Bike-Sharing & the Built Environment

UT Austin School of Architecture's Urban Information Lab (UIL)

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Spring 2018

April 26, 2018

Big Picture: How does the built environment relate to bikeshare activity?

Vs.

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- **Bicycle Safety** – cycling infrastructure & high comfort roadways
- **Aesthetics** – Parks/open space & tree canopy
- **Community Character** – density, average structure age, median rent, & median home value
- **Active Transport Connectivity** – sidewalks, bus stops, rail stations, & transit trip frequency

Past Research Efforts in this Area of Study:

- Noland, Smart, and Guo. 2016. "Bikeshare Trip Generation in **New York** City." *Transportation Research Part A*.
  - **Positive correlation** with Bikeshare utilization near **subway stations** and **bike infrastructure**
- Wang, X., Lindsey, G., Schoner, J., and Harrison, A. (2016) "Modeling Bike Share Station Activity: Effects of Nearby Businesses and Jobs on Trips to and from Stations". *Journal of Urban Planning and Development,* 142(1).
  - In Minneapolis, stations associated with neighborhood **sociodemographics**, **proximity to CBD** + water
- [under review] Alcorn, Louis & Jiao, Junfeng. 2018. "Bike Sharing Station Usage and the Surrounding Built Environments in Major Texas Cities". *Journal of Planning Education and Research*.
  - Limited significance of predictive models except for **high comfort bike facilities in Austin**
- Ma, T., C. Liu, and S. Erdoğan. 2015. "Bicycle Sharing and Transit: Does Capital Bikeshare Affect Metrorail Ridership in Washington, D.C.?" *Compendium of TRB 94th Annual Meeting*: 1-21.
  - People **replacing short-distance bus trips with bikeshare** but still riding metro for longer trips

Focus on the Largest 4 US Systems

- New York Citibike
- Chicago Divvy
- Washington D.C. Capital Bikeshare
- Boston Hubway

City	Start Date	End Date	Stations	Avg. Daily Station Use	Maximum	Minimum
New York	Jul-13	Oct-17	832	102	575	1
Chicago	Jun-13	Jul-17	631	38	485	1
Wash. D.C.	Sep-10	Apr-17	512	51	319	1
Boston	Jul-11	Oct-17	212	21	86	1

Dependent Variable

Average daily bikeshare station usage

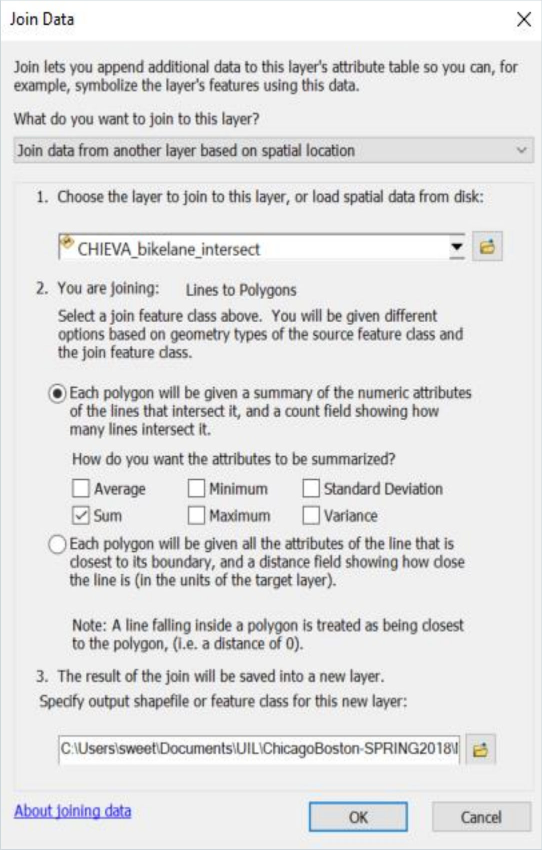
$$= \frac{(\#\ \text{check outs} + \#\ \text{check ins})}{(\#\ \text{of days station is open})}$$

Independent Variables

- High Comfort Roadways (People For Bikes dataset)
- Bike Network - Any Treatment above “sharrows” (City/County GIS portals)
- Open Space/Park Area (City/County GIS portals)
- Sidewalk Area (City/County GIS portals)
- Trees/Tree Canopy (City/County GIS portals)
- Population Density, Housing Unit Density, Median Gross Rent, Median Home Value, Median Structure Age (2016 ACS 5-yr. est.)
- # of Bus/Rail Stops within ¼ mile of bikeshare stations & # of unique daily transit trips available (Historic GTFS feeds)

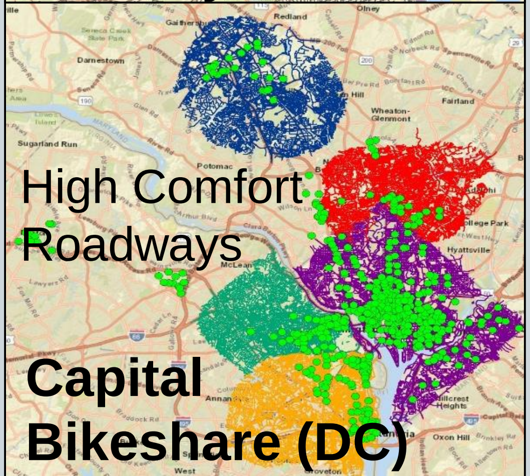
Methodology

- Built environment inventory within ¼ mile of bikeshare station:
  - Generate ¼ mile airline buffer around station areas
  - Intersect independent variable data with these ¼ mile access-sheds
  - Spatially join dependent variable count/area/length data with each station location buffer
  - Bivariate correlations with Pearson’s R
  - Forward Stepwise Regression to account for covariance of dependent variables.



Limitations of Data

- Weaving together multiple datasets
  - Boston = Boston + Cambridge + Brookline + Somerville
  - Chicago = Evanston + Chicago
  - NYC = NYC + Jersey City (NJ)
  - Washington D.C. = DC + Alexandria (VA) + Arlington (VA) + Bethesda (MD) + Rockville (MD) + Fairfax County (VA) + Montgomery County (MD), and more!



Preliminary Results: Chicago

R	*R-Squared*	***Adjusted R-Squared***	*N*
0.7681	0.5900	**0.5839**	609
VAR	*Coefficient*	*p-value > t*	*TOL*
GrossRent	0.0342	5.7086E-9	0.2348
HouDens	0.5171	3.4071E-9	0.4789
OpenSpaceContinuousAccessSqMeters	5.7387E-6	0.0001	0.4015
BikeLaneIntersectMeters	0.0021	1.9045E-9	0.3546
SidewalkAreaSqMeters	-6.4038E-5	0.0031	0.4214
PCB_HC_Meters	-0.0018	0.0314	0.7208
OpenSpaceIntersectSqMeters	2.4046E-5	0.0034	0.4763
REValue	3.4652E-5	0.0122	0.3471
TreeCanopySqMeters	-3.3078E-5	0.0141	0.6626
Intercept	-30.0444		

Preliminary Results: Boston

R	*R-Squared*	***Adjusted R-Squared***	*N*
0.6668	0.4446	**0.4243**	171
VAR	*Coefficient*	*p-value > t*	*TOL*
REValue	2.5446E-5	0.0002	0.5002
DistRail_meter	-0.0088	0.0024	0.6172
HCBikeLength	0.0004	0.0345	0.7128
GrossRent	0.0080	0.0031	0.6001
PopDens	0.1062	0.0582	0.5721
RailStop	-1.2046	0.0875	0.6209
Intercept	-12.9255		

Preliminary Results: NYC

R	*R-Squared*	***Adjusted R-Squared***	*N*
0.6974	0.4863	**0.4802**	765
VAR	*Coefficient*	*p-value > t*	*TOL*
GrossRent	0.0347	9.3283E-5	0.3605
Bikelane_Length_M	0.0024	1.2693E-6	0.3648
HouDens	1.6148	2.7720E-11	0.0876
TreeCount	-0.1181	0.0000	0.7588
DistRail_meter	-0.0426	0.0002	0.8366
OpenSpaceArea	-3.0130E-5	0.0045	0.9544
PFB_HC_Length	0.0007	0.0022	0.3686
PopDens	-0.4346	0.0061	0.0891
REValue	3.7006E-5	0.0105	0.6812
Intercept	-3.5885		

Trends

- Always Positive Coefficients:
  - Median Gross Rent (3)
  - Median Home Value (3)
  - Bike Lane Length (2)
- Always Negative Coefficients:
  - Trees/Tree Canopy Area (2)
  - Distance to Rail Stops (2)
- Mixed Results:
  - High Comfort Cycling Roadways (3)
  - Population Density (2)
  - Open Space (2)
- Limited Significance:
  - Sidewalk area (1)
  - Median Structure Age (0)
  - Frequency of transit trips available within ¼ mile of bikeshare station (0)
  - Proximity to Bus Stops (0)

Work Ahead

- Add Transit-related independent variables to NYC model
- Create Model for Washington D.C.
- Combine all four models to make a fifth 4-city model (pending data continuity)
- Submit to present at TRB

Questions?

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