Measuring the significance of facility availability and policy on bicycle commuting in the 50 most populous U.S. cities

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VIRGINIA TECH

INTRODUCTION

Broad Goal: To provide city planners and transportation coordinators with quantitative evidence on infrastructure and policy measures that positively impact the number of bicycle commuters.

Over the past twenty years, a series of regression models have helped predict bicycle commuting levels across U.S. cities. Variables previously included were:

- bike lane supply[2,3]
- bike path supply[1,2,3]
- bike network (i.e. density, directness)[4]
- number and type of workers[2,4]
- vehicle ownership[2,3,4]
- household income[2,4]
- number of children[2,4]
- college student population[1,2,3,4]
- sprawl index[3]
- transit miles of service[2,3]
- annual precipitation[1,2,3]
- average temperature[1,3]
- gasoline prices[2,3]
- active transport budget[2]
- bicyclist fatalities[3]

Research Gap: Variables representative of bicycle-related policy are underexplored in aggregate models of bicycle commuting in the U.S.

Research Objective: To include measures of policy in a regression of bicycle commuting.

*Note: Variables in red were significant predictors in prior models.

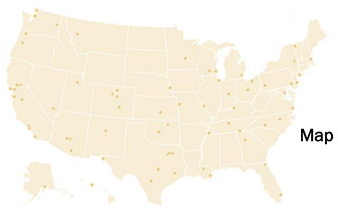
METHODS

Study Approach: Associations between bicycle commuting, infrastructure, and policy.

Study Type: Ecologic study at the city level

Methods: Multiple linear regression models with log-log transforms and mediation testing by causal steps and the Sobel Test

Data Sample: The 50 most populous U.S. cities



Map of the 50 cities in the Data Sample

QUESTIONS & RESULTS

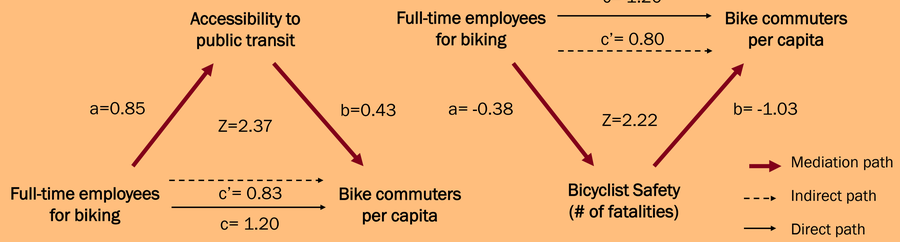
1 Which infrastructure and policy variables have the most significant association with bicycle commuting?

2 How much of the variation in bicycle commuting is associated with these variables?

Variable Name	Infrastructure Model	Policy Model	Infrastructure and Policy	Infrastructure and Controls	Policy and Controls	Complete Model	Stepwise Model
Bike lane supply	0.27*		0.08	0.09		-0.08	
Bike path supply	-0.06		-0.21	-0.20		-0.22	-0.31*
Streets for cyclists	-0.09		-0.03	-0.28*		-0.21	-0.16
Access to public transit	0.55**		0.40**	0.31**		0.16	0.18*
Bike lane quality	0.08		0.03	0.04		-0.00	
Complete streets policy score		-0.20	-0.22		-0.18	-0.24	
Employees for biking		1.03**	0.69*		0.89**	0.70**	0.70**
Community bike programs		1.10	1.03		0.22	0.24	
Bike infrastructure budget		0.47	0.17		0.34	0.21	
Sprawl index				-0.06	0.34	0.07	
Annual precipitation				0.13	0.03	-0.06	
Vehicle ownership				1.92	-4.18	-0.11	
College student population				0.85	0.85	0.53	
Bicyclist safety				-1.07**	-0.78**	-0.99**	-1.01**
Adjusted R^2	0.41	0.35	0.52	0.66	0.68	0.73	0.76

* or **; coefficient significance at the p<0.05 or p<0.01

3 Are policies associated with bicycle commuting mediated by bicycle infrastructure?



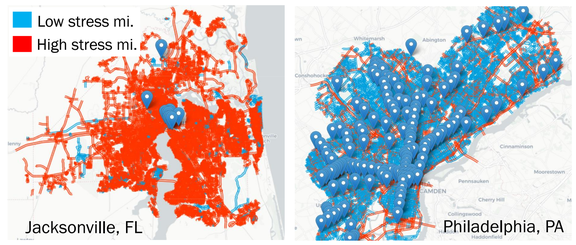
Data Type	Variable and Measurement	Data Source
Bike Commuting	• **Bike commuters per capita** (# of bike commuters per 10K population)	ACS 2013-2017 average
Infrastructure	• **Bike lane supply** (mi. of bicycle lanes per 100K population) • **Bike path supply** (mi. of multi-use paths per 100K population) • **Bike lane quality** (% of bike lanes that are buffered or protected) • **Streets for cyclists** (low stress mi. per 100K population) • **Bike network density** (mi. of low stress network per city area) • **Accessibility to public transit** (score of major transit hubs accessible on the low stress bike network)	Benchmarking Report (LAB, 2019) People for Bikes Bicycle Network Analysis
Policy	• **Complete streets policy scores** (ten ranking categories: vision and intent, diverse users, commitment, design, land use and context sensitivity, project selection criteria, jurisdiction, exceptions, performance measures, and implementation steps) • **Employees for biking** (# of full-time employees working on bike or ped. issues per 100K population) • **Community bike programs** (# of LAB member organizations per 100K population) • **Bike infrastructure budget** (Percent of transportation spending on bicycle-only projects, state level)	Best Complete Streets Initiatives (SGA, 2017) Benchmarking Report (LAB, 2019) Lifting the Veil on Bicycle and Pedestrian Spending (LAB, 2014)
Controls	• **Bicyclist safety** (average number of bicyclist fatalities per 10K bicycle commuters, state level) • **Sprawl index** (regional index combining 22 variables measuring residential density, mix of land uses, strength of downtowns, and connectivity of street network, higher scores = less sprawl) • **Annual precipitation** (average annual number of rainfall days with 0.01 inches or more) • **Vehicle ownership** (average number of vehicles per household) • **College student population** (% of population enrolled in college)	NHTS 2015-2017 average Ewing and Hamidi, 2014 NCDC 1981-2010 average ACS 2013-2017 average

ACS= American Community Survey; LAB= League of American Bicyclists; SGA= Smart Growth America; NHTS= National Highway Traffic Safety Administration; NCDC= National Climatic Data Center; all population and city area estimates are from ACS 2013-2017

CONCLUSIONS

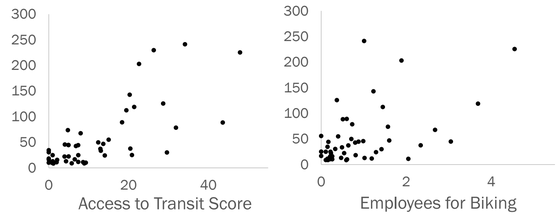
Takeaway 1: Improving linkages to public transit hubs on the bicycle network may encourage more commuters to use a bike.

Maps of the Bicycle Network and Access to Transit[5]



- RQ1: Accessibility to public transit and number of employees working on bike issues have the most significant associations with bicycle commuting.

Associations between Variables of Significance and Bike Commuting



- RQ2: Up to 76% of the variation in bicycle commuting across 50 U.S. cities can be accounted for by the variables in our study.

- RQ3: The number of full-time employees working on bike issues increases accessibility to transit and decreases bicycle fatalities which are both associated with an increase in bike commuters.

Takeaway 2: Hiring full-time staff to work on bike and pedestrian issues is vital for the protection of cyclists' safety and can help improve the bike network.

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[3] Buehler, R., & Pucher, J. (2012a). Cycling to Work in 90 Large American Cities: New Evidence on the Role of Bike Paths and Lanes. *Transportation*, 39(2), 409–432.

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[5] People for Bikes. (2019). Bicycle Network Analysis. Retrieved from: https://bna.peopleforbikes.org/#/