Estimated Intersection Density of Walkable Roads

This EnviroAtlas community map depicts one aspect of the built environment that can affect communities. The density of walkable intersections was determined by a distance-based kernel density calculation.

Why is intersection density important?

Intersection density is an objective method of assessing one aspect of a community's built environment. The density of walkable intersections relays information about street design and connectivity, both of which impact walkability. High intersection density may correspond to a more walkable and therefore health-promoting environment.

Street networks come in a variety of designs, which affect the number of intersections. In traditional grid designs, roads are connected at regular intervals leading to frequent intersections. Modern loop and cul-de-sac patterns have fewer road connections and therefore a lower density of intersections. Grid patterns offer the most direct routes to navigate an area and therefore have higher connectivity, while loops and cul-de-sacs may require travel on an arterial road to reach geographically close locations.

Though intersection density is just one facet of walkability, it is an important one. Scientific literature has consistently identified a positive association between intersection density and walking for transportation.[1] Not only is the link between intersection density and walking well established, but it is also easy to objectively measure with geographic information systems (GIS). Other factors that contribute to a walkable environment include availability of destinations, sidewalks, and environmental features.

Walking for recreation and transportation can be effective ways to meet physical activity guidelines.[2] High intersection density combined with other aspects of walkability characterize environments that promote a healthy and active lifestyle. Conversely, a lack of safe routes or destinations may restrict opportunities for the recommended amount of physical activity.

How can I use this information?

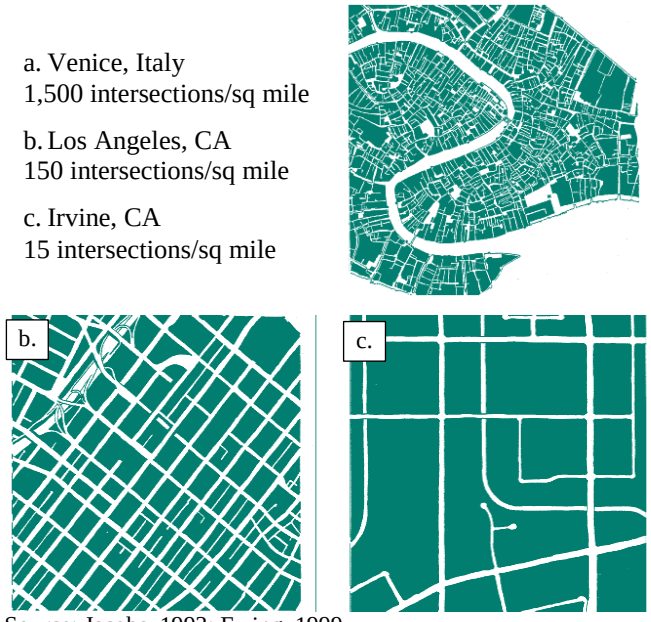
The map, Estimated Intersection Density of Walkable Roads, estimates the intersection density of walkable roads across communities with a distance-based kernel density calculation. Each 10-meter pixel represents the weighted sum of the surrounding intersections.

Street Maps at the Same Scale[3]

a. Venice, Italy
1,500 intersections/sq mile

b. Los Angeles, CA
150 intersections/sq mile

c. Irvine, CA
15 intersections/sq mile



Source: Jacobs, 1993; Ewing, 1999

This map can be used to assist community or neighborhood walkability analyses. Intersection density can be overlaid with green space or tree cover along walkable roads layers to assess areas that may be more or less favorable for walking. Demographic layers can be overlaid to assess disproportionate access to walkable areas.

How were the data for this map created?

This data layer is based on the NAVTEQ mapping database road centerlines and attributes. Roads with a speed limit greater than 54 miles per hour or less than 8 miles per hour were excluded. Additional roads, such as airport, cemetery, and parking lot roads, were manually removed. Roads separated by a median or divider were collapsed from two road centerlines into one. One point was created for each intersection and the ArcGIS kernel density function was used to generate a raster of intersection density within a 750 meter search radius around each 10-meter pixel. In the distance-based kernel density calculation, closer intersections are weighted higher than intersections further from the center pixel; intersections beyond the search radius are not counted (Figure 1).

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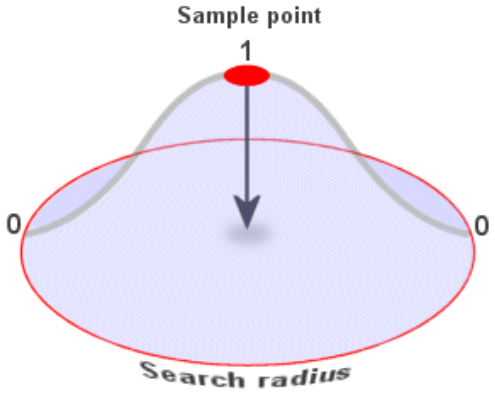

Figure 1. Illustration of kernel density calculation.[4]

What are the limitations of these data?

These data rely on the accuracy of NAVTEQ data. Additionally, a general definition was used to screen for walkable roads (speed limit >8 and <55 miles per hour). However, it is possible that not all of the included roads have conducive or safe walkways. Actual walkability is a factor of many aspects of the environment such as sidewalks, connectivity, and land use.

In the intersection density calculation, a high density of intersections is assumed to indicate that many roads are connected, indicating high accessibility to destinations. However, in some road configurations this may not be true. For example, loop and cul-de-sac intersections do not improve connectivity, though they do contribute to intersection density.

How can I access these data?

EnviroAtlas data can be viewed in the interactive map, accessed through web services, or downloaded.

Where can I get more information?

Numerous resources are available on the relationship between intersection density and physical activity; a small selection of these is below. In-depth information on the relationships between urban ecosystems, such as green space and human health and well-being, can be found in EPA's Eco-Health Relationship Browser. For additional information on the data creation process, access the metadata for the data layer from the drop down menu on the interactive map table of contents and click again on metadata at the bottom of the metadata summary page for more details. To ask specific questions about these data, contact the EnviroAtlas Team.

Acknowledgments

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Selected Publications

1. Ewing, R., and R. Cervero. 2010. Travel and the built environment. *Journal of the American Planning Association*. 76(3):265–294.

2. Centers for Disease Control and Prevention. 2012. Walking: More people walk to better health. Accessed August 2016.

3. Jacobs, A.B. 1993. *Great Streets*, MIT Press, Cambridge, MA, pp. 221, 225, and 249. Reprinted in Ewing, R. 1999. Pedestrian and transit-friendly design: A primer for Smart Growth. Smart Growth Network, U.S. Environmental Protection Agency, Urban and Economic Development Division, Washington, D.C.

4. Albrecht, J. 2005. Kernel density calculations. Hunter College Geographic Information Science Course, Lecture 11.