



A Visual Exploration of Walkability in Washington, D.C.

Corrina Calanoc, Cynthia Ng, Katherine Mead, Madelyne Ventura, Valeria Vera Lagos
Georgetown University, Data Science & Analytics

Introduction

Walkability is the ease with which people can access amenities in a place without the use of cars. It is associated with positive outcomes in health, community, sustainability, and the economy. A report by the Institute for Transportation and Development Policy evaluated the walkability of major global cities and the only city to make the top 25 in any category was Washington, D.C.² As our graduate program has brought us together from around the world to Washington, D.C., our goal is to explore the impacts of the city's walkability on the well-being of its residents.

Research Questions:

1. How is walkability associated with socioeconomic and health outcomes?
2. How accessible are neighborhoods by bike?
3. What is public sentiment around walkability and driving?

Data & Methodologies



U.S. Environmental Protection Agency Walkability: A GeoPandas dataframe was created from a GeoJSON file of D.C. and joined with the Walkability Index and Community Resilience data using Census Tract IDs. All outcome columns were rescaled to 0-100 to ensure consistent scales for visualizations.

PLACES Census: The PLACES Census dataset was filtered to only include D.C. data. The columns were also renamed for more interpretability.

Bikeshare & Bike Lane Analysis: In the Capital Bikeshare dataset, the latitude and longitude values were standardized for each bike station and stations outside of the D.C. boundary were removed. Rows with incomplete trip values were removed as well. A map of the bike lanes in the city was brought in by a GeoJSON file.

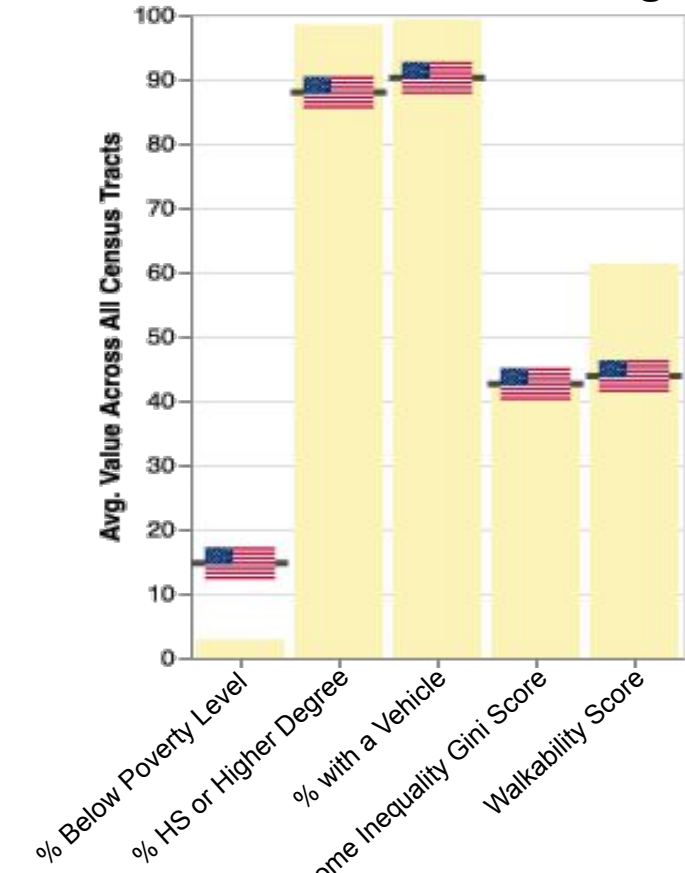
Reddit Sentiment Analysis: In this analysis, the text was preprocessed using the NLTK library to fine-tune a BERT sentiment analyzer and obtain sentiment scores. These scores were then analyzed by topic (Car, Walk, Bike).

Conclusions

1. Walkability is greater in downtown than on the suburban areas. Among the suburbs, the top edges have higher car ownership and socioeconomic outcomes than the low edges.
2. Low walkability is generally associated with poorer health outcomes.
3. More bike stations and bike lanes connect suburb-downtown routes than suburb-suburb routes, making it more expensive and unsafe to travel between lower-income suburbs.
4. People comment on walkability more favorably than biking or driving. Negative opinions commonly mention traveling by car to suburban areas of Washington, D.C., and positive ones mention traveling by foot or bicycle to tourist attractions.

Although walkability has come a long way in Washington, D.C., it is not distributed equitably throughout the district, and those who are low-income and without a vehicle (particularly in Wards 7 and 8) suffer the most. Further research could be conducted to understand the causal and correlative relationships between socioeconomic, health, and walkability factors to aid policy suggestions.

Barnaby Woods (Ward 4) - D.C.'s 9th Least Walkable Neighborhood



Socioeconomic Outcome Bellevue (Ward 8) - D.C.'s 5th Least Walkable Neighborhood

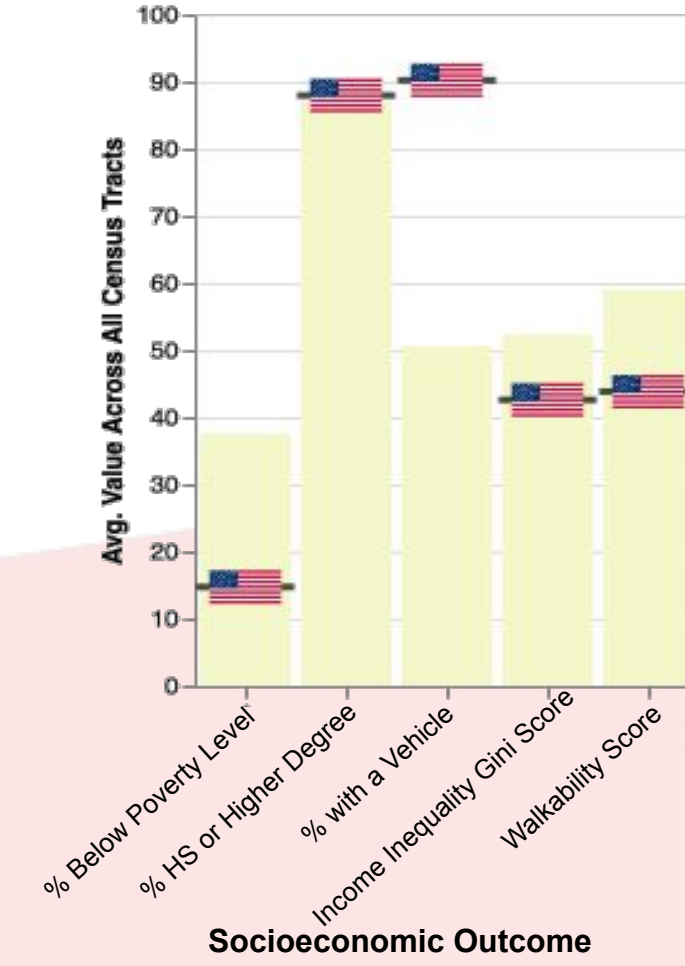
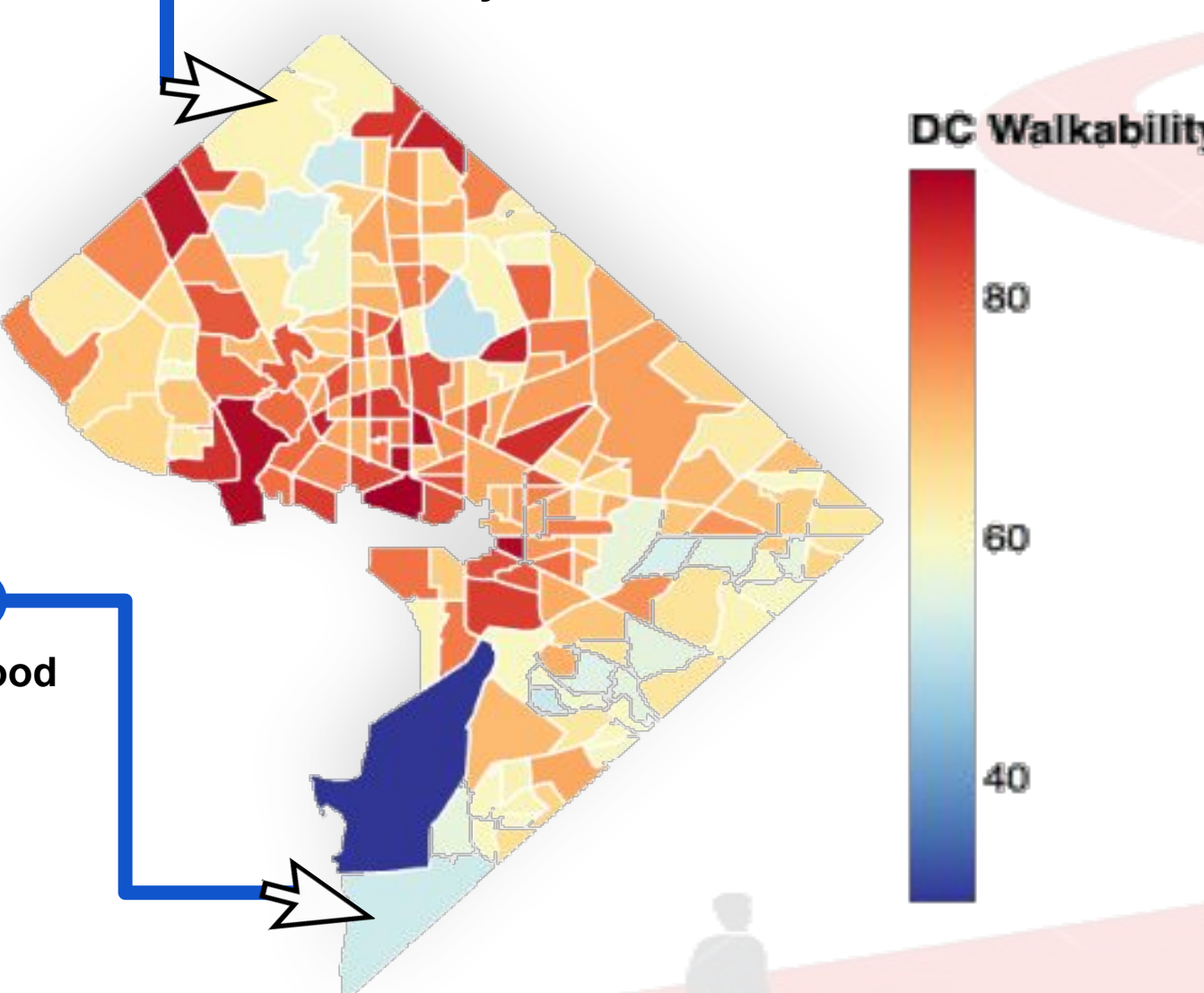


Figure 1. An Altair choropleth of walkability scores across all 179 D.C. Census Tracts. Clicking on a neighborhood renders a bar graph with socioeconomic outcomes for that neighborhood, with the color of the bars being the walkability score of that neighborhood. American flags on each bar represent the national average for each outcome.

Walkability of D.C. Census Tracts



The map shows that walkability is concentrated around downtown and decreases on the outskirts. Although most edges of the city have lower walkability, Northwest D.C. (wards 3 & 4) has higher vehicle ownership, lower poverty, and higher high school attainment rates compared to Southeast D.C. (wards 7 & 8). This suggests that car ownership is key to economic success in neighborhoods with low walkability.

Sentiment Polarity of Reddit Posts by Category

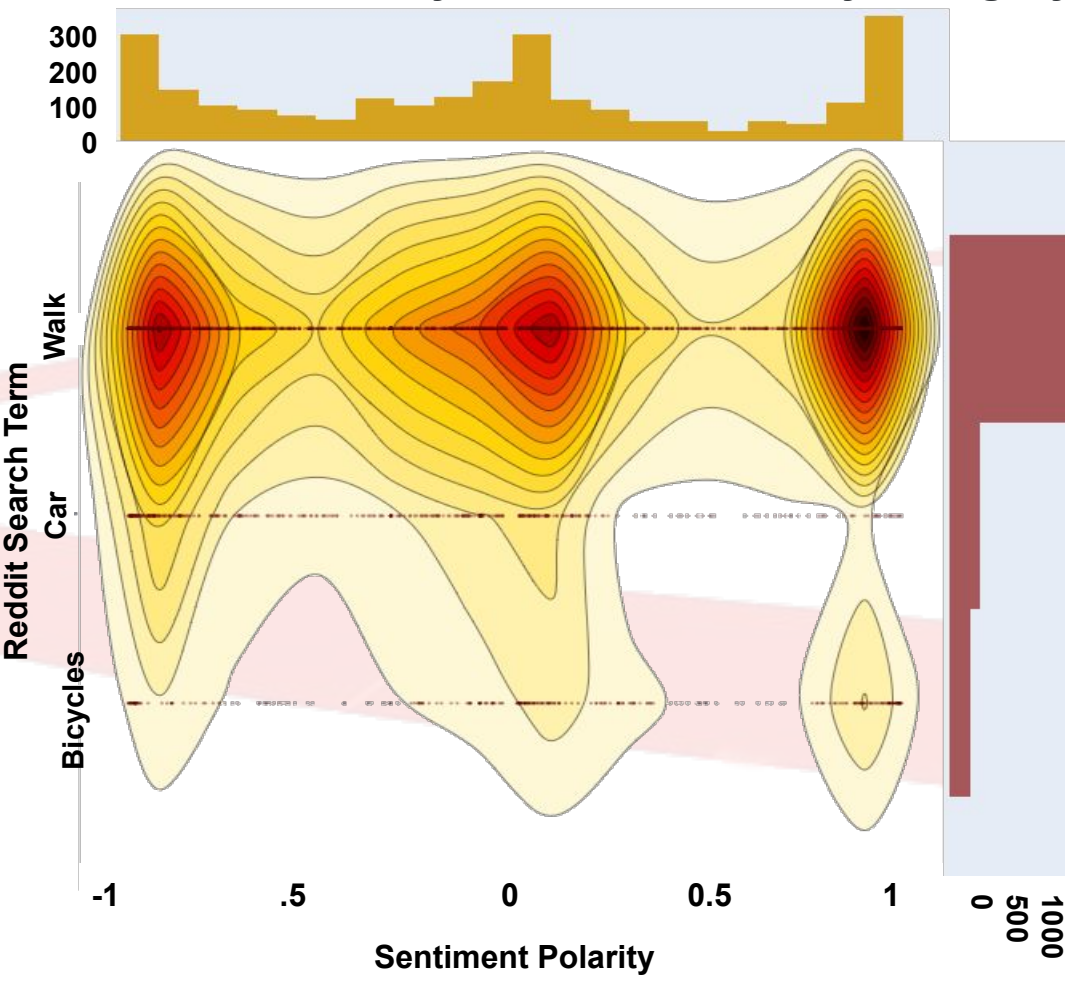


Figure 2. A Plotly density map of Sentiment polarity and histograms of posts per Category.

The density on positive opinions for Car is lower, while Walk has the most (382). The right histogram shows Bike receives fewer opinions than the rest but more positive ones than Car.

A bigrams analysis supports the density plot insights where car opinions mention suburbs together (Maryland and Virginia), bicycles bigrams focus on avenues and intersections, and walk mentions parks, museums, and monuments with positive adjectives. Cars have negative bigrams like "pedestrian death", "rush hour" and "traffic camera" and Walk has negative bigrams such as "better infrastructure".

Walkability & Health Outcomes

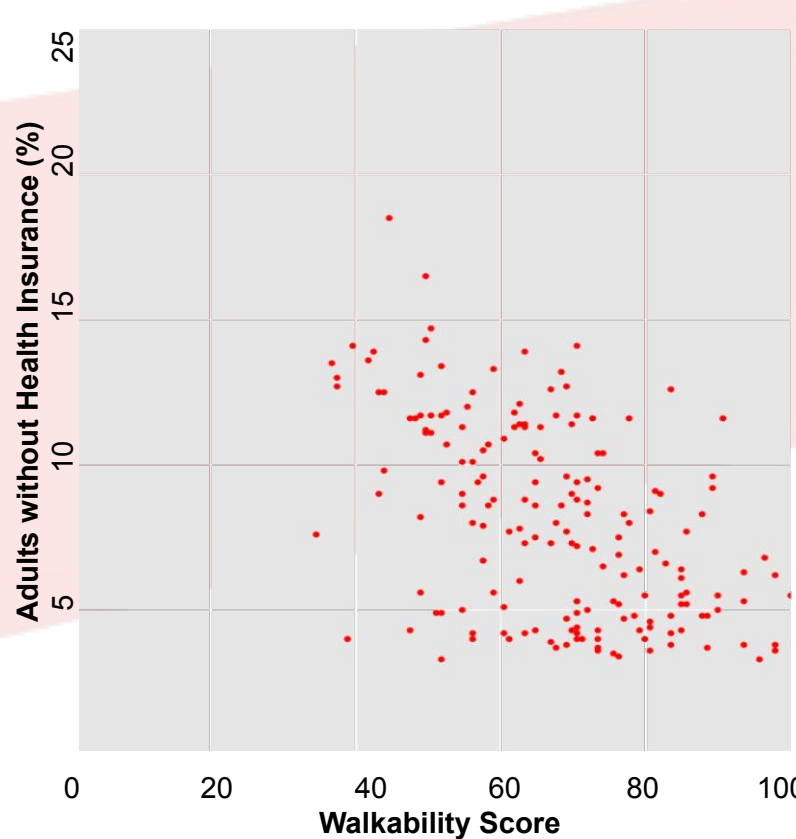


Figure 3. Interactive Plotly scatter plots examining the relationship between walkability and various health outcomes were completed. The data were taken from the PLACES small area health estimates initiative by the Centers for Disease Control and Prevention (CDC).

The figure shows one possible selection: a scatterplot of the percent of adults in a DC neighborhood without health insurance vs. the walkability score of the neighborhood. A modest negative association can be seen in the plot. In the interactive version, over 20 different health outcomes can be explored by toggling the y-axis drop-down menu.

Map of D.C. Bike Lanes, Capital Bikeshare Stations, & Routes in March 2023

Legend
● Bike Station
● Bike Lane

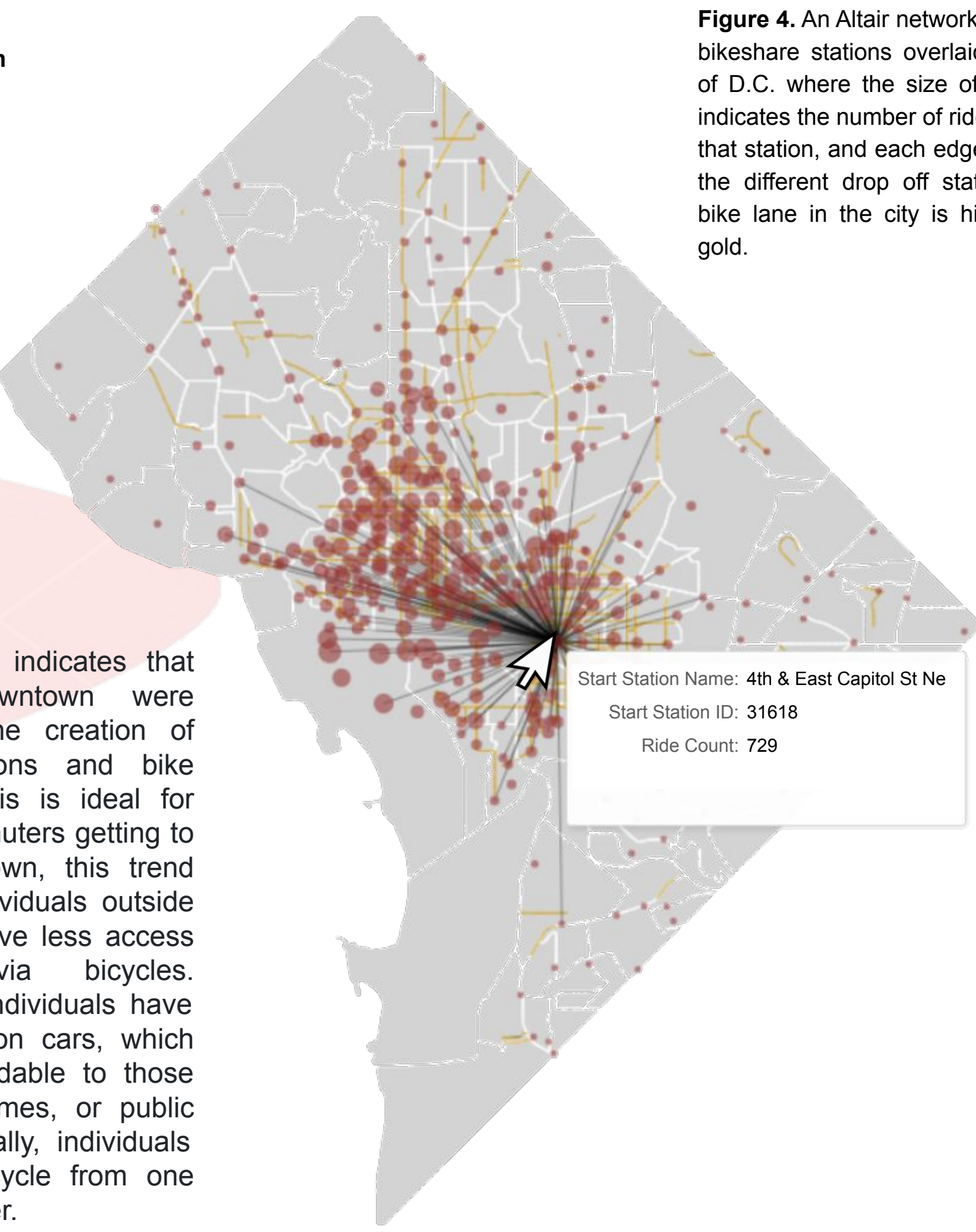


Figure 4. An Altair network graph of all bikeshare stations overlaid on a map of D.C. where the size of each node indicates the number of rides started at that station, and each edge represents the different drop off stations. Every bike lane in the city is highlighted in gold.

Our visual plot indicates that routes to downtown were prioritized in the creation of bikeshare stations and bike lanes. While this is ideal for tourists or commuters getting to work in downtown, this trend implies that individuals outside of downtown have less access to transit via bicycles. Consequently, individuals have to rely mostly on cars, which may be unaffordable to those with lower incomes, or public transit. Additionally, individuals cannot safely cycle from one suburb to another.

References

¹Edward L. Glaeser, Matthew E. Kahn, Chapter 56 - Sprawl and Urban Growth, Editor(s): J. Vernon Henderson, Jacques-François Thisse, *Handbook of Regional and Urban Economics*, Elsevier, Volume 4, 2004, Pages 2481-2527, ISSN 1574-0080, ISBN 9780444509673, [https://doi.org/10.1016/S1574-0080\(04\)80013-0](https://doi.org/10.1016/S1574-0080(04)80013-0).
²"Report: U.S. Cities Lag behind Global Peers in Walkability." US News, 16 Oct. 2020, <https://www.usnews.com/news/cities/articles/2020-10-16/us-cities-trail-behind-global-peers-in-walkability-report-finds>.