

Portland State University

**PDXScholar**

---

PSU Transportation Seminars

Transportation Research and Education Center  
(TREC)

---

4-1-2016

# Rerouting Mode Choice Models: How Including Realistic Route Options Can Help Us Understand Decisions to Walk or Bike

Joseph Broach

Portland State University, [jbroach@pdx.edu](mailto:jbroach@pdx.edu)

Follow this and additional works at: [https://pdxscholar.library.pdx.edu/trec\\_seminar](https://pdxscholar.library.pdx.edu/trec_seminar)



Part of the [Transportation Commons](#), [Urban Studies Commons](#), and the [Urban Studies and Planning Commons](#)

**Let us know how access to this document benefits you.**

---

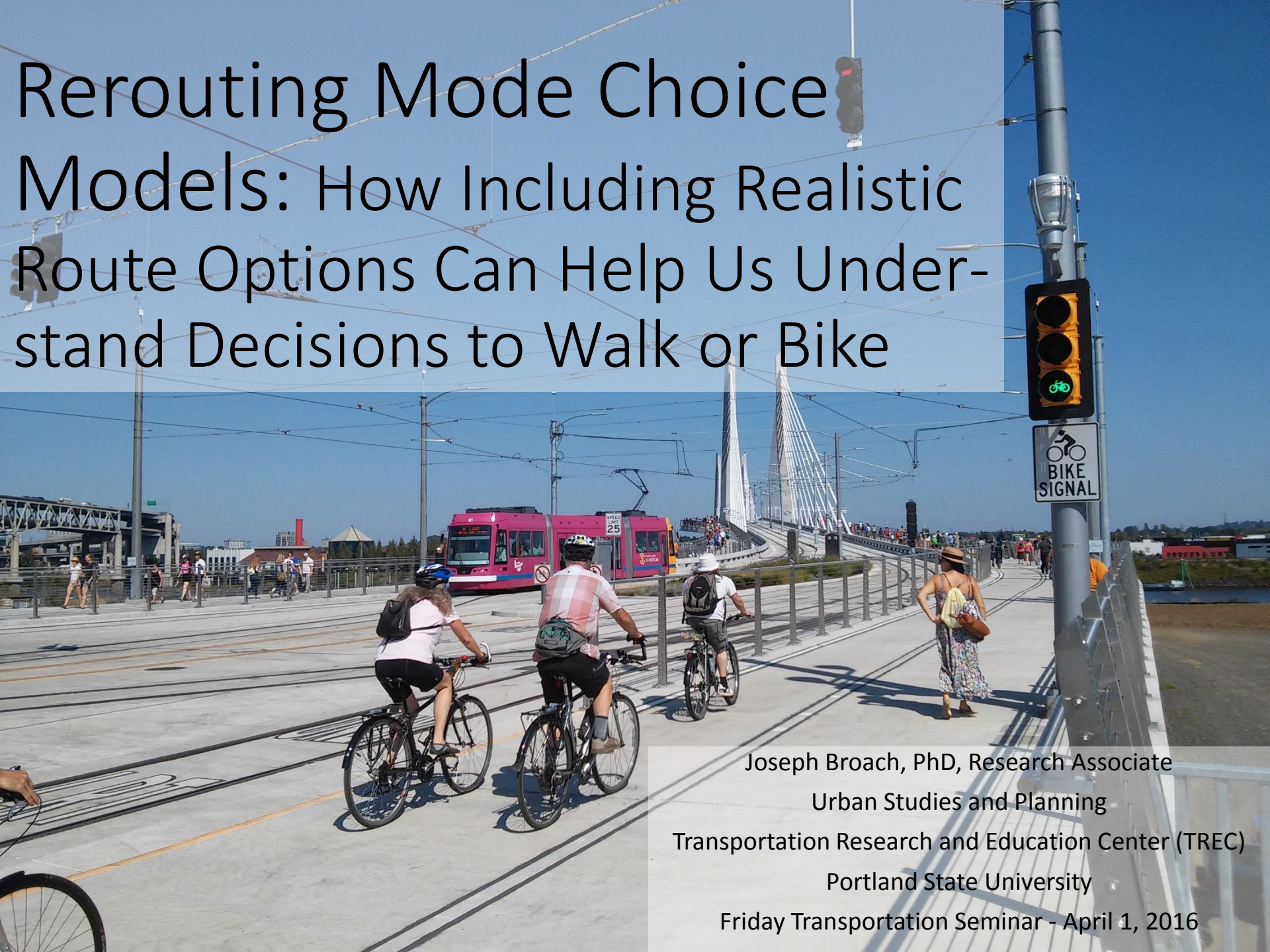
## Recommended Citation

Broach, Joseph, "Rerouting Mode Choice Models: How Including Realistic Route Options Can Help Us Understand Decisions to Walk or Bike" (2016). *PSU Transportation Seminars*. 37.

[https://pdxscholar.library.pdx.edu/trec\\_seminar/37](https://pdxscholar.library.pdx.edu/trec_seminar/37)

This Book is brought to you for free and open access. It has been accepted for inclusion in PSU Transportation Seminars by an authorized administrator of PDXScholar. Please contact us if we can make this document more accessible: [pdxscholar@pdx.edu](mailto:pdxscholar@pdx.edu).

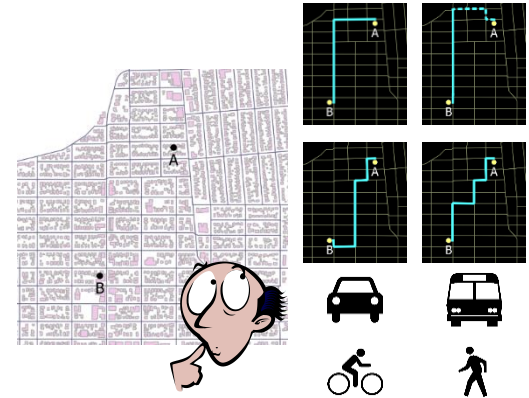
# Rerouting Mode Choice Models: How Including Realistic Route Options Can Help Us Under- stand Decisions to Walk or Bike



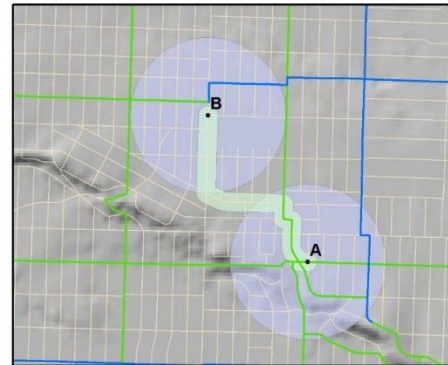
Joseph Broach, PhD, Research Associate  
Urban Studies and Planning  
Transportation Research and Education Center (TREC)  
Portland State University  
Friday Transportation Seminar - April 1, 2016

# Motivation

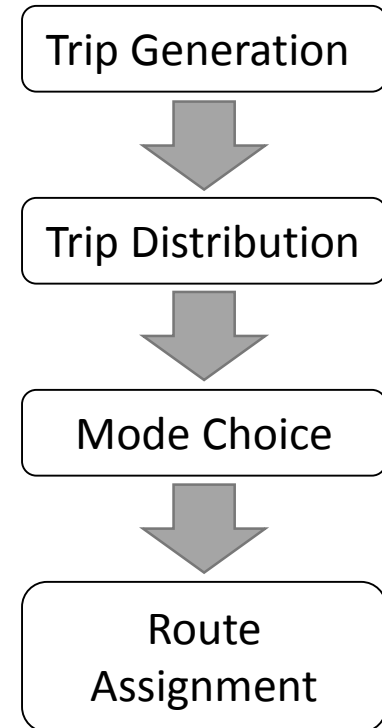
1. Understand behavior



2. Inform policy



3. Improve prediction





# The story so far

Revealed Preference  
Bike Route Choice  
Bike GPS Study

Transferability of  
Bike Route Choice  
Preferences



2010-2013

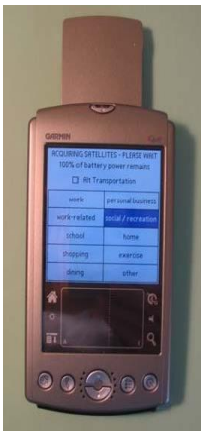
2015-2016

2007-2012

2014

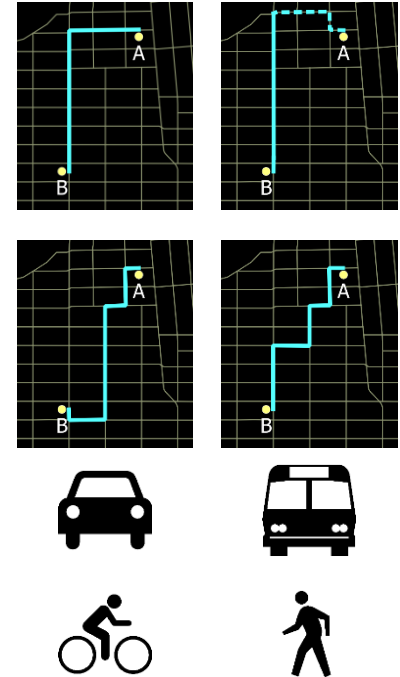
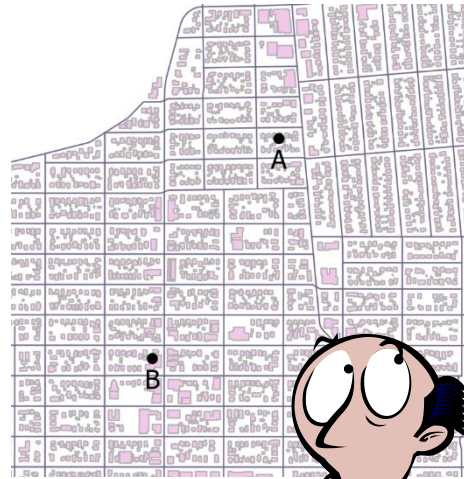
Revealed Preference  
Walk Route Choice  
Family Activity Study

Revealed Preference  
Mode Choice

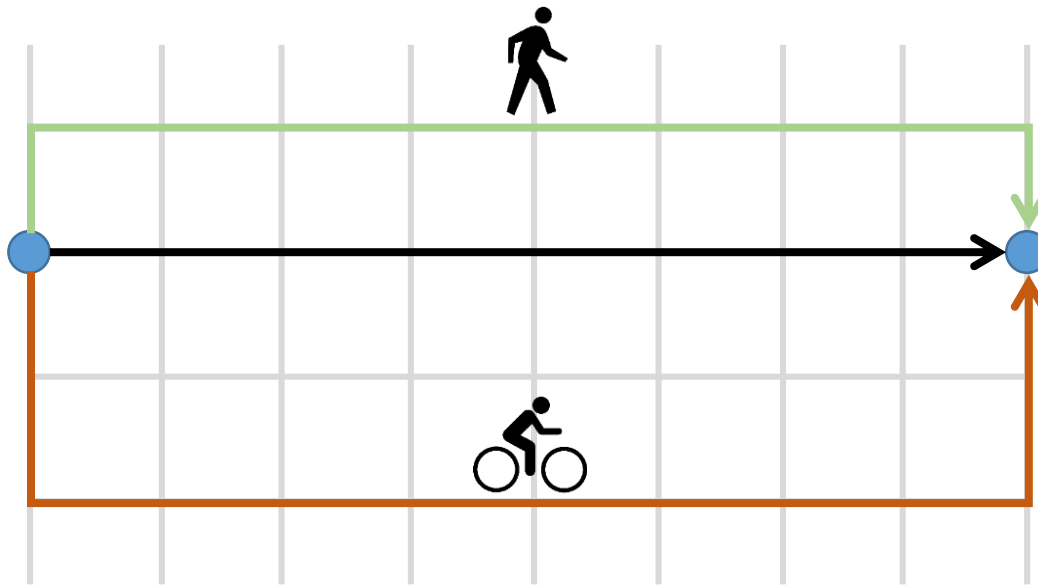
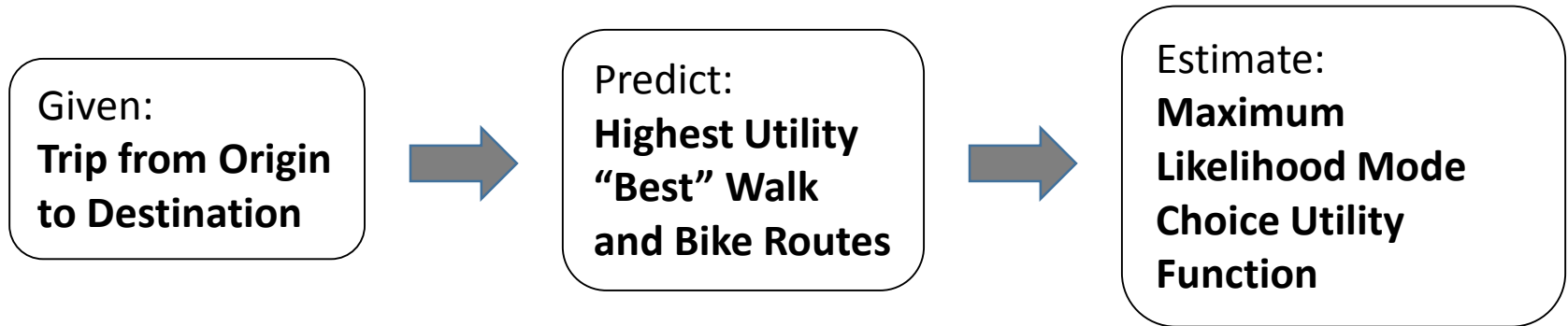


# The conceit

1. Given trip from A to B
2. Routes that *would* be taken are considered for each mode
3. Attributes along those routes affect mode choice



# The plot

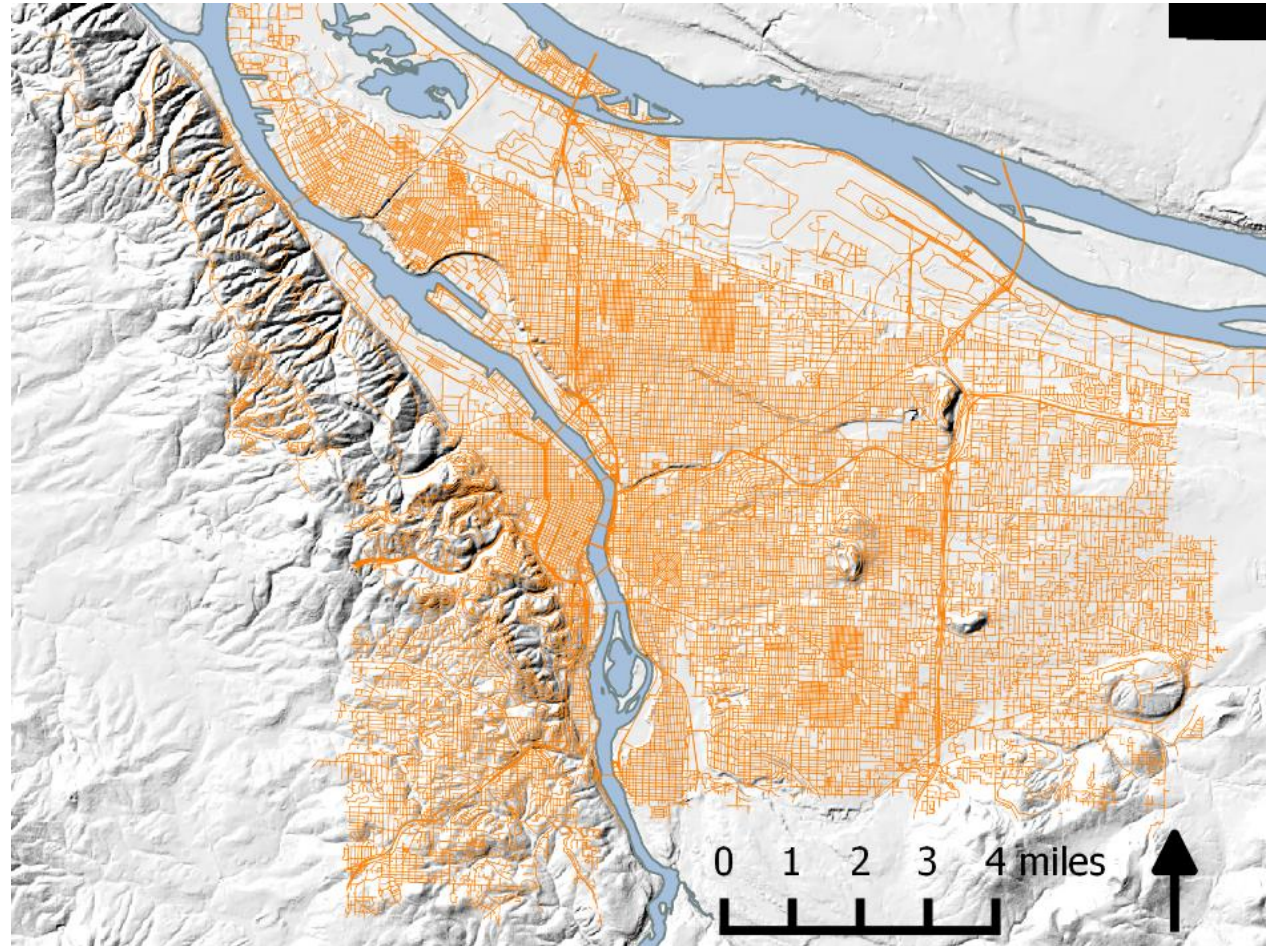


# The setting

Only trips starting and ending within the City of Portland

Rich GIS data from Metro & City

- walk/bike network
- facilities
- land-use
- terrain



# The characters (1)

## Adult participants in the Family Activity Study (2010-2013)

### How does your family get around?

*We would like to know!*

#### Family Activity Study

##### For Additional Information

Website: [fastudy.cts.pdx.edu](http://fastudy.cts.pdx.edu)

Phone: 503-725-4024

Email: [FamilyActivityStudy@pdx.edu](mailto:FamilyActivityStudy@pdx.edu)



Dear Portland Resident,

We need your help on an important study that is trying to better understand how, why, and where families with children walk and bicycle and how physically active they are. The results of the study will help Portland and other cities create better neighborhoods.

We are asking families in a handful of neighborhoods, including yours, to participate. For the study to succeed, we need all types of families to participate, *even if you do not bicycle or walk very often*. Participating families will complete a survey and collect data for five days, once this year and once next year. More information about the study is on the other side of this flyer and at the website listed on the left.

If you want to participate or have questions, please call 503-725-4024, email [FamilyActivityStudy@pdx.edu](mailto:FamilyActivityStudy@pdx.edu), or complete the card below and mail it back (postage is pre-paid). We will then contact you to set up a time to answer any questions and get you started.




Compared with block group and typical Portland household with children...

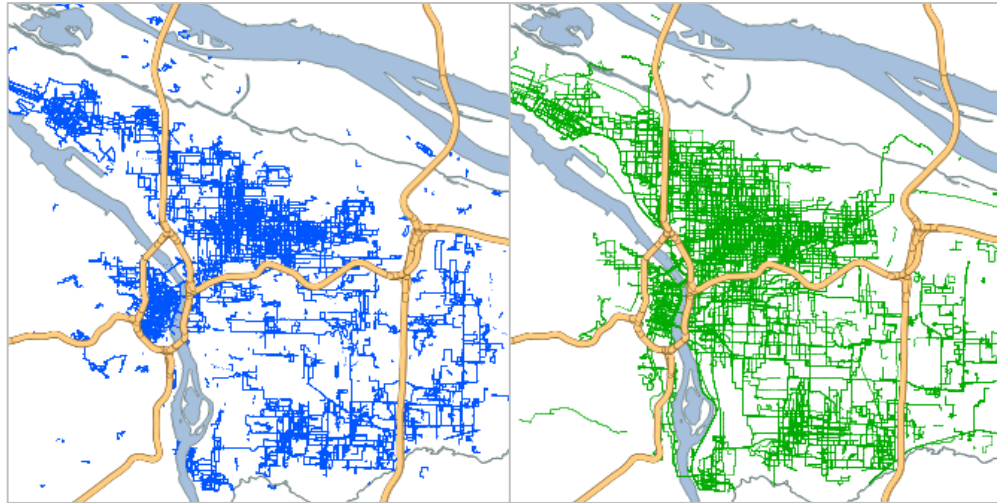
- more educated 60% college
- less diverse 85% white
- more women 62% female
- more owners 81% own home
- similar income \$50-75k
- more cars 1.7 cars
  
- more biking 11% trips
- more driving 75% trips





# The characters (2)

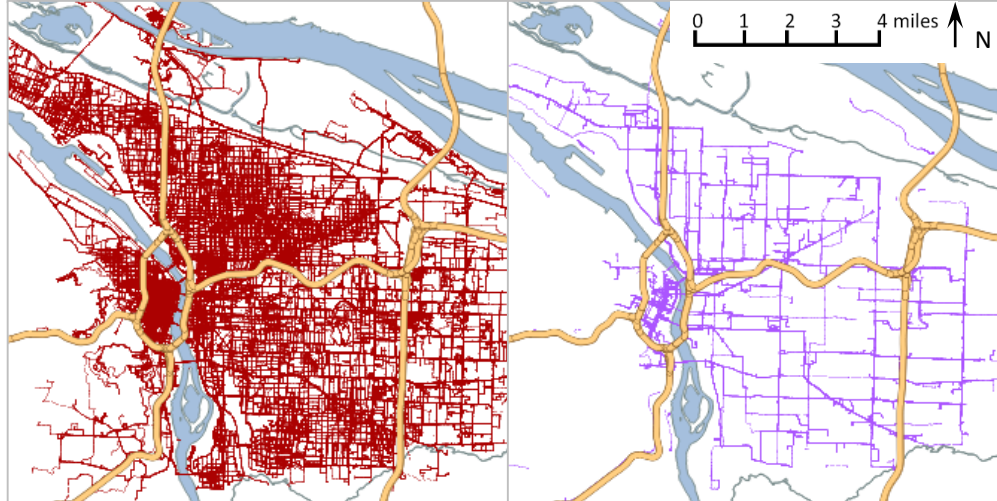
GPS  
Trips  
(& tours)



  
1,419 (11%)



  
1,501 (11%)

  
9,957 (75%)

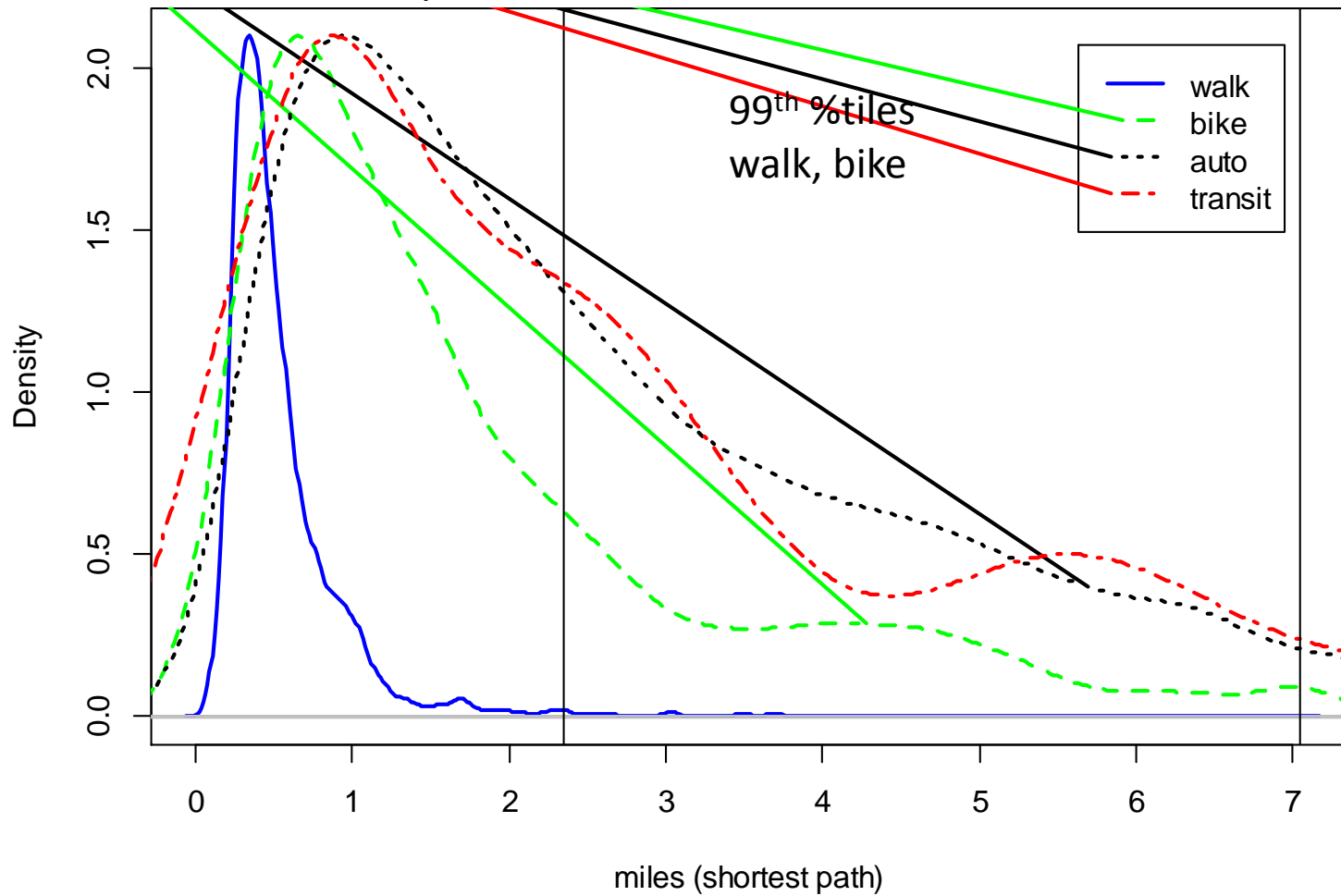


  
  
384 (3%)

# Editing

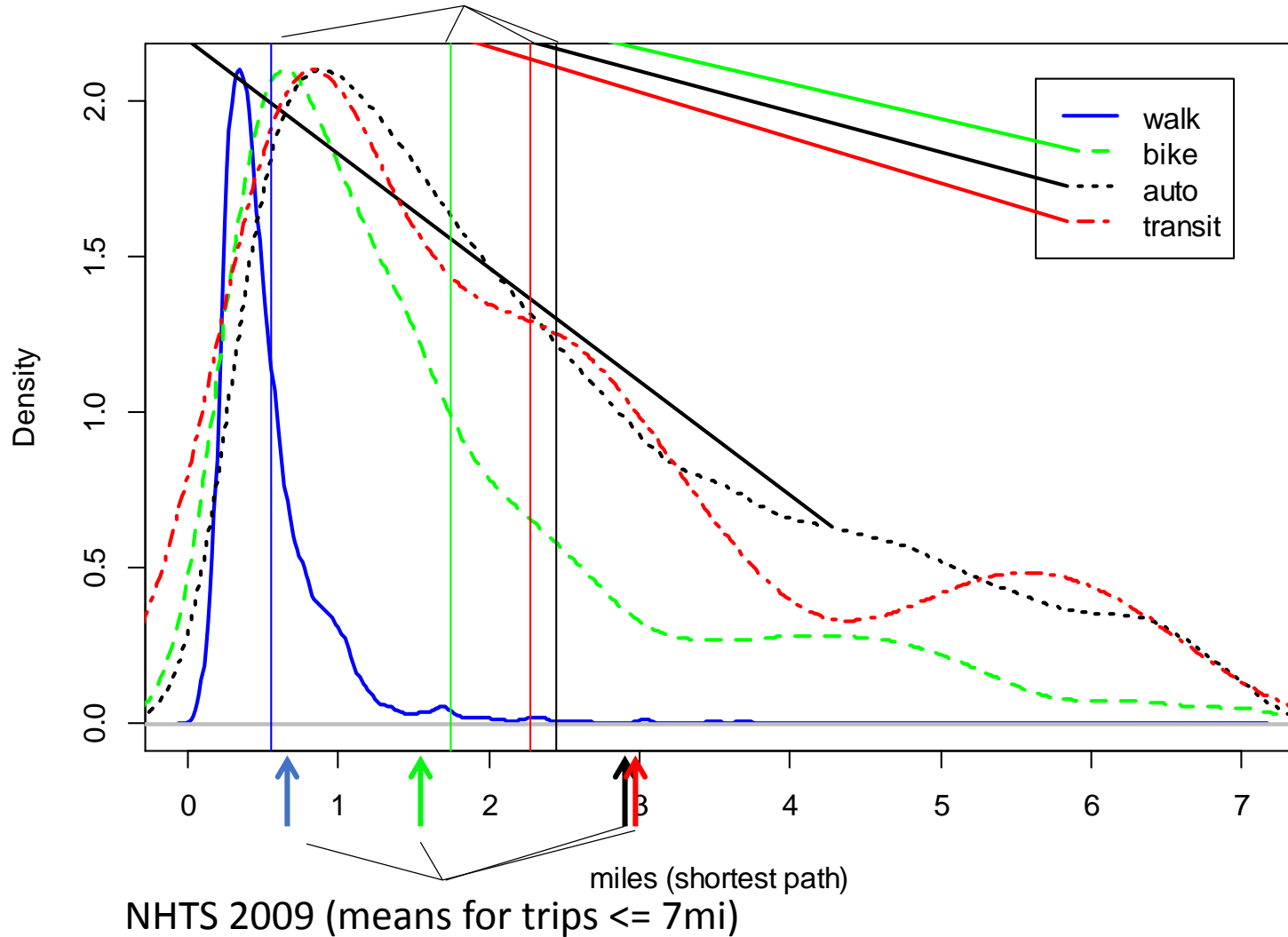
walk considered an option <-

trips over 7mi excluded ->



# Editing

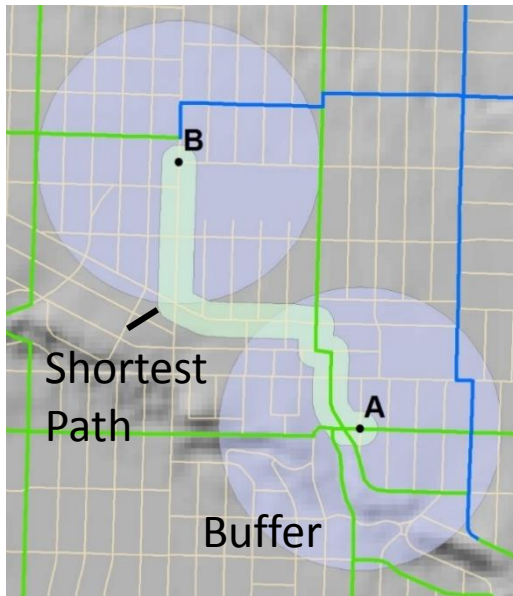
data means (trips <= 7mi)



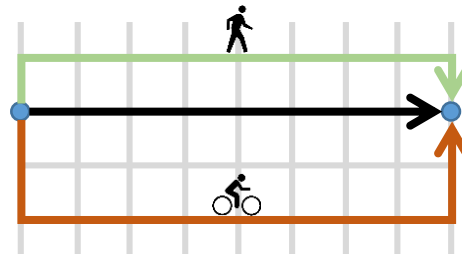
# The action

All models include: socio-demographics (gender, car ownership),  
trip context (purpose, day of week, transit access)

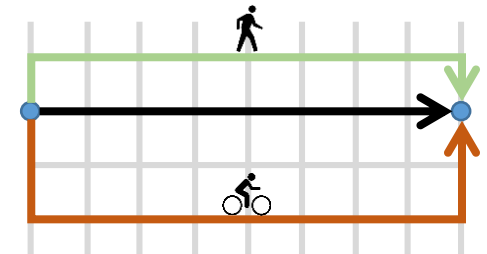
Model 1: Shortest Paths  
& OD Buffers (0.25-1 mi)



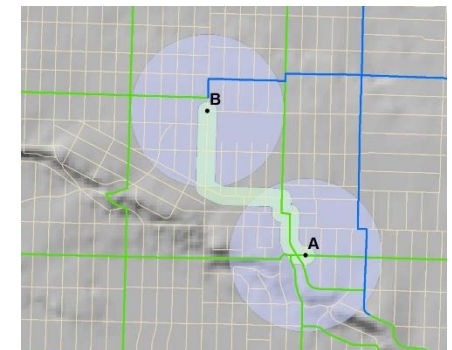
Model 2: Predicted Walk  
& Bike Routes



Model 3: Combination  
of Route, OD + Home area



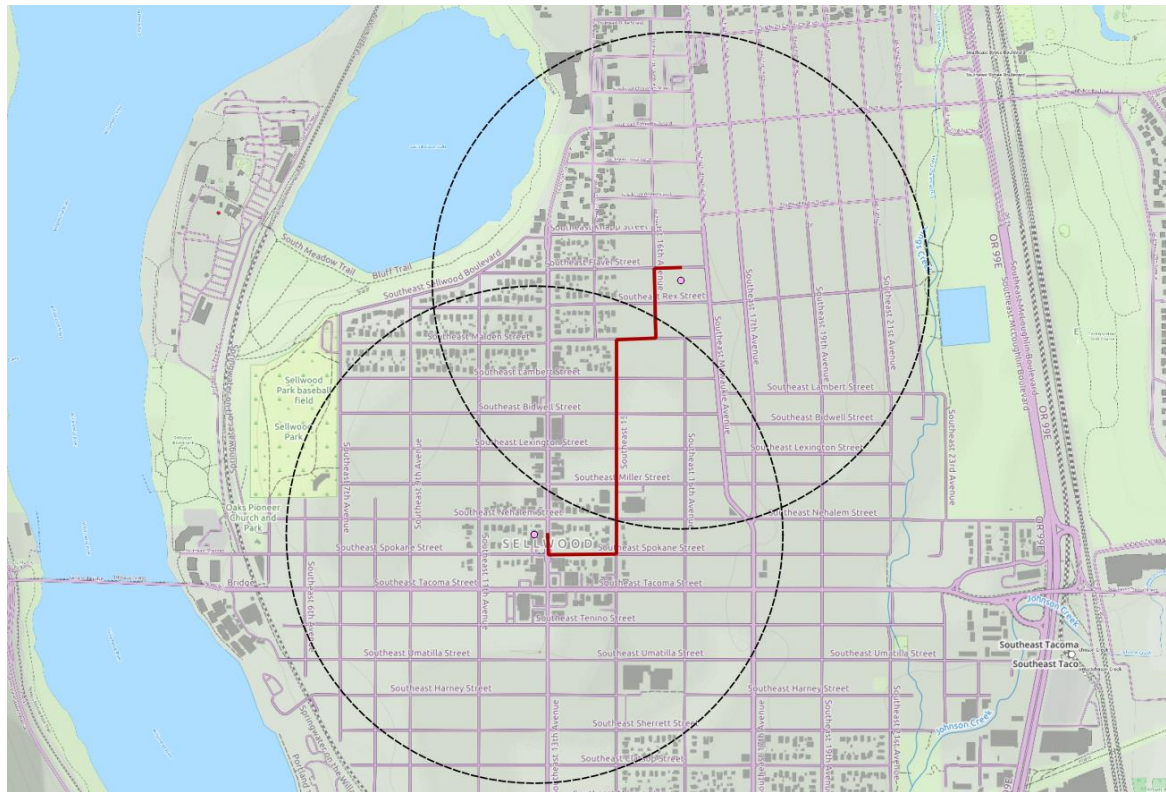
+





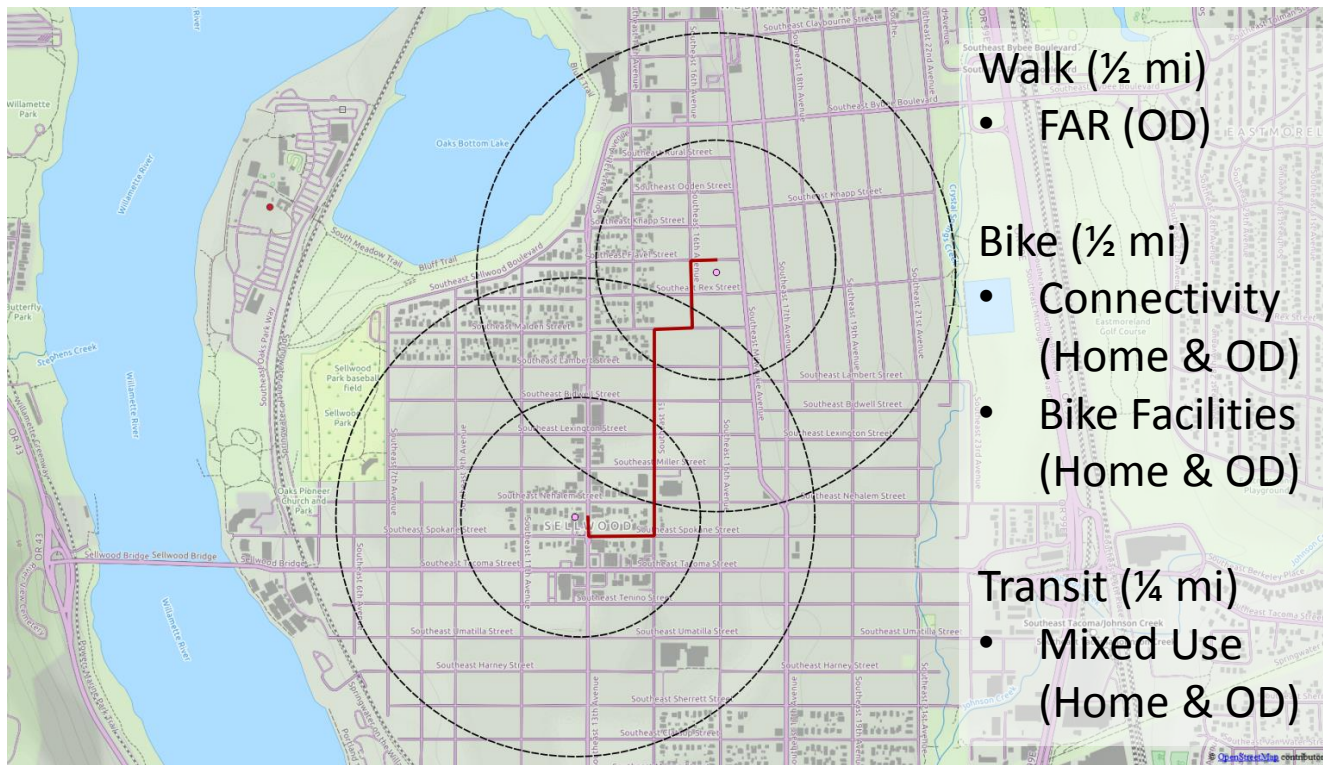
# Big reveal #1

Measuring along single best walk & bike routes predicts mode choice significantly better than within origin-destination buffer areas.



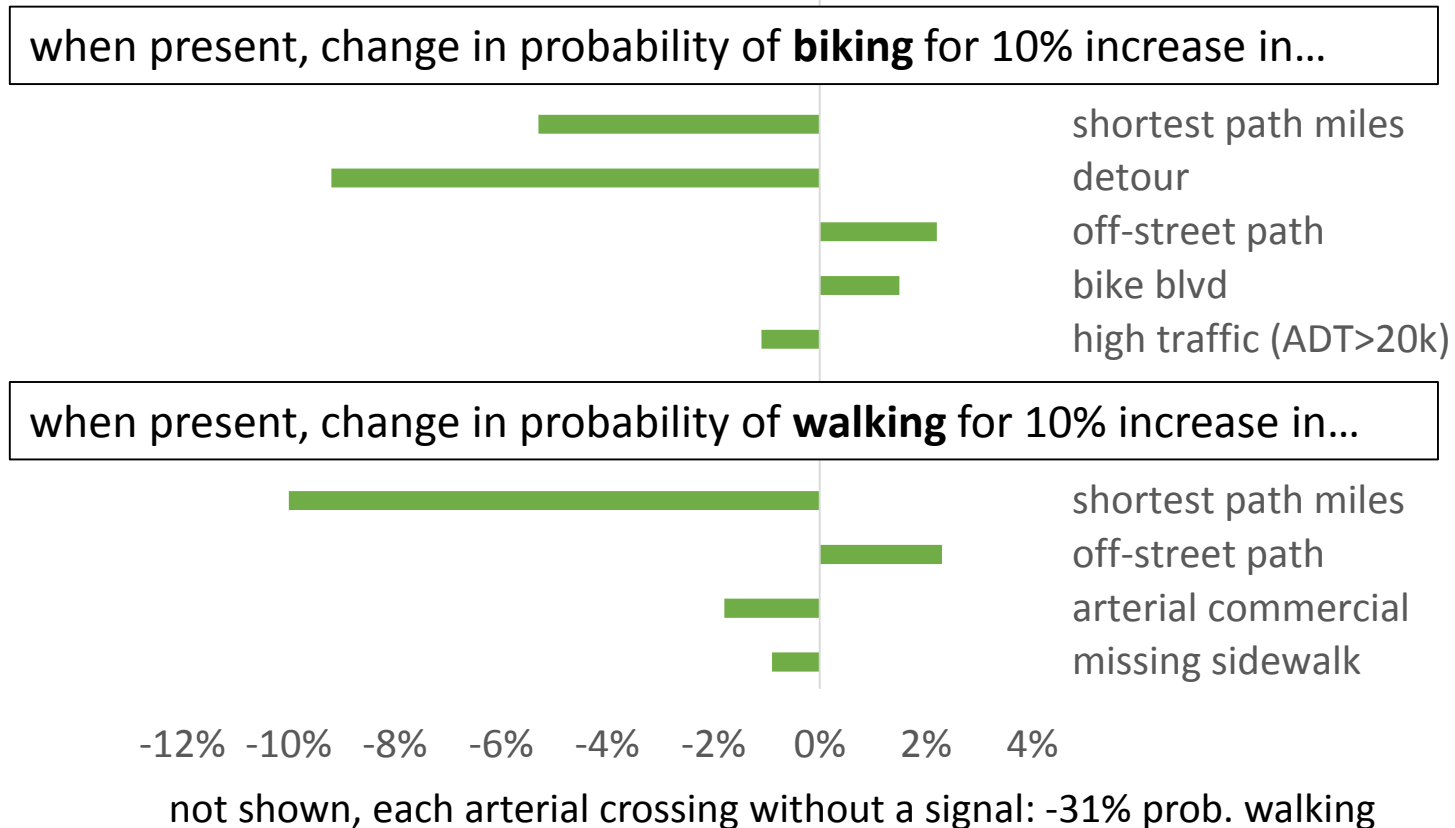
# Big Reveal #2

Route and area measures complementary to route measures, in some cases.



# Big reveal #3

Bike and walk facilities matter in decisions of *whether* to bike or walk.



# Big reveal #4

Gender matters for decisions of *whether* to bike, unlike decisions of *where* to bike.



**-38%**

Overall, for similar trip



**-70%**

When “best” route entirely along moderate traffic streets (ADT 5-20k)



**+68%**

When “best” route entirely along low-traffic bike boulevard



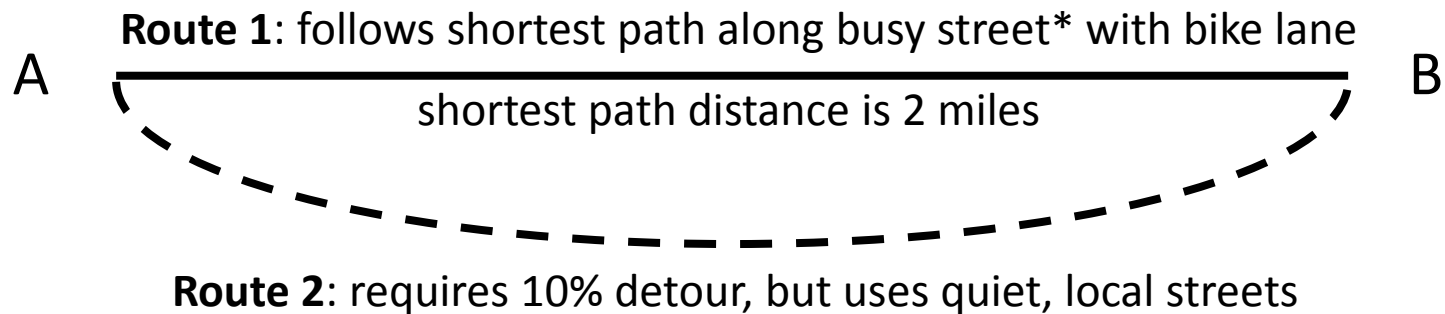
**+0%**

On trips that cross Willamette River (Men: 2.2x as likely)



# Big reveal #5

Sensitivity to corridor-level policies substantially increased using predicted routes.



Initial Probability of Biking  
 (“best” route is Route 1)

	Male	Female
Area Model	1.7%	1.3%
<b>Route Model</b>	<b>3.1%</b>	<b>2.1%</b>

Probability of Biking w/ proposed  
 bike boulevard treatment along  
 Route 2 (“best” route shifts)

	Male	Female
Area Model	1.7%	1.5%
<b>Route Model</b>	<b>21.5%</b>	<b>30.1%</b>

\* ADT 20k (cars per day)

# Plot twist!

- Self-selection: Could those wanting to bike or walk more just live where facilities are better?
- Importance (1-5) in choice of current home...
  - ...good walking neighborhood (mean=4.2)
  - ...good biking neighborhood (mean=3.8)
- Significant impact but w/in range of travel environment effects (+22% walk, +39% bike)
- Significance and magnitude of route attributes largely unchanged, suggesting complementary effects

# Critics always find something!

- Trip-based model (though included tour distance)
- Assumed order entirely destination -> mode
- Panel data (though controlled for time effects)
- Single “best” route for everyone
- Transit/Auto missing variables
- Preferences can only be revealed within existing conditions (new facility types, different urban forms)
- Attitudes not included

# Morals of the story

- Quality bike and walk routes not only improve experience on existing trips but also encourage new trips by walking and biking.
- Low traffic-stress facilities are good for all users and may be especially important to encourage women to bike.
- For maximum value, bike facilities should follow shortest paths; however, still have value even when that's not feasible, particularly when other options poor.



# Questions? Ideas?



Special thanks to: NITC Dissertation Fellowship  
Portland Metro  
City of Portland  
Jennifer Dill & FAS Team

# Further reading...

Contact me at [jbroach@pdx.edu](mailto:jbroach@pdx.edu) if you need help accessing any of my articles\*:

## *Bike Route Choice*

\*Broach, J., Dill, J., & Gliebe, J. (2012). Where Do Cyclists Ride? A Route Choice Model Developed with Revealed Preference GPS Data. *Transportation Research Part A: Policy and Practice*, 46(10), 1730–1740. <http://doi.org/10.1016/j.tra.2012.07.005>

\*Broach, J., Gliebe, J., & Dill, J. (2010). *Calibrated labeling method for generating bicyclist route choice sets incorporating unbiased attribute variation*. *Transportation Research Record*. <http://doi.org/10.3141/2197-11>

Hood, J., Sall, E., & Charlton, B. (2011). A GPS-based bicycle route choice model for San Francisco, California. *Transportation Letters: The International Journal of Transportation Research*, 3(1), 63–75. <http://doi.org/10.3328/TL.2011.03.01.63-75>

Menghini, G., Carrasco, N., Schüssler, N., & Axhausen, K. W. (2010). Route choice of cyclists in Zurich. *Transportation Research Part A: Policy and Practice*, 44(9), 754–765. <http://doi.org/10.1016/j.tra.2010.07.008>

## *Pedestrian Route Choice*

\*Broach, J., & Dill, J. (2015). Pedestrian Route Choice Model Estimated from Revealed Preference GPS Data. In *Transportation Research Board 94th Annual Meeting*. Washington, DC. Retrieved from <http://trid.trb.org/view.aspx?id=1338221>

\*Broach, J. P. (2016). *Travel Mode Choice Framework Incorporating Realistic Bike and Walk Routes*. Portland State University. Retrieved from <http://archives.pdx.edu/ds/psu/16897>

Guo, Z., & Loo, B. P. Y. (2013). Pedestrian environment and route choice: evidence from New York City and Hong Kong. *Journal of Transport Geography*, 28, 124–136. <http://doi.org/10.1016/j.jtrangeo.2012.11.013>

Rodríguez, D. A., Merlin, L., Prato, C. G., Conway, T. L., Cohen, D., Elder, J. P., ... Veblen-Mortenson, S. (2015). *Influence of the Built Environment on Pedestrian Route Choices of Adolescent Girls*. *Environment and Behavior* (Vol. 47). <http://doi.org/10.1177/0013916513520004>

## *Mode Choice*

\*Broach, J. P. (2016). *Travel Mode Choice Framework Incorporating Realistic Bike and Walk Routes*. Portland State University. Retrieved from <http://archives.pdx.edu/ds/psu/16897>

\*Broach, J., & Dill, J. (in press). Using Predicted Bicyclist and Pedestrian Route Choice to Enhance Mode Choice Models. *Transportation Research Record*.

Hood, J., Erhardt, G., Frazier, C., & Schenk, A. (2014). Estimating Emissions Benefits of Bicycle Facilities with Stand-Alone Software Tools: Incremental Nested Logit Analysis of Bicycle Trips in California's Monterey Bay Area. *Transportation Research Record: Journal of the Transportation Research Board*, (2430), pp 124–132. <http://doi.org/10.3141/2430-13>