metrics to summarize urban form. The final outcomes of this work will inform on design features that are supportive for cycling.

Background and Relevance

There is growing interest in promoting active transportation, such as walking or cycling, to improve personal and environmental health (Ogilvie et al. 2004). The design of cities, or the "built environment", has an influence on transportation patterns and travel mode choice (Frumkin et al. 2004; TRB & IOM, 2005). Recent evidence suggests that regions with higher density, greater intersection connectivity, and higher land use mix are associated with higher levels of walking (Saelens et al. 2003; Frank et al. 2005). However, few studies have focused on cycling behaviors. This study aims to identify which measures of the built environment are associated with an increased likelihood of making a trip by bicycle. The project faces several methodological questions with regards to the spatial analysis approach.

Methods and Data

We conducted a population-based survey of 2,149 adult residents using telephone and self-administered questionnaires. The survey gathered trip mode and origin and destination data for over 4,000 trips (~2 trips per person), but for logistical reasons did not record the exact route traveled. This travel data will be linked to spatial datasets with GIS. Spatial data has been compiled from the Greater Vancouver Regional District, the BC Assessment Authority, TransLink (the regional transportation authority), the Border Air Quality Study, and the census to derive the following characteristics: elevation variability; intersection density; land use density; land use mix; street types; speed limits; road types; availability

of cyclist-activated signals; density of designated bike routes; connectivity of designated bike routes; air pollution levels; and population density. A variety of buffering methods are used to generate objective measures of the built environment which describe the region around the origin, the destination, and along the trip corridor. Potential buffering techniques include: (1) crow-fly buffers (with a radius of 3 km, representing easily bikeable distances) around each of the origin and the destination; (2) a distance-weighted buffer around a straight line between the origin and destination, resulting in an oval shaped buffer (both unweighted, and weighted more heavily along the crow-fly path); (3) a linear buffer (of 100m) along the shortest street network route between the origin and destination. The metrics derived by each buffering method are compared by examining their correlations (Pearson r) and their differences (paired t-test). Ultimately, a single buffering method to will be selected to generate summary measures of the built environment for analyses.

Results

Geo-coding of origin and destination locations was 98.1% successful and resulted in a total of 3,925 trips with valid points for both the origin and destination. Of these, 26.1% of trips were made by bicycle (1,027 of 3,925). Trip distances (point-to-point) ranged from 0.04 km to 165.0 km, with a median of 3.4 km. For bicycle trips only, distances ranged from 0.04 km to 67.6 km, with a median of 1.9 km. The next stage of work involves generating buffers and built environment measures.

Conclusions

The outputs of this spatial analysis are for use in statistical models, to determine if objective measures of the built environment correlate with cycling. These findings are valuable as they provide evidence for decision makers and urban planners on ways to design cities so that they support cycling. This in turn should increase cycling rates and improve public health through active transportation.

References

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