THE OHIO STATE UNIVERSITY

Does Public Transit Generate New Physical Activity?

Evidence from Individual GPS and Accelerometer Data Before and After Light Rail Construction in a Neighborhood of Salt Lake City, Utah, USA

Harvey J. Miller[1], Calvin P. Tribby[1], Barbara B. Brown[2], Ken R. Smith[2,3], Carol Werner[4], Jean Wolf[5], Laura Wilson[5] and Marcelo G. Simas Oliveira[5]

[1]Department of Geography
The Ohio State University

[2]Department of Family and Consumer Studies
[3]Huntsman Cancer Institute
[4]Department of Psychology
University of Utah

[5]Westat, Inc.

Introduction

Active transportation

Walking, biking, public transit

Green: Reduce pollution, congestion, sprawl; support public transit

Social: Improve accessibility, quality of life, affordability, equity, social capital

Healthy: Encourage *physical activity* (PA)


hiddencityphila.org


www.houstontomorrow.org

Introduction

Does transit generate new PA?

Transit users are more active

But this may not be *new* PA

Why not new PA?

Confounding: Other, non-transit factors

Substitution: Public transit takes more time

We need more longitudinal (quasi-experimental) studies

Introduction

Light Rail Transit (LRT) in Salt Lake City

New light rail line from downtown to airport

Dedicated bike and pedestrian lane/paths; street rehabilitation

Opened 13 April 2013

An opportunity for a quasi-experimental study of public transit and PA


MAPS Overview
Airport Line Stops
Existing Stops
Airport TRAX Route
Existing TRAX Lines
Study Area
Near Group
0 500 1,000 2,000 Meters
Data: AGRC; ESRI; Author. 2012.
Salt Lake City Int'l Airport
Wingpointe Golf Course
W Northtemple St
W North Temple
W South Temple St
W South Temple
Terminal Dr
N Redwood Rd
S Redwood Rd
W 1000 N
W 900 N
W 800 N
W 700 N
W 600 N
W 500 N
W 400 N
W 300 N
W 200 N
W 100 S
W 200 S
W 300 S
W 400 S
W 500 S
W 600 S
W 700 S
W 800 S
W 900 S
W 1300 S
Riverside Park
Constitution Park
Sherwood Park
Popular Grove Park
9th South Park
Jordan Park
Pioneer Park
Jefferson Park
Warm Springs
Rosewood Park
West Point
Salt Lake City
Indiana Ave
Genesee Ave
Euclid Ave
Pacific Ave
Gillespie Ave
Arapahoe Ave
Mead Ave
Fremont Ave
Victory Rd
Beck St
Frontage Rd
Surplus Canal
Jordan River

Data collection

Design: Adult panel

Before/After intervention (2012 and 2013)

Diverse Spanish/English speaking population

Recruitment via door-to-door and mail

Accelerometer and GPS devices

Full participation: 10+ or hours of wear time on 3+ days

Also: Attitudinal surveys, BMI measures, prompted recall of activity bouts

Data collection

Movement and activity data

GPS: GlobalSat DG-100 wearable GPS

Accelerometer: Actigraph GT3X+

Initial data processing

(Westat)

Data uploaded, fused and map-matched

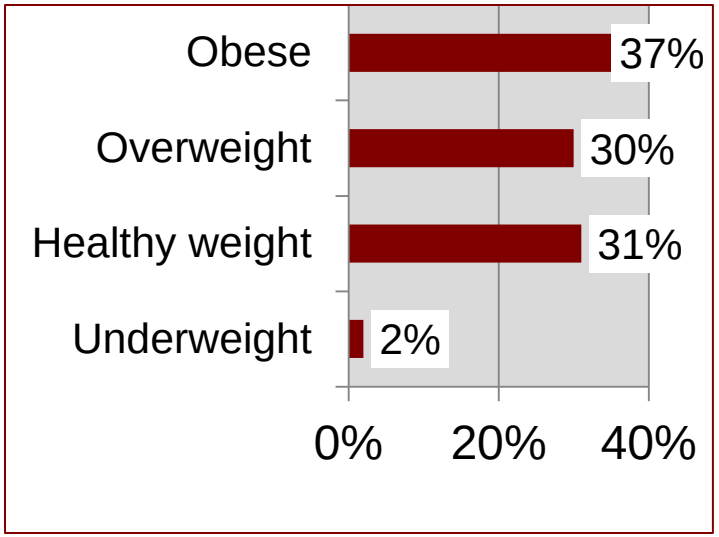
Download maps to browser for participant review

Mode detection (walk, bike, car, bus, LRT)

Data collection

Complete sample (2012 & 2013)

- n = 537
- 51% female
- 25% Hispanic
- Lived in home 7.5 years
- But 25% only 1 year
- 68% employed
- 24% up to high school completed; 37% college grads
- $30-40,000 median household income



BMI distribution in sample

Definitions

PA bouts

Min 5 minute with a min of 1000 accelerometer counts per minute (Saelens et al. 2014)

Types of PA

Overall PA (PA-Total): PA regardless of its relationship with public transit

Transit-related PA (PA-Transit): PA within a trip that contains a segment with bus or LRT

Non-transit PA (PA-Other): PA that does not occur within a trip with a public transit segment

PA-Total = PA-Transit + PA-Other

Saelens et al. (2014) *AJPH*, 104(5) 854-859

Definitions

Public transit user

Participant who rode either bus or LRT at least once during data collection

Transit groups (below)

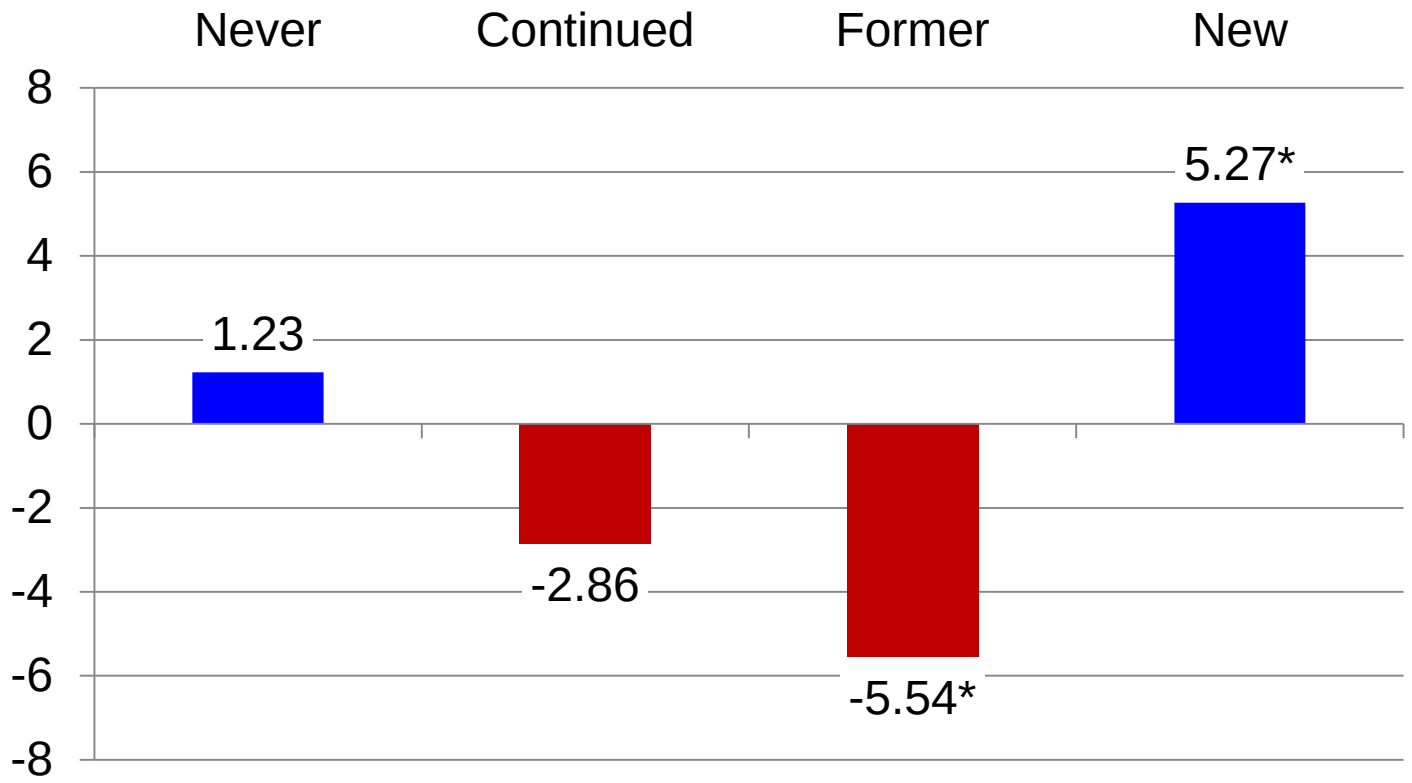
Transit group	N	Public transit user in: 2012?	2013?
Never	392	No	No
Continued	51	Yes	Yes
Former	42	Yes	No
New	52	No	Yes

Hypotheses

New PA implies:	**Public transit user group:** **Never**	**Continued**	**Former**	**New**
i) no confounding	**No change** in PA-Other	**No change** in PA-Other	**Decrease** in PA-Transit	**Increase** in PA-Transit
ii) no substitution			**No increase** in PA-Other	**No decrease** in PA-Other
Net change in PA-Total	**No change**	**Any change**	**Decrease**	**Increase**

Changes in PA-Overall time by group
(difference 2013 - 2012)

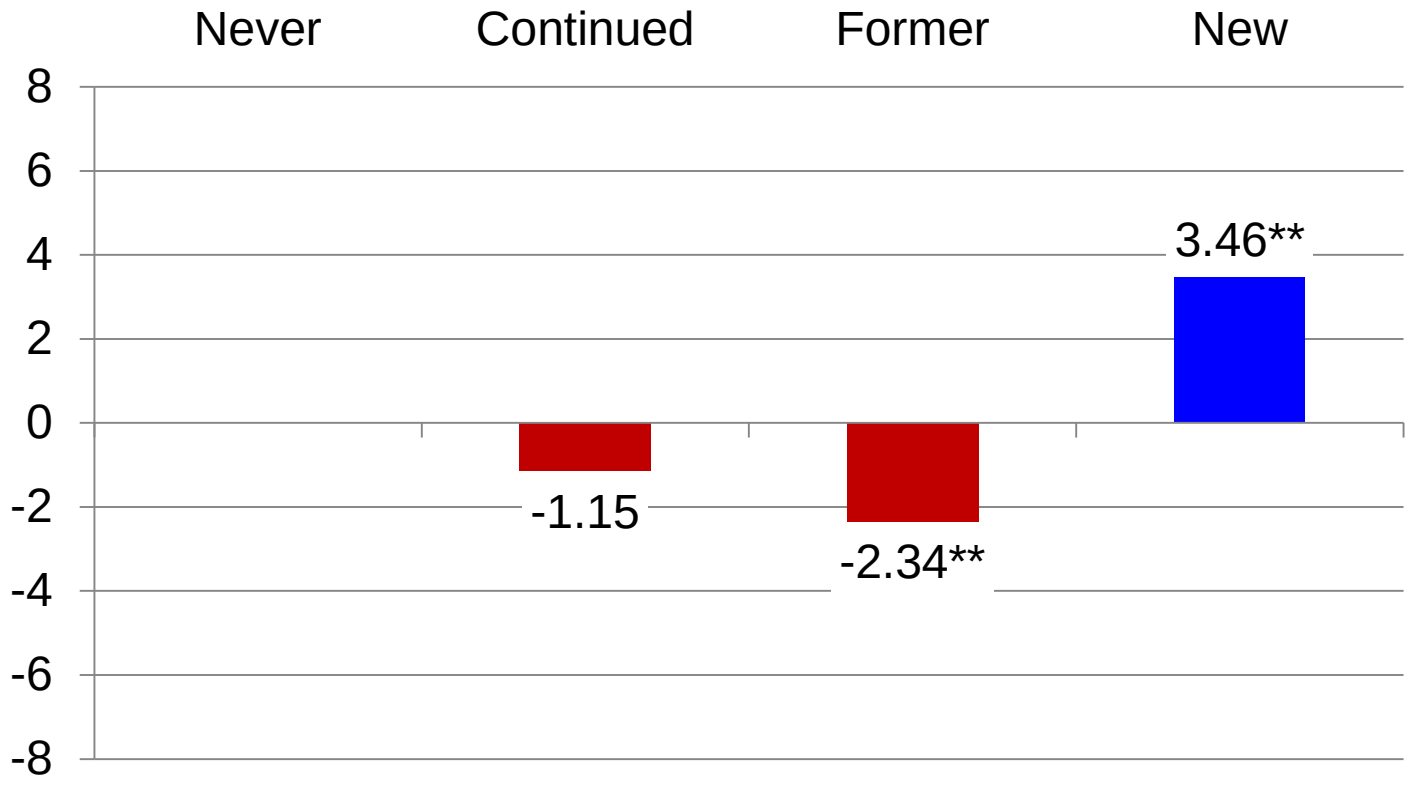
Results



Average time: Minutes per 10 hr. wear period
PA: Min 1000 cpm in min 5 minute bout
Within group differences: * $p < 0.1$

Changes in PA-Transit time by group
(difference 2013 - 2012)

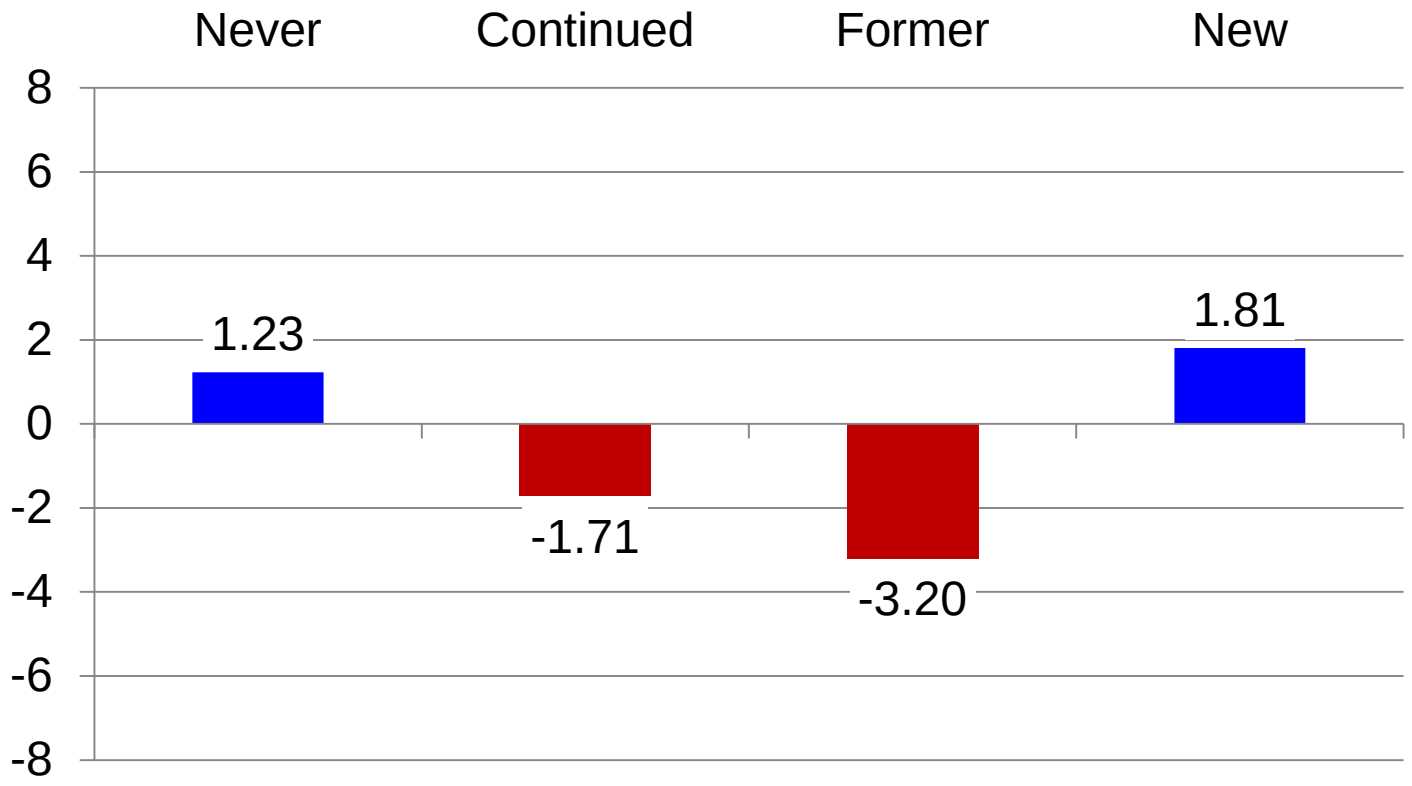
Results



Average time: Minutes per 10 hr. wear period
PA: Min 1000 cpm in min 5 minute bout
Within group differences: ** $p < 0.05$

Changes in PA-Other time by group
(difference 2013 - 2012)

Results



Average time (minutes per 10 hr. wear period);
PA: Min 1000 cpm in min 5 minute bout
Within group differences: None significant

Summary

User behavior (2013 vs. 2012)	**PA-Total**	**PA-Transit**	**PA-Other**
Did not change (Never; Continuing)	No change	No change	No change
Stopped using transit (Former)	Decrease	Decrease	No change
Started using transit (New)	Increase	Increase	No change

No confounding factors

No substitution for non-transit PA

→ Transit PA is new

Results

Spatial distribution of transit-related PA

Spatial distribution of GPS points associated with PA types

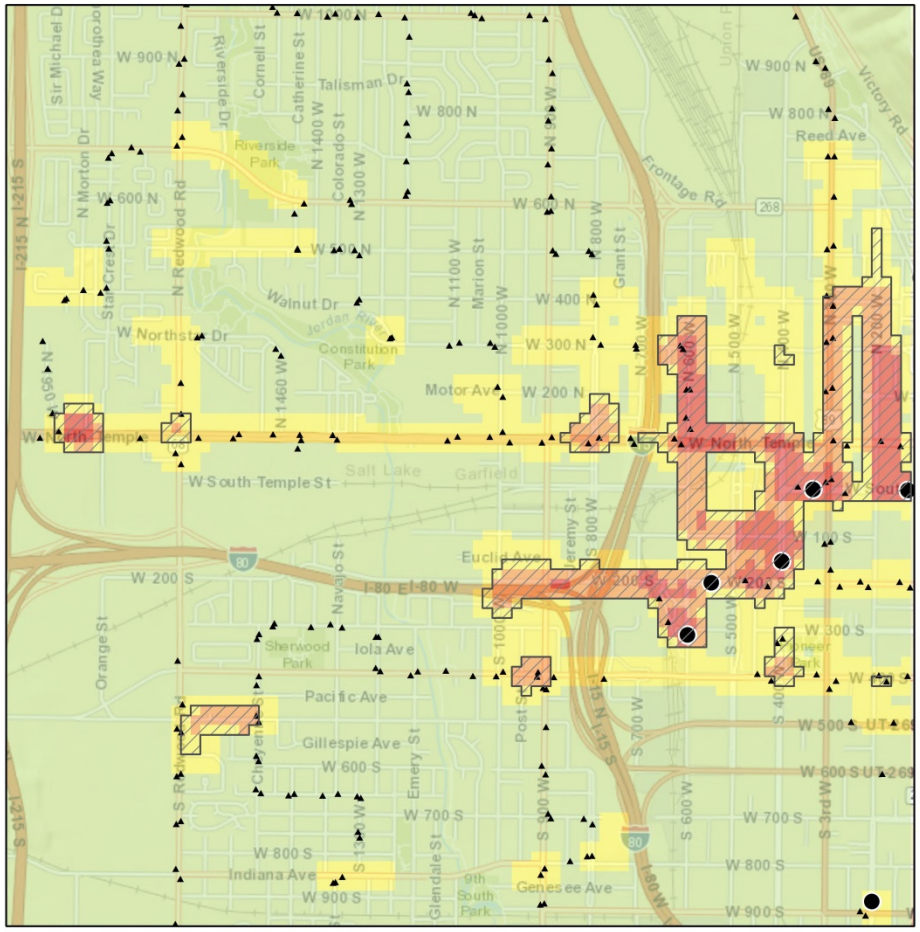
Spatial autocorrelation using local Moran's I

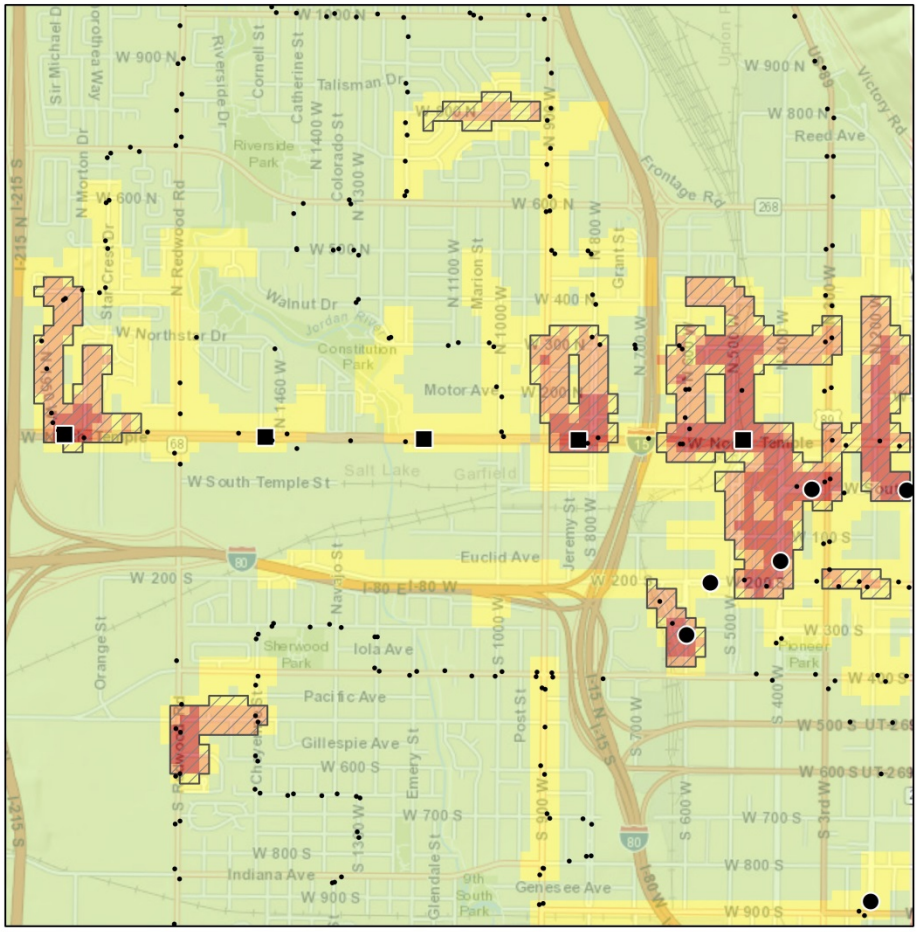
Spatial clustering of PA

LRT versus bus?

Changes in spatial patterns

New LRT → New clustering, more intense clustering?





2012 Transit-related Physical Activity

2012 Bus Stops
2013 Bus Stops
New TRAX Stations
Existing TRAX Stations

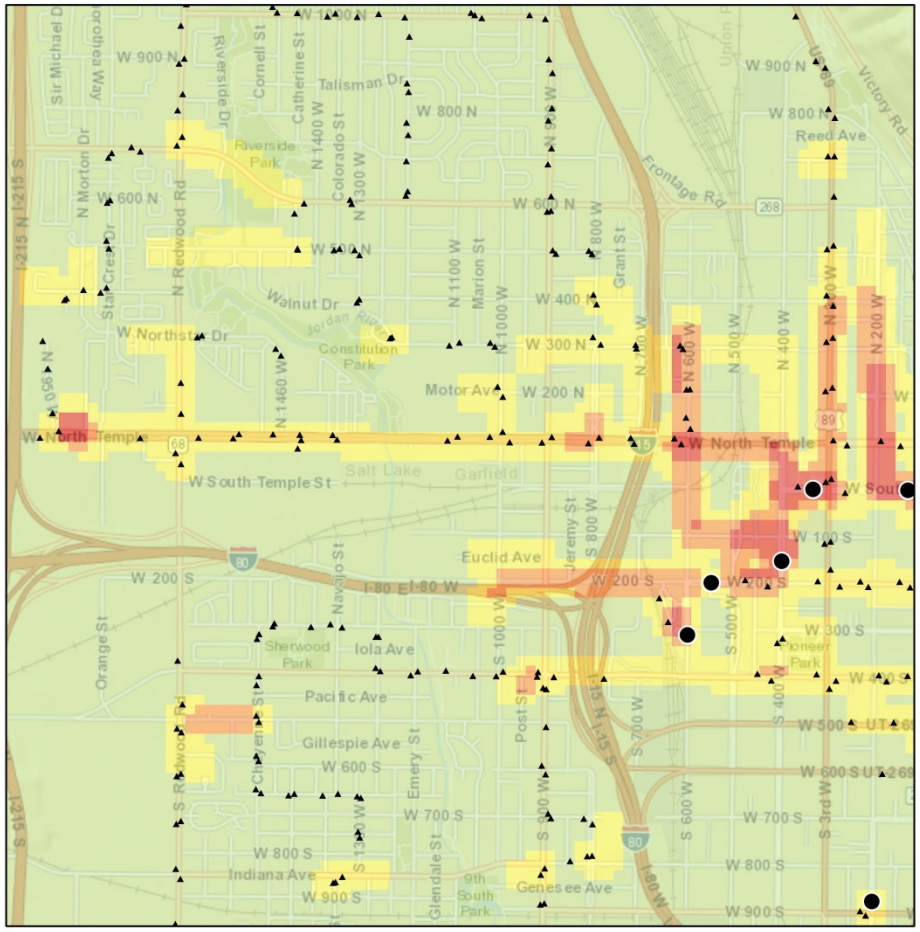
No GPS Points
Low Density
Medium Density
High Density

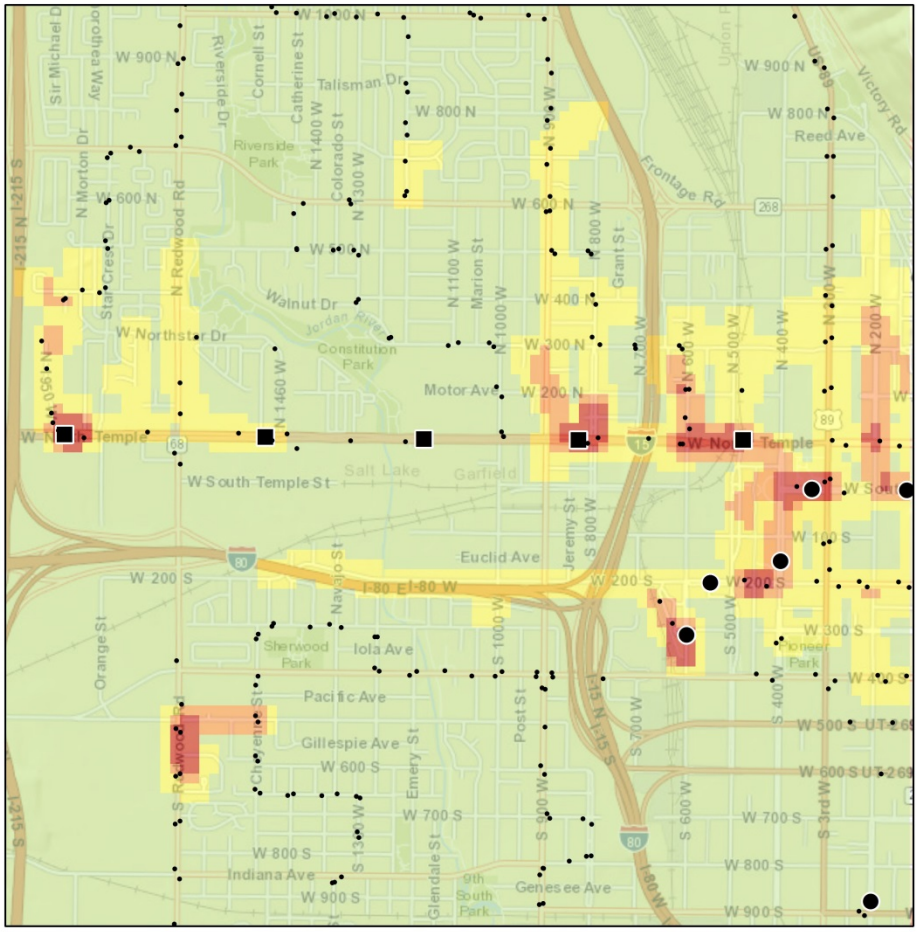
Local Moran's I
Density Clusters

1
Kilometers

Basemap: Esri; Transit stops: AGRC.

2013 Transit-related Physical Activity





2012 Transit-related Physical Activity CONTINUED

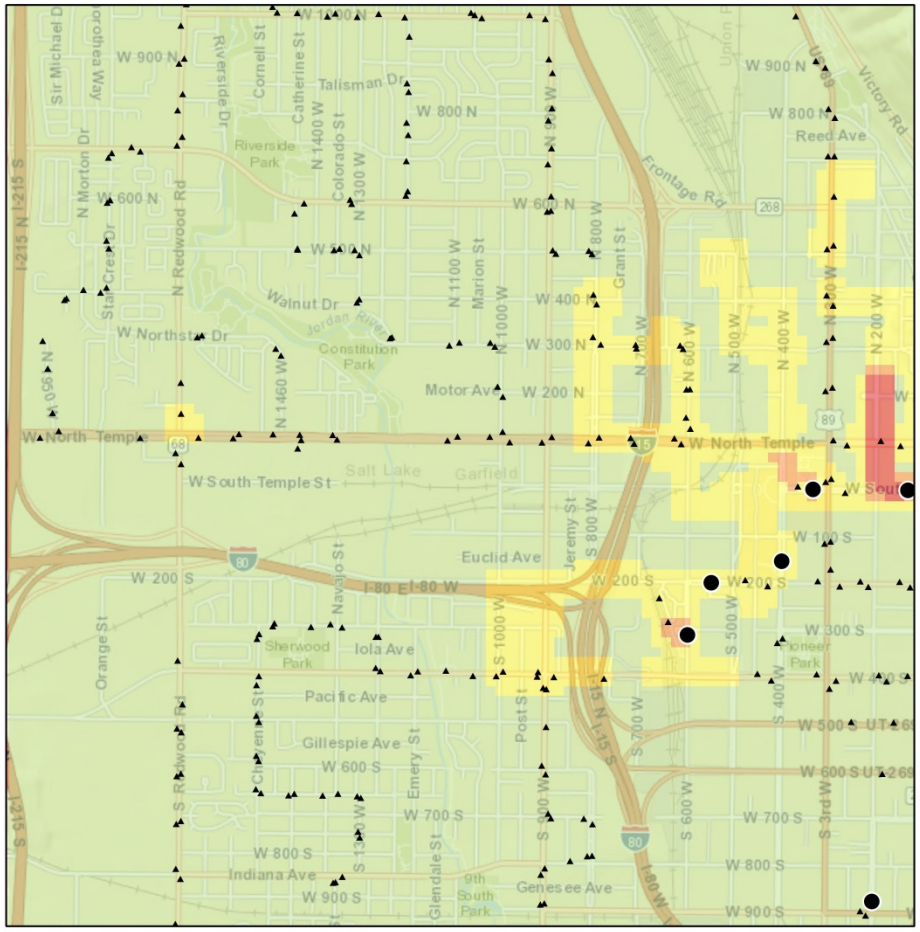
- 2012 Bus Stops
- 2013 Bus Stops
- New TRAX Stations
- Existing TRAX Stations

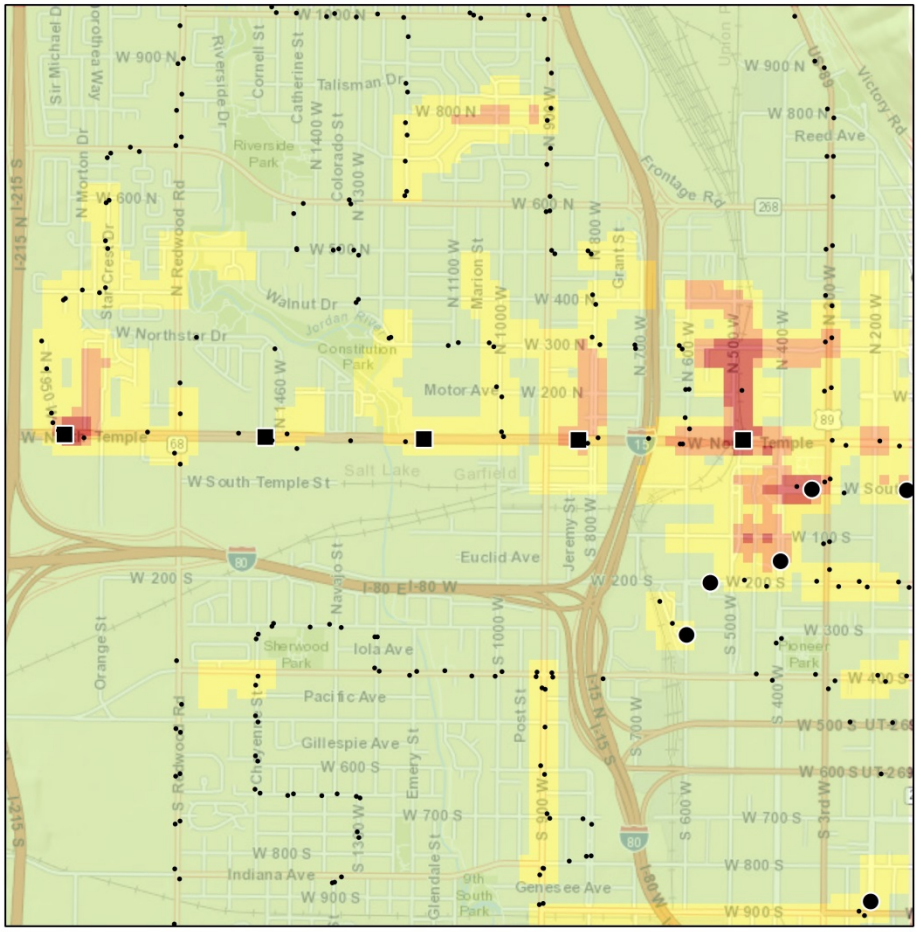
- No GPS Points
- Low Density
- Medium Density
- High Density

2013 Transit-related Physical Activity CONTINUED

Basemap: Esri; Transit stops: AGRC.

1 Kilometers





2012 Bus Stops
2013 Bus Stops
New TRAX Stations
Existing TRAX Stations

No GPS Points
Low Density
Medium Density
High Density

2012 Transit-related Physical Activity FORMER

2013 Transit-related Physical Activity NEW

Basemap: Esri; Transit stops: AGRC.

1
Kilometers

Results

Daily PA time of transit users

Transit days versus non-transit days

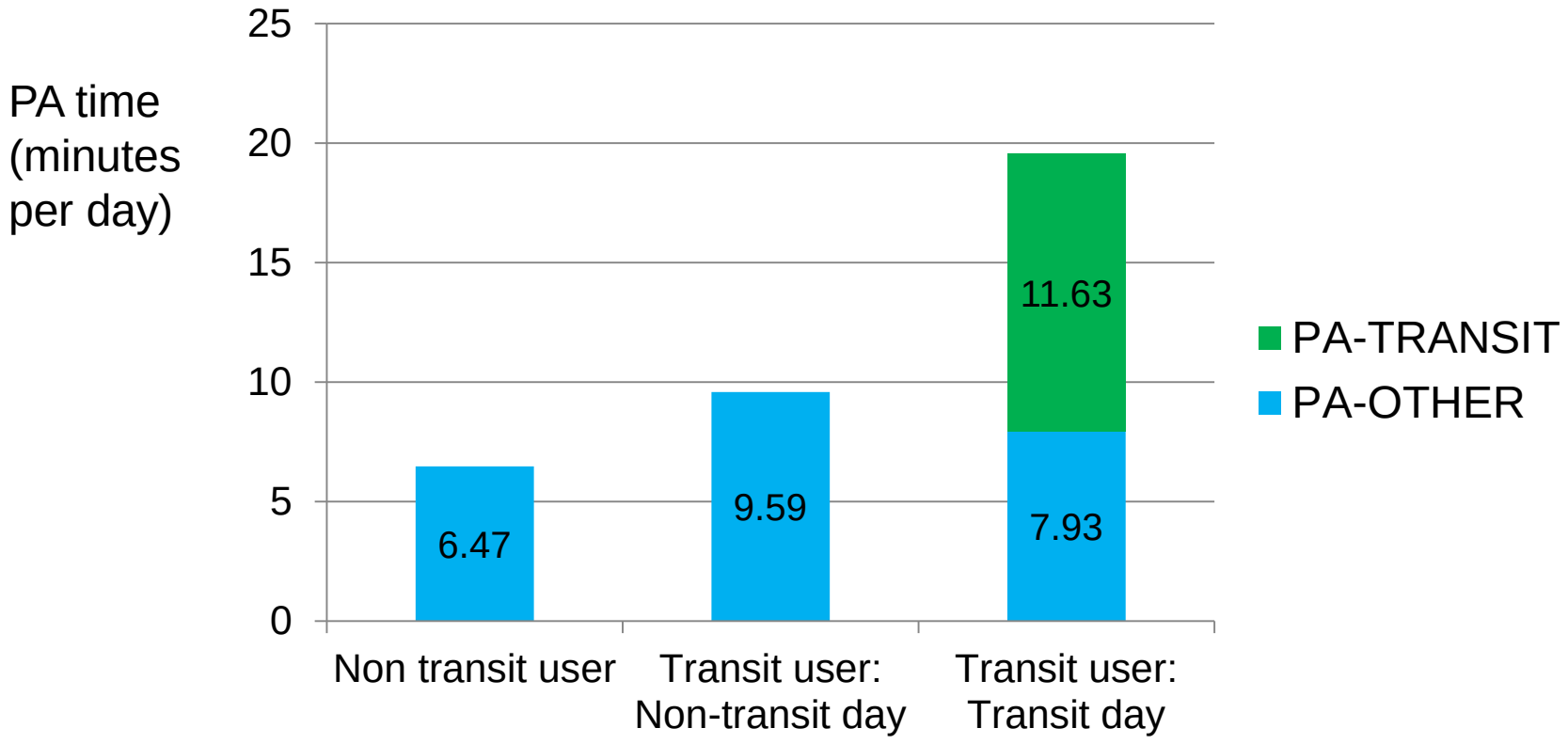
Non-transit users for comparison

Analyses

1. Group-level estimates
2. Individual differences for transit users: Transit day versus non-transit day

2012 group-level estimates

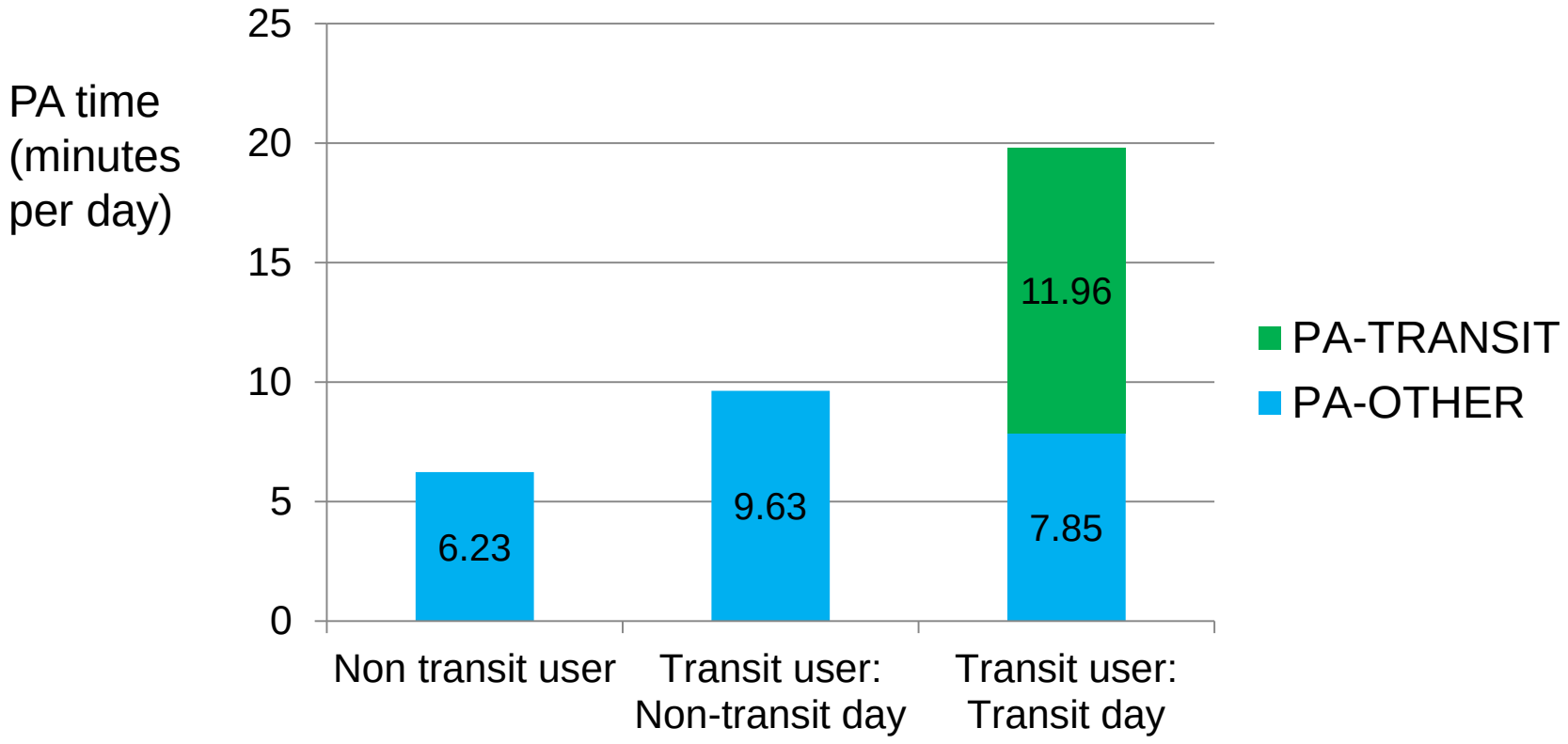
Results



PA: Min 1000 cpm in min 5 minute bout

2013 group-level estimates

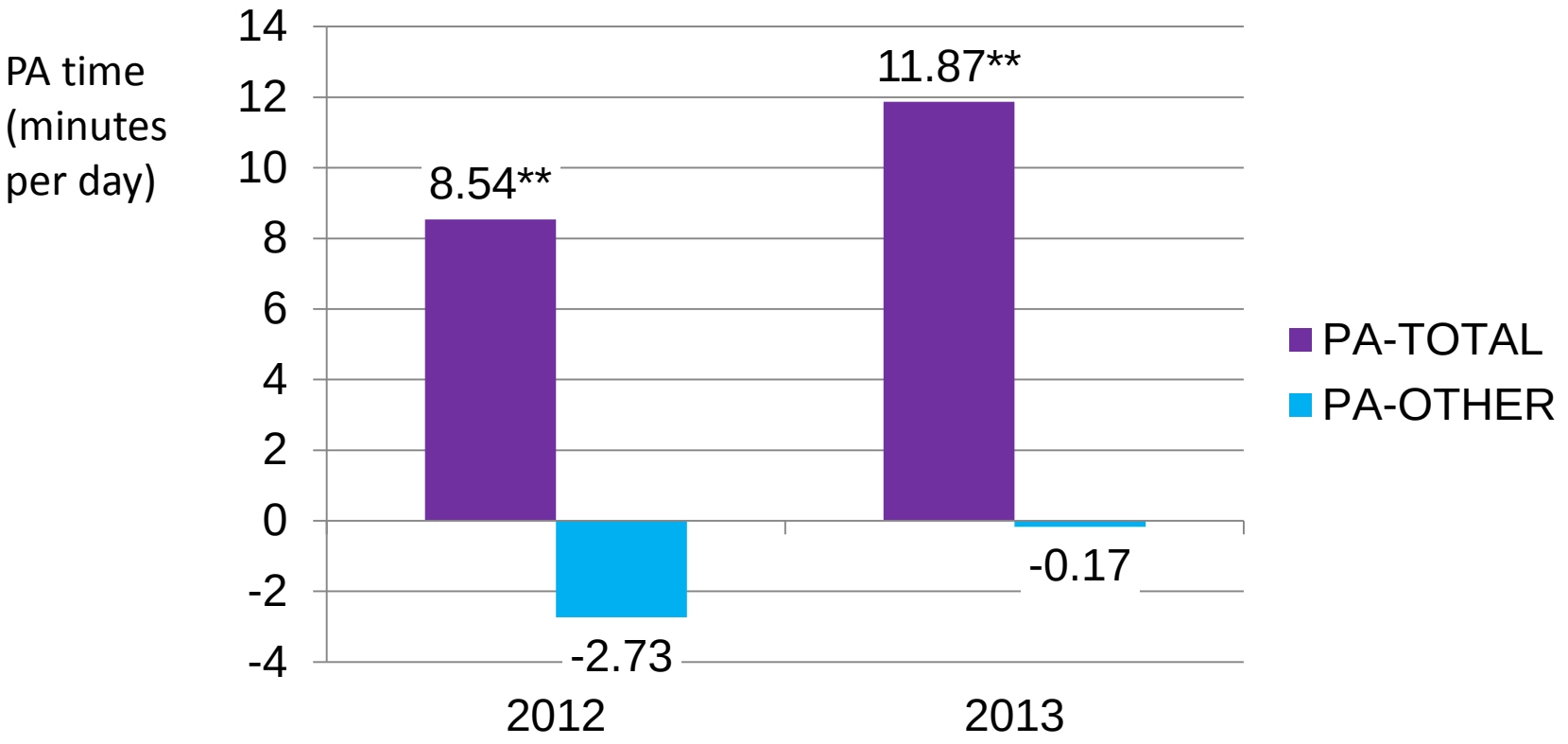
Results



PA: Min 1000 cpm in min 5 minute bout

Individual differences for transit users: (Transit day) – (Non-transit day)

Results



PA: Min 1000 cpm in min 5 minute bout
Paired t-test: ** $p \leq 0.05$

Conclusion

Q: Does public transit generate new PA?

Quasi-experimental study before/after LRT construction

Salt Lake City

GPS + accelerometer data

A: Yes

PA changes associated with transit behavior changes only

No substitution for other PA

Transit-related PA spatially clusters near LRT stops

Day to day PA patterns confirm at individual level

Policy implications

Public health should be considered in public transit planning, infrastructure and service decisions

Next steps

Near versus far effects

Bus cannibalization?

Analyzing walking route choice based on built environmental and personal factors

Thank you!

Contact

Email: miller.81@osu.edu
Web: u.osu.edu/miller.81
Twitter: @MobileHarv

Acknowledgements

Grant number CA157509 from the National Cancer Institute at the National Institutes of Health

Active Living Research Program of the Robert Wood Johnson Foundation (accelerometer equipment)