A METHOD FOR LINKING TRANSIT SMART CARD DATA AND SURVEY RESPONSES TO EVALUATE TRAVEL BEHAVIOR AND ITS APPLICATION TO A BEFORE-AFTER ANALYSIS OF REAL-TIME INFORMATION

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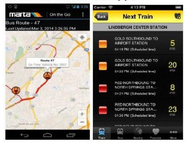
Background on Real-Time Information in Atlanta

- **Background**: Real-time transit information provided via smartphone apps has rapidly become available for the Metropolitan Atlanta Rapid Transit Authority's (MARTA) buses and trains, including:
  - **On the Go** smartphone apps launched by MARTA in November 2013
  - **OneBusAwa**y web and smartphone apps released by Georgia Tech in February 2014
  - **Many other apps** created by third party software developers in 2013 and 2014

MARTA's On the Go Apps



Georgia Tech's OneBusAway Apps

Research Question and Methodology

- **Research Question:** Do transit riders who use real-time information make more trips on MARTA buses and trains?
- **Methodology:** Before-after analysis of MARTA trips comparing April 2013 to April 2014
- **Unit of Analysis:** Individual riders (enrolled in this study)
- **Primary Data Source:** Breeze Card smarts cards, which measure the number of bus and train trips
- **Secondary Data Source:** Survey questions asking about use of real-time information and the respondent's unique 16-digit smart card ID number, which links the individual's survey response and smart card data

Image Source: itsmarta.com

Survey Data Collection

- **Data Collection**
  - Web-based survey conducted during the first week of May 2014
- **Recruitment**
  - Both real-time information (RTI) users and non-users
  - Respondents must have a Breeze Card to participate
- **Matching the Survey Responses and Smart Card Data**
  - 669 study participants entered survey software
  - 538 respondents provided a 16-digit smart card number
  - 494 survey responses matched usable, active smart cards
- **Final Dataset**
  - The 494 survey responses were then joined with the corresponding smart card trip information for two months (April 2013 & April 2014)

Serial Number

*3. What is your 16-digit Breeze Card number?
Please do not enter spaces or dashes.

Image: Survey question

Conditions Imposed on the Dataset

Three conditions (1A-3B) were investigated to assess if each record in the joint smart card/survey dataset accurately reflects an individual's travel behavior. This process reduced the sample size.

No.	Condition	Meaning	Sample Size	% Total
-	Full Survey/Smart Card Dataset	Surveys joined with corresponding smart card data	494	100%
1A	Panel Eligibility of the Intervention	Began using apps before April 2014 or non-users	431	87%
1B	Panel Eligibility of the Smart Card	Had smart card for at least one year (April 2013)	305	62%
2A	Complete with One Breeze Card	Does not have 2 or more Breeze Cards	219	44%
2B	Complete with No Other Fare Media	Does not use a paper ticket to pay for MARTA	193	39%
2C	Unique	Does not share their Breeze Card with friends/family	159	32%
3A	Closely Congruent	Stated MARTA trips closely match smart card trips	135	27%
3B	Perfectly Congruent	Stated MARTA trips perfectly match smart card trips	100	20%

Before-After Comparison of MARTA Trips

Difference of mean tests were used to compare the change in transit trips from the smart card records before and after the availability of real-time information for users and non-users. After the conditions were imposed, there was not a significant difference between the two groups (highlighted).

		All Data		Closely Congruent		Perfectly Congruent	
Use of Real-Time Information (RTI)		RTI	No	RTI	No	RTI	No
	Count	302	192	60	75	38	62
April [1] 2013	Mean	10.2	4.7	15.6	5.7	12.8	4.1
	SD	20.2	14.5	21.7	12.3	22.2	9.4
April [1] 2014	Mean	21.9	9.6	21.7	7.9	21.1	5.1
	SD	29.3	22.4	27.5	14.7	29.8	10.6
Difference	Mean	11.7	4.9	6.1	2.2	8.3	1.0
	SD	27.8	15.8	25.4	11.3	25.1	8.9
		t = -3.478 *p=0.0006*		*t = -1.097* *p=0.276*		*t = -1.732* *p=0.0905*	
Total Sample Size		494		135		100	

[1] Four weeks in April 2013 and four weeks in April 2014 beginning with the first Tuesday of the month.

Regression Analysis of MARTA Trips

Regression analysis was used to control for other factors that may have affected an individual's transit trips. The dependent variable was the difference in monthly[1] trips from April 2013 to 2014 from the smart card records. After the conditions were imposed, use of real-time information was not significant.

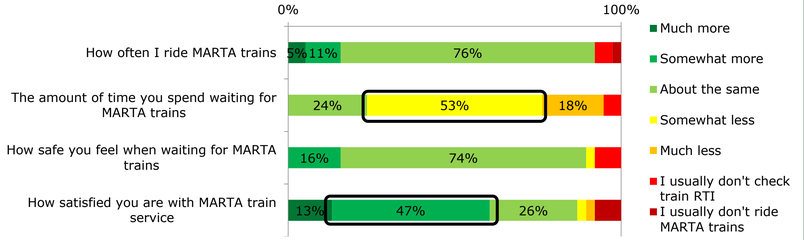
Dataset	All Data	Closely Congruent	Perfectly Congruent
Intercept	20.887 (5.644)***	37.115 (14.754)**	36.146 (16.956)**
Use Real-Time Information	6.61 (1.897)***	-0.664 (2.526)	2.651 (3.04)
Has a License	-18.633 (5.886)***	-38.944 (15.191)**	-38.436 (17.662)**
African American	16.544 (5.797)***	18.47 (9.266)**	10.815 (9.45)
Increased Cars in Household	-8.215 (2.488)***	-4.237 (2.393)*	-2.159 (2.305)
Aware of Service Change	0.012 (2.15)	6.231 (2.819)**	6.647 (3.056)**
R^2	0.15	0.35	0.30
Observations^	477	131	98

*p<0.1; **p<0.05; ***p<0.01; Values shown in parentheses are robust standard errors.
^Number of observations reduced due to missing responses for specific questions.

[1] Four weeks in April 2013 and four weeks in April 2014 beginning with the first Tuesday of the month.

Perceived Changes when Riding MARTA Trains

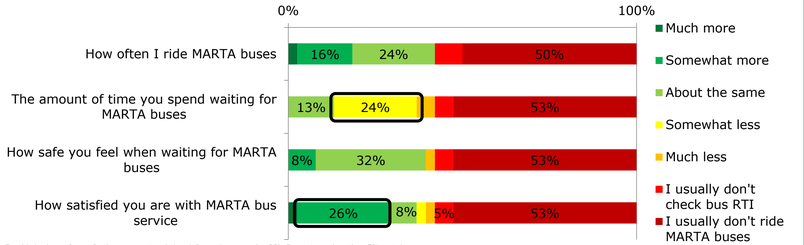
On the survey, real-time information (RTI) users were asked about perceived changes when riding MARTA trains since they began using RTI. Many respondents perceived decreases in wait times and increases in satisfaction with MARTA train service.*



*Graphic is shown for perfectly congruent real-time information users (n=38). Percentages less than 5% not shown.

Perceived Changes when Riding MARTA Buses

On the survey, real-time information (RTI) users were asked about perceived changes when riding MARTA buses since they began using RTI. Some respondents perceived decreases in wait times and increases in satisfaction with MARTA bus service.*



*Graphic is shown for perfectly congruent real-time information users (n=38). Percentages less than 5% not shown.

Conclusions, Limitations and Future Research

- **Conclusions**
  - Statistical analysis of the full dataset (n=494) suggests that real-time information users increased transit trips; however, after the conditions were imposed and the sample size was reduced (n=100), there was not a significant difference between real-time information users and non-users.
  - Many real-time information users perceived a decrease in wait times and increase in satisfaction with MARTA service.
- **Limitations**
  - The sample size decreased substantially when conditions were imposed.
  - Non-probability sampling was used to collect the survey responses.
- **Future Research**
  - Transit agencies can ask for smart card numbers on surveys to assess changes in passenger behavior.

Image Source: itsmarta.com

Acknowledgements

The written results of this research can be found in Candace Brakewood's Georgia Tech dissertation. The corresponding paper is currently under review by *Transport Policy*.

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