Do New Bike Share Stations Increase Member Use?: A Quasi-Experimental Study

Jueyu Wang & Greg Lindsey

Humphrey School of Public Affairs

University of Minnesota

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Message for Today

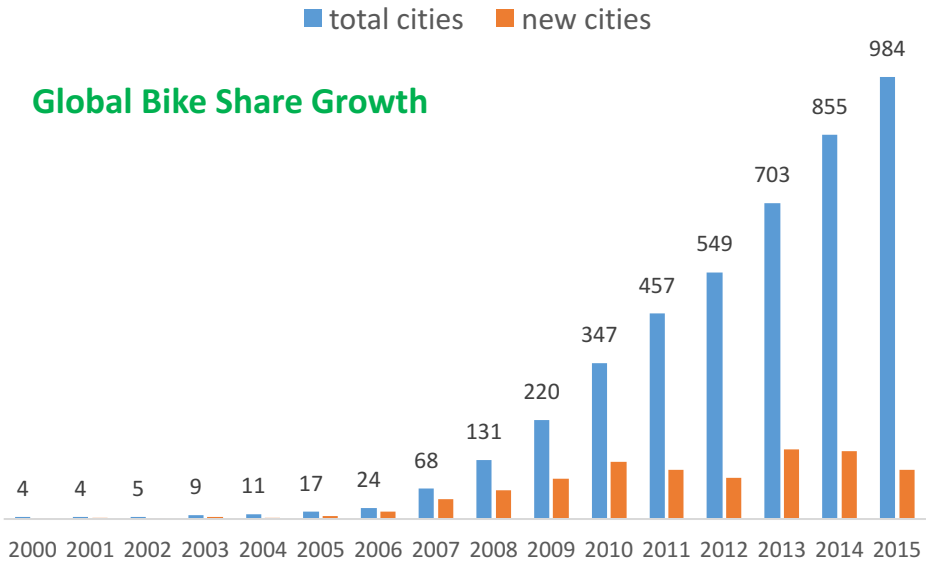
Do New Bike Share Stations Increase Member Use?

- Yes, improved accessibility increases member frequency of use

- Contributions
  - Panel study, DID research design moves beyond correlation
  - Document heterogeneous effects of accessibility in different built environment settings

- Implications
  - Managers can increase accessibility and better serve users
  - Bike facility investments may increase impacts of accessibility

Background



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Previous Studies

Bike Share Users

- Socio-demographic characteristics
    - White
    - Higher income
    - Young
    - Higher educated
- Less is known about behaviors/ demand of current users

Bike Share Demand

- Station-level analyses
- Correlates of bike share demand
    - Socio-demographics
    - Land use/built form
    - Transportation infrastructure
    - Time/weather

Previous Studies

Bike Share Accessibility

- Correlates of bike share use
- Research designs: cross-sectional analyses
    - Establish only correlation
    - Do not establish causality
    - Have not controlled for heterogeneous effects of different built environment settings

Research Questions

Research Question 1

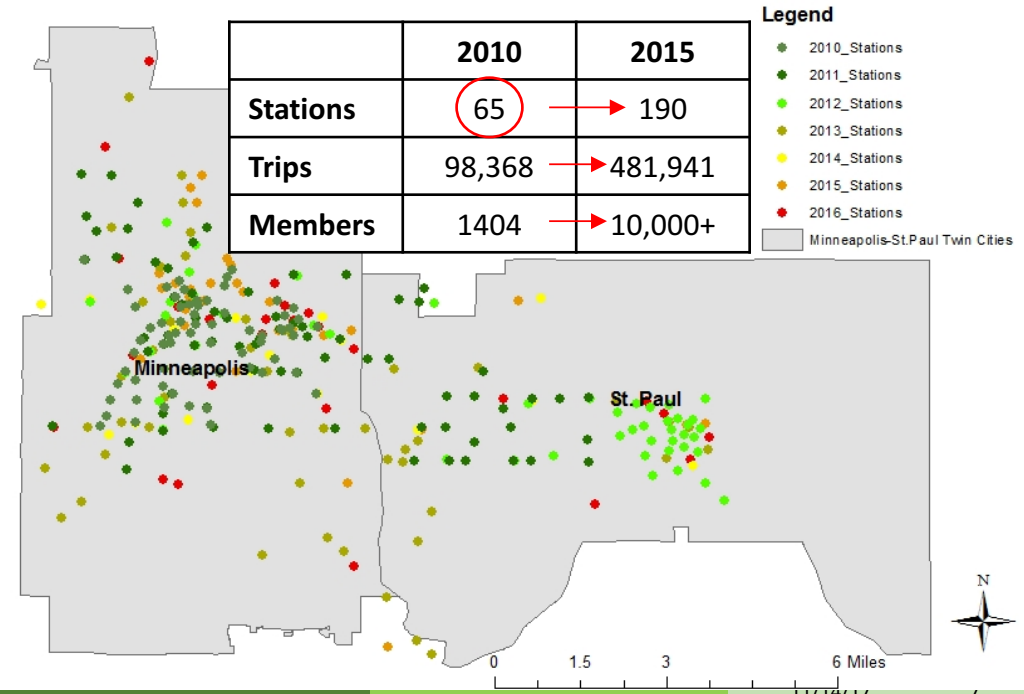
- How does improvement of accessibility to bike share stations influence frequency of use by annual members? (Causality)

Research Question 2

- How do impacts of accessibility differ in different contexts, specifically, in relation to different features of the built environment settings?

Nice Ride Bike Share System In Twin Cities

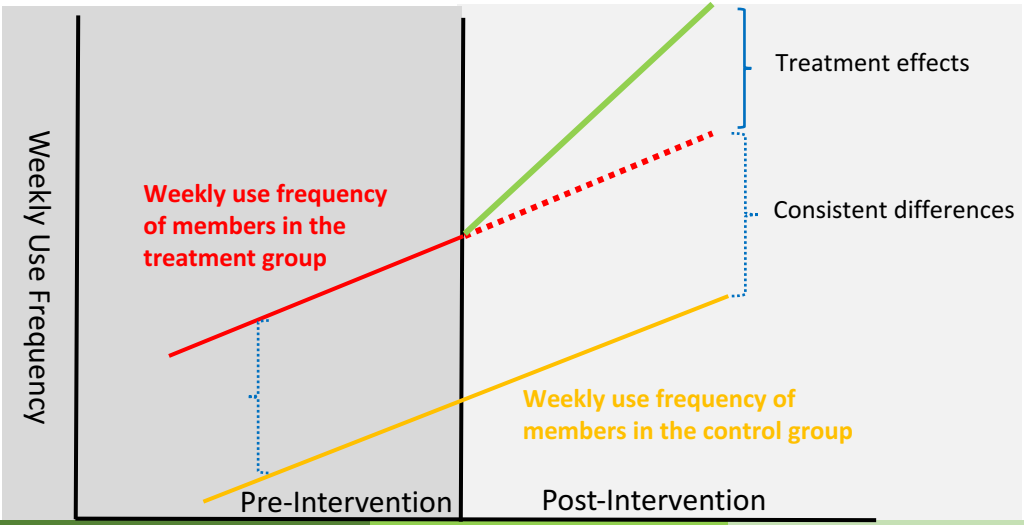
	2010	2015
Stations	65	190
Trips	98,368	481,941
Members	1404	10,000+



Nice Ride Bike Share System In Twin Cities

	Annual Members	30-day Users	Casual Users
Number of Trips in 2010	44,284 (46%)	1,794 (1%)	52,290 (53%)
Number of Trips in 2015	180,245 (37%)	141,781 (29%)	159,915 (33%)
Average Weekly Use Frequency in 2010	2.7	NA	NA
Average Weekly Use Frequency in 2015	1.4	NA	NA

A Quasi-Experimental, Difference-In-Difference Modeling



A Quasi-Experimental, Difference-In-Difference Modeling

D_{it}: The treatment, network distance from home addresses to the nearest bike station

$$Y_{it} = \sigma D_{it} + \gamma X_{it} + \alpha_i + \eta_t + \nu_{it}$$

Y_{it}: Weekly use frequency by annual members

X_{it}: Time and member variant variables (Bike facilities and LRT)

α_i: The time-invariant error term

η_t: The common unobserved time trend

ν_{it}: The error term with standard properties

$$Y_{it} = X_i D_{it} \beta + \sigma D_{it} + \gamma X_{it} + \alpha_i + \eta_t + \nu_{it}$$

X_i: Time-invariant variables, mainly built environment

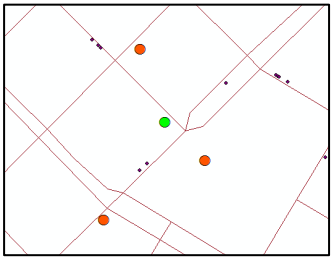
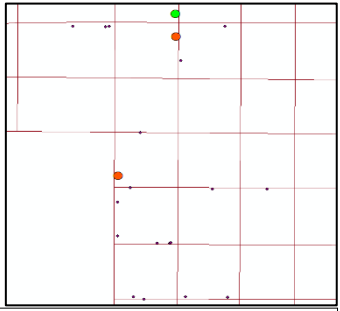
Research Design

Datasets

Data	Sources
A five-year panel data set of members' bike share trips from 2010 to 2015	Nice Ride
Land use	Metropolitan Council
2010-2015 five-year bike lane/trail dataset	City of Minneapolis and St. Paul
Street network	Metropolitan Council

Research Design

Three Different Models

Model 1	Model 2 (Dit<1/4 mile)	Model 3 (Dit>1/4 mile)
All members living within 3 miles of stations		

home addresses 2011 stations 2015 stations

Descriptive Statistics

Variable	Mean	Std. Dev.
Treatment Variable (NT=450, 753)		
Distance (10^{-1} mile)	5.44	8.3
Weekly Observation Level (NT=450, 753)		
Bike Lane Length (meters)	1124	1212
LRT	0.06	0.24
Member Level (N=9510)		
Female (N=9434)*	0.43	0.5
Job density	0.007	0.04
Pop density	0.008	0.008
% Recreation	0.21	0.23
% Retail	0.40	0.44
% Office	0.07	0.13
% Industrial	0.17	0.33

Basic DID Model Estimation Results

	Model 1		Model 2		Model 3	
	Coef.	IRR	Coef.	IRR	Coef.	IRR
Distance	-0.002	0.998	-0.12	0.89	-0.001	0.999
Bikeway	0.0001	1.0001	0.0001	1.0001	0.00002	1.00002
LRT	-0.11	0.89	-0.07	0.93	-0.61	0.54
Log Likelihood	-740042.75		-421590.06		-317939.09	

- Distance has significant, negative effects on frequency of member use
- 0.1 mile increase in distance decreases the weekly use for members in model 2 by 11% (1-0.89). If 0.1 mile increase in distance, the average frequency to use would decrease from 2 to 1.76
- The substitutional effect of transit on bike share is larger in Model 3

Effects of Access are Heterogeneous

	Model 1	Model 2	Model 3
	Coef.	Coef.	Coef.
LRT	-	-	-
Bikeway Length	+	+	+
Distance*LRT	-	-	-
Distance*Bikeway length	-	-	-
Distance*Pop density	-	-	-
Distance*Job density	+	+	+
Distance* % recreation	-	-	-
Distance*% retail	-	-	-
Distance*% office	+	-	+
Distance*% industrial	-	-	-
Prob.>Chi2	0	0	0
Log Likelihood	-738111.14	-421262.79	-316204.62

Practical implications – Exploratory Analysis

Scenario 1

0.3 miles

1.13 times

Scenario 2

0.12 miles

1.15 times

0.12 miles

0.12 mile

bike way

2.0 times

Findings

Research Question 1

- How does improvement of accessibility to bike share stations influence frequency of use by annual members? (Causality)
  - Accessibility to bike share station **+**

Research Question 2

- How do impacts of accessibility differ in different contexts, specifically, in relation to different features of the built environment settings?
  - Bike facility ↗
  - Higher population density, higher percentage of recreation, retail land use and industrial land use ↗

Implications

Findings

- Accessibility to Bike Share Stations: **+**;
- Bike facility: ↗
- Land use : ↗

Implications

- Prioritize to place Nice Ride stations in the area with concentrated current users and bike facilities
- New bike facility investment
- Place a Nice Ride station in the area

Limitations & Future Research

Exogenous of bike share station location choices?

Measurement of accessibility

Likelihood of being bike share members

Implications

Findings

- Accessibility to Bike Share Stations: **+**;
- Bike facility: ↗
- Land use : ↗

Implications

- Prioritize to place Nice Ride stations in the area with concentrated current users and bike facilities
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Thank you!
Any Questions?

Research Design

Three Different Models

	Model 1	Model 2	Model 3
	Dit ≤ 3 miles	Dit ≤ ¼ miles	¼ miles< Dit≤3 miles
Total N (NT)	9,510 (450,753)	5,043 (217,878)	4,467 (125,477)
N (NT) in the treatment	1,370 (107,398)	225 (16,230)	1,145 (91,168)
N (NT) in the control group	8140 (343,355)	4,818 (234,108)	3,322 (216,645)
Weekly Use (Mean/St.d)	1.7 (3.5)	2.0 (3.7)	1.4 (3.2)

Modeling Approach

- Fixed effect Poisson models
  - Count data
  - Conditional likelihood of negative binomial fixed effects model is problematic