

Evaluating the Benefits of Light Rail Transit

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Presentation Outline

1. Introduction

- Policy Context
- Motivation for Evaluating the Expo Line

2. Study Design

- Study Area
- Survey Samples and Methods
- Analytical Approach

3. Results

- Part 1. Longitudinal Analysis of Factors Associated with Travel Changes
- Part 2. Comparison of New Residents vs. Long-Term Residents

4. Conclusion and Recommendations

Policy Context: Changing Times

Transportation used to be this:



But has become this:



Source: KCET SoCal Focus,
http://www.kcet.org/updaily/socal_focus/history/la-as-subject/before-the-carnageddon-a-photographic-look-at-the-construction-of-5-socal-freeways-35191.html

Sources: <http://www.ciclavia.org/about/>,
<http://www.bikelongbeach.org/News/Read.aspx?ArticleId=85>,
<http://park101.org/>,
<http://laecovillage.wordpress.com/2010/06/04/lovely-long-beach-bike-lanes/>, and Western Riverside Council of Governments.

Research for an Era of Locally Innovative Transportation

- High occupancy toll lanes
- Real time parking pricing
- Bicycle sharing
- Neighborhood electric vehicles
- Pedestrian mall
- Traffic calming
- Employer provided transit pass
- Los Angeles' rail transformation
 - Six new lines opening between 2012 and 2020
 - Expo Line Phase I is the first of the six
 - When complete: Los Angeles Metropolitan Transportation Authority (MTA) rail system will be larger than Washington (DC) Metro
- California Senate Bill 375 (2008)
 - Southern California Association of Governments: 8% reduction by 2020; 13% reduction by 2035

Need for Program Evaluation

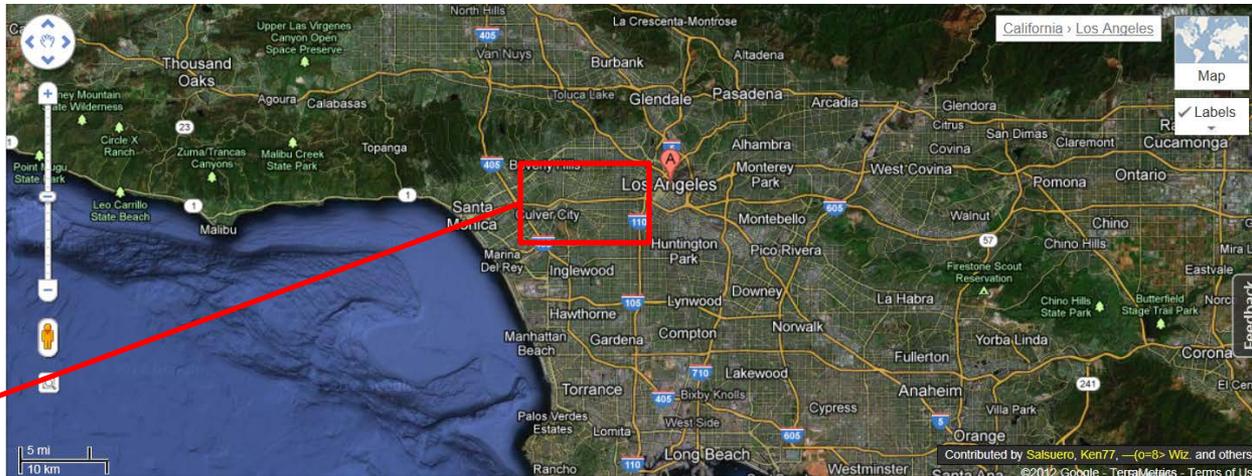
- **The Expo Line Study:** The first *Before-After, Experimental-Control Group* study of rail transit impact in California



- Motivation:
 - Better evidence on causal impact of rail
 - Estimate of magnitude of impact
 - Pilot test program evaluation more generally
- Previous similar studies in:
 - Charlotte (McDonald et al., 2010)
 - Salt Lake City (Brown and Werner, 2008)
 - Seattle (in progress, Saelens et al., U of Washington)

Study Design

Expo Line Phase I opened April 28, 2012 (Culver City station opened June 20, 2012)



Source: Google Maps



Source: L.A. Metro

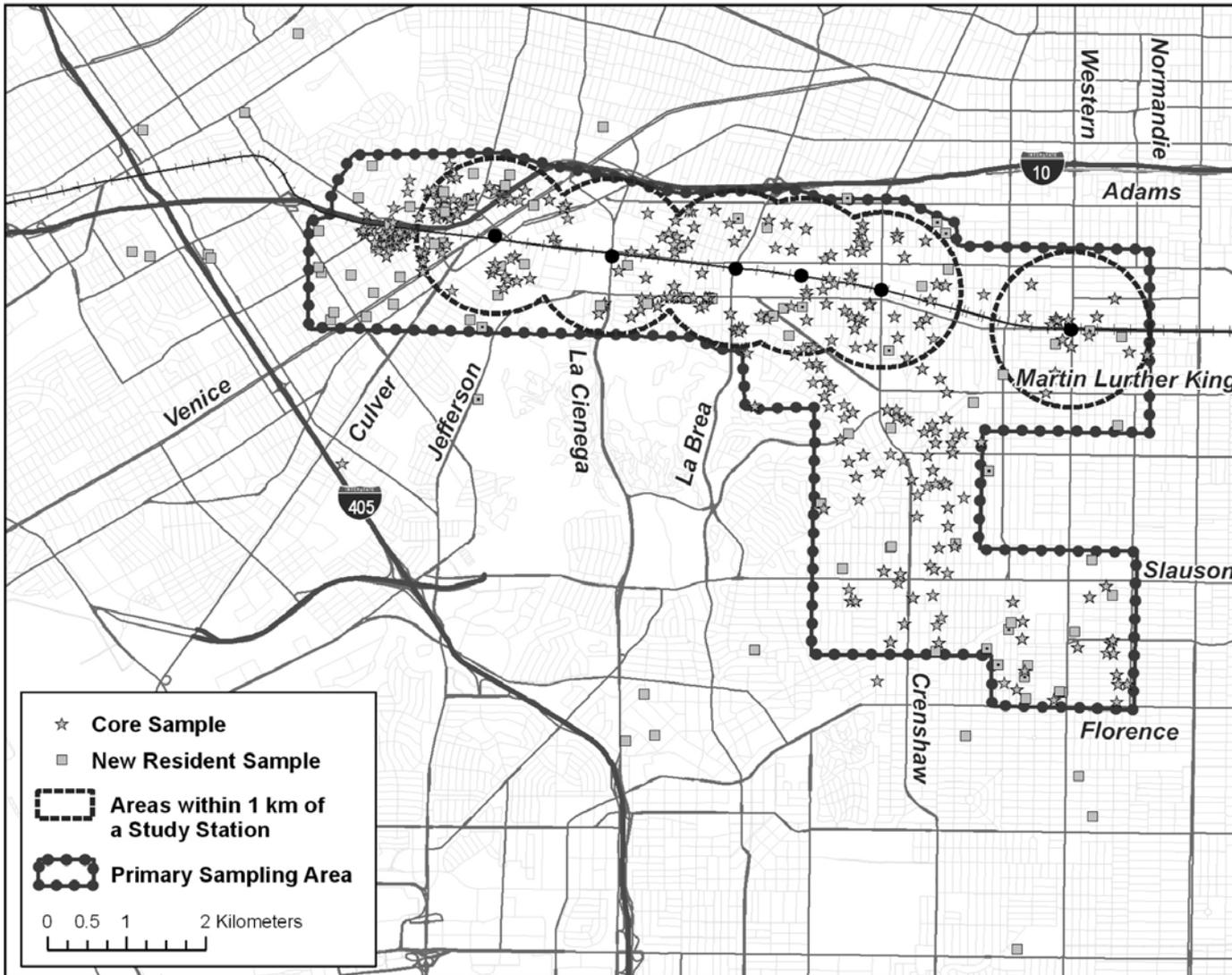
Experimental & Control Areas

Experimental Areas:

Within 1 kilometer of new stations which will receive the “treatment” (new rail service)

Control Areas:

Comparable areas beyond 1 km of stations which we did not expect to respond to the new rail service



Experimental & Control Areas

Census Data for Expo Line
Experimental and Control Areas

		Experimental	Control	Source
	Land Area (acres)	3590	5011	2010 Census SF1 Data
	Population Density*	21.1	18.1	2010 Census SF1 Data
	Housing Unit Density*	7.8	7.2	2010 Census SF1 Data
Race and Ethnicity:				
	Hispanic	51.8%	32.7%	2010 Census SF1 Data
	African American	27.7%	46.4%	2010 Census SF1 Data
	White	11.5%	12.5%	2010 Census SF1 Data
	Asian	5.8%	5.3%	2010 Census SF1 Data
	Other	1.0%	0.8%	2010 Census SF1 Data
	Multiple Races	2.1%	2.3%	2010 Census SF1 Data
Age:				
	Under 20 Years Old	27.5%	25.4%	2010 Census SF1 Data
	65 Years Old and Older	9.2%	12.0%	2010 Census SF1 Data
Household Income and Benefits (2010 Inflation-adjusted Dollars):				
	Less than \$25,000	29.8%	31.9%	ACS 2010 5-year Estimate
	\$25,000 to \$50,000	26.4%	27.8%	ACS 2010 5-year Estimate
	\$50,000 to \$74,999	18.5%	17.5%	ACS 2010 5-year Estimate
	\$75,000 to \$99,999	11.9%	8.1%	ACS 2010 5-year Estimate
	\$100,000 or more	13.5%	14.6%	ACS 2010 5-year Estimate

Participants by Survey Phase

Sample	Phase 1 6 Months Before Opening Sept. 2011 – Feb. 2012			Phase 2 6 Months After Opening Sept. 2012 – Feb. 2013			Phase 3 18 Months After Opening Sept. 2013 – April 2014		
	Exp.	Control	Total	Exp.	Control	Total	Exp.	Control	Total
Core	172	117	289	128	80	208	104	69	173
New Resident	0	0	0	55	35	90	34	24	58
Supp. New Resident	0	0	0	0	0	0	8	13	21
Total	172	117	289	183	115	298	146	106	252

Core Group Sample

Sample	Phase 1 6 Months Before Opening Sept. 2011 – Feb. 2012			Phase 2 6 Months After Opening Sept. 2012 – Feb. 2013			Phase 3 18 Months After Opening Sept. 2013 – April 2014		
	Exp.	Control	Total	Exp.	Control	Total	Exp.	Control	Total
	Core	172	117	289	128	80	208	104	69
New Resident	0	0	0	55	35	90	34	24	58
Supp. New Resident	0	0	0	0	0	0	8	13	21
Total	172	117	289	183	115	298	146	106	252

The “Core” sample of long-term households (Phases 1, 2, and 3)

- Longitudinal survey of all household members 12 and older
- 7-day trip and vehicle logs
- Household and individual sociodemographics
- Attitudes toward transit, environment, safety, etc.
- “Mobile tracking” sub-sample: 1 adult carried global positioning system (GPS)/accelerometer

Core Group Recruitment

NEIGHBORHOOD TRAVEL AND ACTIVITY STUDY

UCI IRVINE
survey website:
ntas.its.uci.edu

NONPROFIT ORG.
U.S. POSTAGE
PAID
Santa Ana, CA
Permit No. 1106

Planning, Policy and Design
300 Social Ecology I
University of California, Irvine
Irvine, CA 92697-7075

Please help improve transportation in your neighborhood!

¡Por favor ayude a mejorar los metodos de transporte en su comunidad!

Your Household Survey ID (HID):

Invitations

- Mailed to all 27,275 households in study area
- Phased from September-November 2011

Incentives

- Grocery gift cards
- \$15-\$50 per household
- Mobile tracking households: \$30-\$75

We need your help!

Participate in the NTAS study to inform decision makers about your area's traffic and transportation options and needs.

*As an incentive to participate, you will receive a **\$30** grocery gift card after you complete the study!*

To participate or for more information:

Go to the study website:
ntas.its.uci.edu

Or, call us (in English):
1-323-364-4824

¡Necesitamos su ayuda!

Participe en el estudio de NTAS para proveer información acerca del tráfico y las opciones de transporte en su comunidad.

*¡En gratitud por su participación, recibirá **\$30** para el supermercado al terminar el estudio!*

Para participar o para mas información:

Entre a la pagina web:
ntas.its.uci.edu

O, llame por teléfono (en Español) al:
1-323-570-4824

Core Group Recruitment

Overall response rate: 1%

- Response did not vary greatly across subgroups
- Compared to all households contacted, the study sample included a slightly lower percentage of the following (*differences were not statistically significant*):
 - Households headed by a male (36% vs. 42%)
 - Households headed by a younger adult aged 18–39 (21% vs. 27%)
 - Households with an annual income below \$30,000 (33% vs. 38%)
- Response is comparable to recent travel surveys:
 - **1.4%** response rate for region's *2010-2012 California Household Travel Survey* (defined as LA and Ventura County)
 - **0.4%** response rate for the *2012 Neighborhood Travel and Activity Study*

Core Group Survey Methods

Neighborhood Travel and Activity Study

Travel Log

Person Name:

	Car Driver	Car Passenger	Motorcycle/Scooter	Bus	Train	Bicycle		Walk		Other	Notes? Problems? Please describe below.
						# of Trips	Total Minutes	# of Trips	Total Minutes		
Monday											
Tuesday											
Wednesday											
Thursday											
Friday											
Saturday											
Sunday											

Instructions

- Count each trip you take during each day
- Include walk/bike trips over 5 minutes
- Count trips you take for recreation or exercise
- Log the total minutes you walk or bicycle each day
- Count each trip mode as a separate trip (car, walk, etc)

Suggestions

- Carry and complete the log as you travel
- Or you can complete the log at the end of each day
- Note any problems each day (forgot to fill out one day)
- See the back of this log for examples

Core Group Survey Methods

Neighborhood Travel and Activity Study

Vehicle Mileage Log

Vehicle Year: _____

Make (Ford, Honda, etc): _____

Model (Focus, Accord, etc): _____

	Start	End
Monday		
Tuesday		
Wednesday		
Thursday		
Friday		
Saturday		
Sunday		

Instructions

- Place one log in each vehicle in a visible location
- Enter vehicle year, make, and model
- Log mileage at the start and end of each day
- Obtain mileage from the *odometer* near the speedometer

New Resident Sample

Sample	Phase 1 6 Months Before Opening Sept. 2011 – Feb. 2012			Phase 2 6 Months After Opening Sept. 2012 – Feb. 2013			Phase 3 18 Months After Opening Sept. 2013 – April 2014		
	Exp.	Control	Total	Exp.	Control	Total	Exp.	Control	Total
Core	172	117	289	128	80	208	104	69	173
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Total	172	117	289	183	115	298	146	106	252

The “New resident” sample (Phases 2 and 3)

- Goal: to compare new resident travel to that of established households
- Households who moved to the study area after service began:
 - Longitudinal sample of new resident households (Phase 2 and 3)
 - Supplemental, cross-sectional sample of new resident households (Phase 3)
- Generally same survey protocol, except...
 - 3-day trip and vehicle logs
 - No “mobile tracking”

New Resident Survey Methods

Neighborhood Travel and Activity Study

Travel Log

Person Name:

	Car Driver	Car Passenger	Motor-cycle/ Scooter	Bus	Train	Bicycle		Walk		Other	Notes? Problems? Please describe below.
						# of Trips	Total Minutes	# of Trips	Total Minutes		
Tuesday											
Wednesday											
Thursday											

Instructions

- Count each trip you take during each day
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Suggestions

- Carry and complete the log as you travel
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- See the back of this log for examples

New Resident Survey Methods

Neighborhood Travel and Activity Study

Vehicle Mileage Log

Vehicle Year: _____

Make (Ford, Honda, etc): _____

Model (Focus, Accord, etc): _____

	Start	End
Tuesday		
Wednesday		
Thursday		

Instructions

- Place one log in each vehicle in a visible location
- Enter vehicle year, make, and model
- Log mileage at the start and end of each day
- Obtain mileage from the *odometer* near the speedometer on the instrument panel

Results Part 1. Long-Term Residents

Analytical Objectives

- Evaluate the impact of the Expo Line on the travel patterns of nearby residents
- Investigate changes in key travel patterns between the before-Expo and after-Expo phases
- Use descriptive and multivariate analysis to identify factors associated with changes in key travel outcomes

Sample Characteristics

	Phase 1			
	6 Months Before Opening			
	Experimental		Control	
	N	percent	N	percent
Household Income				
Less than \$35k	57	35.9%	48	44.0%
\$35k to \$75k	55	34.6%	38	34.8%
More than \$75k	47	29.6%	23	21.1%
Total	159	100.0%	109	100.0%
Home Ownership				
Rent	86	52.4%	60	56.6%
Own	78	47.6%	46	43.4%
Total	164	100.0%	106	100.0%
Housing Tenure				
Less than 1 year	12	7.6%	6	5.7%
1 to 5 years	53	33.8%	27	25.7%
5 to 10 years	29	18.5%	19	18.1%
More than 10 years	63	40.1%	53	50.5%
Total	157	100.0%	105	100.0%
	mean	S.D.	mean	S.D.
Household Size	2.05	1.22	2.18	2.04
Number of Vehicles	1.28	0.81	1.48	0.95
Number of Drivers Licenses	1.60	0.84	1.68	0.76
Household Age Composition (average in each age group)				
Under 12 years old	0.26	0.65	0.19	0.48
12 to 17 years old	0.14	0.49	0.17	0.38
18 years and older	1.65	0.74	1.82	0.89

Note: Figures in bold indicate differences significant at the 0.10 level.

Before-After Between Group Differences

		Phase 1 6 Mo. Before Opening			Phase 2 6 Mo. After Opening			Phase 3 18 Mo. After Opening		
Variable	Group	Mean	Mean Diff.	Sig.	Mean	Mean Diff.	Sig.	Mean	Mean Diff.	Sig.
VMT	exp	25.19	-3.47		23.22	-6.89	°	24.17	-9.75	*
	control	28.66			30.11			33.92		
Train trips	exp	0.07	0.01		0.29	0.25	***	0.30	0.21	*
	control	0.06			0.04			0.09		
Total Transit Trips	exp	0.69	0.14		0.84	0.21		0.74	0.15	
	control	0.55			0.63			0.59		

Significance codes: *** < 0.001 ** < 0.01, * < 0.05, ° < 0.10

VMT = vehicle miles traveled

Difference-in-Difference (DID) Regression Results

Controlling for income and # of persons and vehicles in households

Travel Outcome	DID Est. 6			DID Est. 18			Model Adj. R-sq.	N
	mo. After opening	t	Sig.	mo. After opening	t	Sig.		
VMT	-7.71	-1.63		-10.87	-2.18	*	0.32	524
Car Driver Trips	0.15	0.30		0.03	0.06		0.37	575
Car Passenger Trips	0.04	0.12		-0.05	-0.16		0.25	579
Bus Trips	-0.19	-0.87		-0.11	-0.49		0.25	579
Train Trips	0.23	2.39	*	0.20	2.00	*	0.09	579
Total Transit Trips	0.04	0.17		0.09	0.33		0.24	579
Walk Trips	-0.08	-0.22		-0.32	-0.78		0.14	577
Bicycle Trips	0.17	1.29		0.03	0.18		0.05	579
Total Trips	-0.36	0.24		-0.36	-0.37		0.37	573

Significance codes: ** < 0.01, * < 0.05, ° < 0.10

Difference-in-Difference Regression Results

Controlling for income and # of persons and vehicles in HH

What dynamics were associated with this ***substantial drop in daily VMT*** for near-Expo households?

- Train trips captured only a small share of travel (4.4% at 18 months after opening)
- It is unlikely that substitution of rail-for-car could completely account for the change in VMT

An alternate hypothesis...

- A combination of ***mode substitution*** and ***changes in car use*** were responsible for the VMT drop in experimental households

Rail Riders

Reduced Car Trip Length

	6 Months Before Opening			6 Months After Opening			18 Months After Opening		
	Train Users (n = 25, 8.8 %)	Non-train Users (n =260, 91.2 %)		Train Users (n = 41, 19.8 %)	Non-train Users (n =166, 80.2 %)		Train Users (n = 35, 20.3 %)	Non-train Users (n = 138, 79.7 %)	
	Mean	Mean	Sig.	Mean	Mean	Sig.	Mean	Mean	Sig.
Car Trip Length	9.02	9.56		6.75	9.30		4.13	9.86	**
Cars Available	0.72	1.42	***	1.05	1.36	*	1.09	1.39	°
Household Income (\$1,000)	17.0	55.7	***	46.9	54.7		35.9	53.4	*

Significance Codes: * < 0.001, ** < 0.01, * < 0.05, ° < 0.10**

And Rail Riders Became More Like Non-Riders

	6 Months Before Opening			6 Months After Opening			18 Months After Opening		
	Train Users (n = 25, 8.8 %)	Non-train Users (n =260, 91.2 %)		Train Users (n = 41, 19.8 %)	Non-train Users (n =166, 80.2 %)		Train Users (n = 35, 20.3 %)	Non-train Users (n = 138, 79.7 %)	
	Mean	Mean	Sig.	Mean	Mean	Sig.	Mean	Mean	Sig.
Car Trip Length	9.02	9.56		6.75	9.30		4.13	9.86	**
Cars Available	0.72	1.42	***	1.05	1.36	*	1.09	1.39	°
Household Income (\$1,000)	17.0	55.7	***	46.9	54.7		35.9	53.4	*

Significance Codes: * < 0.001, ** < 0.01, * < 0.05, ° < 0.10**

Shorter Car Trips are More Important than Rail Displacing Car Trips

				Fraction of Total VMT Reduction
1. Rail Trips Displace Car Trips				
Effect Size	Car Trip Length	Effect Calculation	Effect	
-0.20 trips per day	10.6 miles/trip	10.6 miles/trip * 0.20 trips per day	-2.12 daily miles	20.0%
<i>Change in rail trips</i>	<i>experimental, Wave 1, car trip length</i>			
2. Car Trips Get Shorter				
Effect Size	Penetration	Effect Calculation	Effect	
-5.44 miles/trip	26.0%	penetration (26.0%) * effect size (-5.44 miles/trip) * number of car trips (3.12 car trips per day, experimental, before opening)	-4.41 daily miles	41.6%
<i>Change in car trip length for rail riders</i>	<i>Fraction rail riders among experimental group</i>			

Fraction of 10.87 household miles per day VMT reduction

Results Part 2. New vs. Longer-Term Residents

Residents who relocate from outside the area to live near light rail transit (LRT) may prefer to live in denser, mixed-use, and transit-accessible areas.

Analytical Objectives

- Compare the influence of LRT on long-term and new residents
- Assess potential differences in travel patterns
- Investigate the value that residents place on living near transit

New vs. Longer-term Residents

Sample Characteristics

New resident households... (compared to core households)

- Tended to be younger
- Had a higher rate of renting their homes
- Had higher income

New resident and core households were similar in terms of...

- Household size
- Vehicle ownership
- Number of household members with driver's licenses

New vs. Longer-term Residents Travel Patterns

All Households	LA County CHTS		Phase 1 6 Months Before Opening		Phase 2 6 Months After Opening				Phase 3 18 Months After Opening			
	(n = 8,219)		(n = 284)		(n = 207)		(n = 90)		(n = 173)		(n = 78)	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Personal Vehicle (driver + psnger)	6.39	6.61	4.22	4.00	4.03	3.73	3.73	2.43	4.38	4.37	3.86	2.64
Bus	0.33	1.43	0.60	1.63	0.64	1.44	0.50	1.23	0.43	1.15	0.52	1.35
Rail transit	0.07	0.59	0.09	0.37	0.19	0.57	0.28	0.72	0.16	0.49	0.21	0.56
Walk	1.36	3.24	1.50	3.20	1.60	1.98	1.78	2.03	1.40	2.12	1.29	1.55
Bike	0.11	0.72	0.16	0.62	0.29	1.19	0.08	0.26	0.24	0.69	0.22	0.71
Other	0.11	0.63	0.35	3.25	0.03	0.26	0.02	0.14	0.02	0.17	0.00	0.00
Total trips	8.37	7.88	6.98	6.69	6.82	5.11	6.43	3.20	6.76	5.37	6.18	3.46
VMT	35.15	46.15	25.84	26.15	26.46	28.52	33.87	36.08	28.94	33.48	35.65	37.01

Expo Study samples include travel on Tuesday, Wednesday, and Thursday only.

New vs. Longer-term Residents Travel Patterns

All Households	LA County CHTS		Phase 1 6 Months Before Opening		Phase 2 6 Months After Opening				Phase 3 18 Months After Opening			
			Core		Core		New Resident		Core		New Resident	
	(n = 8,219)		(n = 284)		(n = 207)		(n = 90)		(n = 173)		(n = 78)	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Personal Vehicle (driver + psnger)	6.39	6.61	4.22	4.00	4.03	3.73	3.73	2.43	4.38	4.37	3.86	2.64
Bus	0.33	1.43	0.60	1.63	0.64	1.44	0.50	1.23	0.43	1.15	0.52	1.35
Rail transit	0.07	0.59	0.09	0.37	0.19	0.57	0.28	0.72	0.16	0.49	0.21	0.56
Walk	1.36	3.24	1.50	3.20	1.60	1.98	1.78	2.03	1.40	2.12	1.29	1.55
Bike	0.11	0.72	0.16	0.62	0.29	1.19	0.08	0.26	0.24	0.69	0.22	0.71
Other	0.11	0.63	0.35	3.25	0.03	0.26	0.02	0.14	0.02	0.17	0.00	0.00
Total trips	8.37	7.88	6.98	6.69	6.82	5.11	6.43	3.20	6.76	5.37	6.18	3.46
VMT	35.15	46.15	25.84	26.15	26.46	28.52	33.87	36.08	28.94	33.48	35.65	37.01

Expo Study samples include travel on Tuesday, Wednesday, and Thursday only.

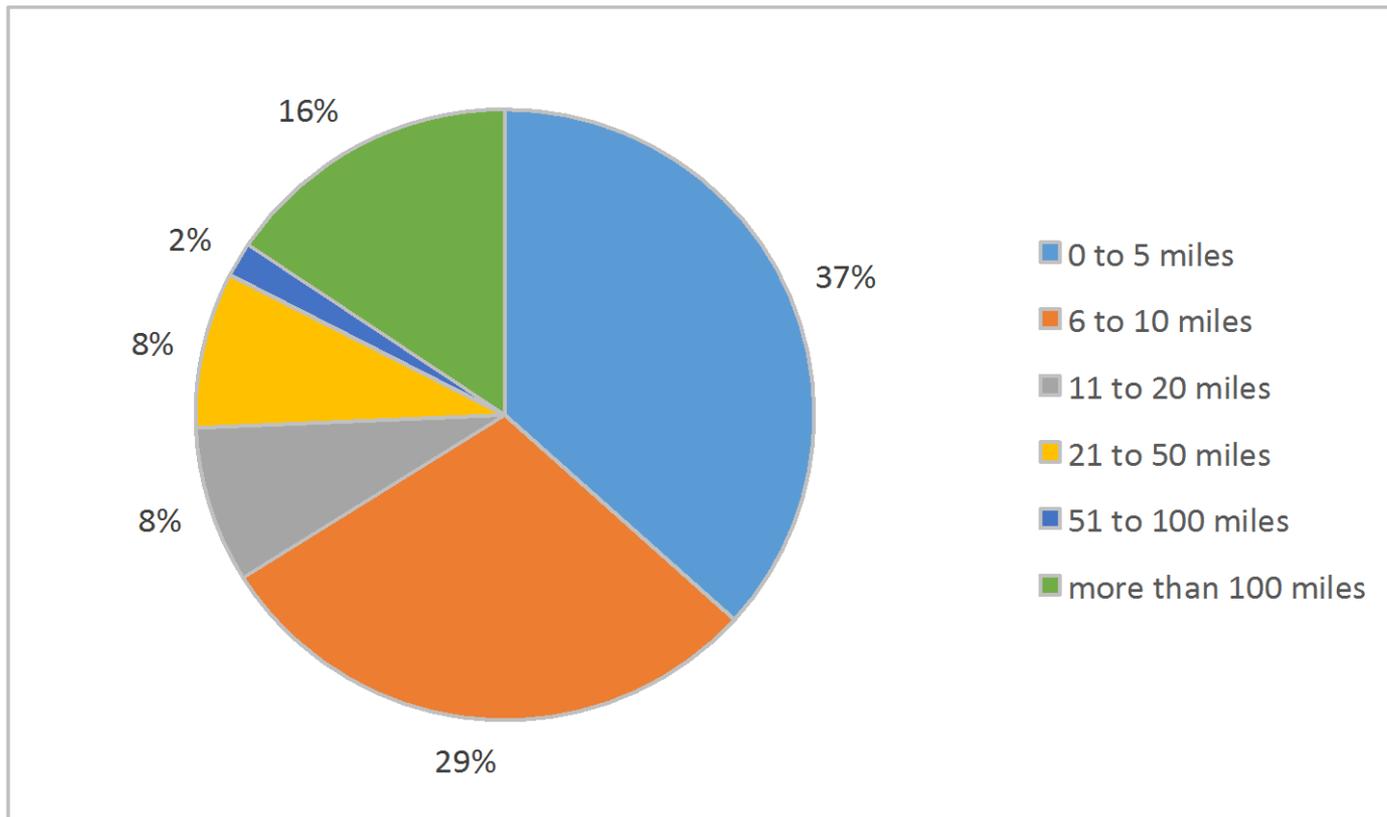
New vs. Longer-term Residents Experimental Areas

	6 Months After Opening					18 Months After Opening				
	Core		New Resident		Sig.	Core		New Resident		Sig.
	(n = 128)		(n = 33)			(n = 104)		(n = 31)		
	Mean	S.D.	Mean	S.D.		Mean	S.D.	Mean	S.D.	
VMT	23.36	25.28	31.43	33.4	*	25.17	25.92	34.38	35.76	
Car Driver	3.41	2.97	2.97	1.87		3.74	3.52	3.03	2.04	
Car Passenger	0.59	1.18	0.38	0.54		0.53	1.04	0.75	1.09	
Bus	0.61	1.44	0.31	0.94		0.39	0.99	0.54	1.71	
Rail transit	0.28	0.57	0.48	1.03		0.21	0.59	0.43	0.81	°
Walk	1.78	1.98	1.99	1.92		1.42	2.17	1.19	1.43	
Bike	0.38	1.19	0.12	0.49		0.25	0.68	0.29	0.96	
Total trips	7.05	5.11	6.25	3.01		6.58	4.77	6.06	3.77	
Avg. Car Trip Length	7.60	11.61	16.61	29.63	**	7.53	10.72	11.89	2.18	°

Significance: ** < 0.01, * < 0.05, ° < 0.10

- New residents near a station had higher VMT and took longer car trips, but had rail ridership rates

New Residents: Move Distance



New Residents: Residential Selection Factors

	Experimental Households			Control Households			Sig.
	N	Mean	S.D.	N	Mean	S.D.	
Housing affordability	42	6.60	0.89	67	6.43	1.09	
Low crime	42	5.45	1.40	65	5.74	1.36	
A particular type/quality of housing in the neighborhood	43	5.14	1.61	66	5.41	1.55	
Access to shops and services (grocery stores, etc.)	43	5.14	1.61	67	5.21	1.64	
Short commute to your workplace or school	43	5.23	1.97	66	5.12	2.04	
Visual attractiveness of the neighborhood	43	4.93	1.40	66	5.32	1.30	
Access to open space (parks, beaches, mountains, etc)	43	4.58	1.69	65	4.80	1.71	
Lower traffic noise or safety from traffic	43	4.60	1.61	66	4.76	1.74	
Access to highways, generally	29	4.52	1.70	57	4.70	1.88	
Access to public transit, generally	43	4.58	2.05	65	4.29	2.16	
Near to family and friends	43	4.00	2.10	66	4.27	2.15	
Access to the rail transit system (Metro subway or light rail)	43	4.49	2.11	66	3.70	2.16	°
Short commute to work/school for other household adult	41	3.66	2.59	65	4.20	2.39	
Wanted to live near certain kinds of people/households (families with children, ethnic or cultural group, etc)	43	3.63	1.99	66	3.76	2.21	
Familiarity with the neighborhood	43	3.77	2.08	65	3.60	2.10	
Quality of the public schools	43	3.02	2.40	65	2.85	2.31	
Short trip to school/daycare for children in your household	41	2.12	2.16	62	2.34	2.33	
Access to child care	43	2.33	2.20	64	1.66	1.71	°
Wanted to move in with someone in the neighborhood	43	1.91	1.63	64	1.64	1.50	

All items measured on a scale of 1 (not important at all) to 7 (extremely important)

Significance codes: ** < 0.01, * < 0.05, ° < 0.10

The Expo Line Study is the most comprehensive evaluation of a new light rail transit line on travel behavior and physical activity

Longer-term residents

- The line had a significant and policy-relevant impact
- Daily household vehicle miles traveled (VMT) dropped by about **11 miles per day** (group av. \cong 27 mi/day)
 - Nearly two thirds of the VMT reduction can be attributed to *shorter car trips* and *eliminated driving trips* among rail riders
- The line was associated with increased in rail trips, but not walking and bicycling

New residents

- Tended to be younger, had higher rental rates, and higher income
- Were similar in terms of household size, vehicle ownership, and number of household drivers.
- Those near a station drove 8-10 more miles/day and took longer car trips but had *higher rail ridership rates*
- Being able to walk to shops and services was important for recent move

Study Limitations

- Low response rate (1%)
 - Comparable to the response rate for two recent travel surveys in the region
 - Responses rates for subgroups suggests the final sample was largely representative of the study area population
- More research is needed to determine whether the observed effects of light rail will hold for different neighborhoods. The study area was...
 - Largely low-income and non-white (primarily African-American, Hispanic)
 - Moderate residential density and corridor-oriented commercial development
- Research is needed to more fully investigate the role that residential self-selection may play in the observed patterns
 - Could impacts of the line could be due to households moving to the study area to suit their travel and activity preferences?

Recommendations

Future research is needed to extend, clarify and validate our findings:

- Additional longitudinal evaluations of the impacts of light rail transit and other infrastructure and land use changes on travel behavior
- Greater incorporation of psycho-social, attitudinal, and neighborhood preference factors in studies local land use and transit investments
- Assessments of gentrification processes and residential displacement
- Investigation of land use and development changes associated with rail investments

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