Bus Lanes in NYC: Design & Performance

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9/18/2013

What they aren't (yet)

Curitiba

Cleveland

Guangzhou

What they are

Bus lanes in NYC are permeable surfaces, which may be used or not used by bus drivers, and obstructed or unobstructed by other vehicles.

Purpose & Methodology

- Study seeks to quantitatively assess the impact of bus lane design features on bus lane effectiveness across different traffic conditions.
  - Tests effects of lane configuration and markings color on bus lane obstruction, usage, and bus speed.

- Two Studies:
  - Bus Lane Obstruction and Usage Study
  - Bus Speed Study

STUDY 1

Bus Lane Obstruction and Usage

Variables & Hypotheses

Dependent Variables

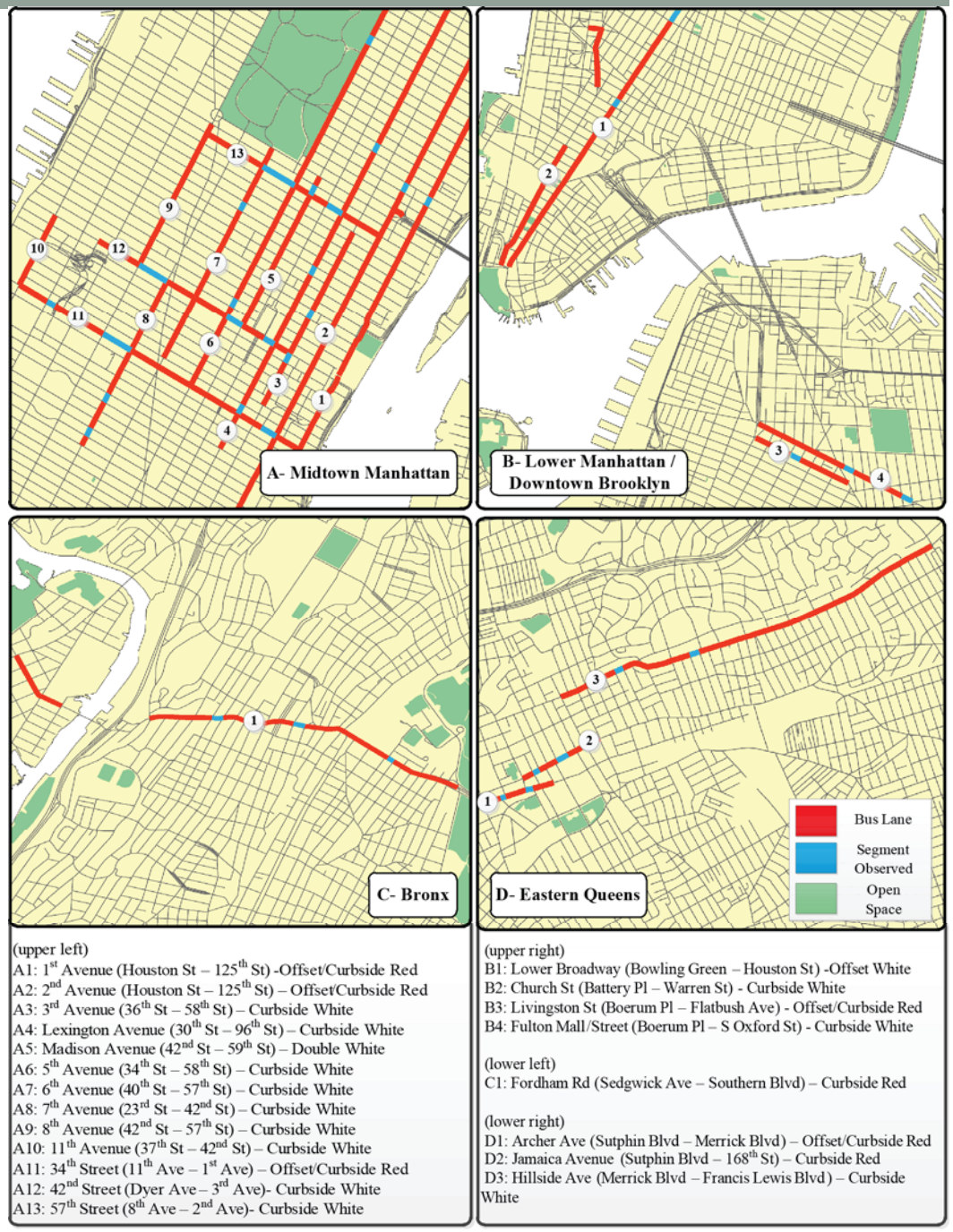
- Obstruction (binary)
- Usage (ordinal: none, some, full)

Independent Variables

- Lane Configuration
- Markings Color
- Vehicular Volume
- Pedestrian Volume
- Bus Type
- Taxi Presence

Hypotheses

- Offset & red-painted lanes will be obstructed less and used more.



(upper left)
A1: 1st Avenue (Houston St – 125th St) -Offset/Curbside Red
A2: 2nd Avenue (Houston St – 125th St) – Offset/Curbside Red
A3: 3rd Avenue (36th St – 58th St) – Curbside White
A4: Lexington Avenue (30th St – 96th St) – Curbside White
A5: Madison Avenue (42nd St – 59th St) – Double White
A6: 5th Avenue (34th St – 58th St) – Curbside White
A7: 6th Avenue (40th St – 57th St) – Curbside White
A8: 7th Avenue (23rd St – 42nd St) – Curbside White
A9: 8th Avenue (42nd St – 57th St) – Curbside White
A10: 11th Avenue (37th St – 42nd St) – Curbside White
A11: 34th Street (11th Ave – 1st Ave) – Offset/Curbside Red
A12: 42nd Street (Dyer Ave – 3rd Ave)- Curbside White
A13: 57th Street (8th Ave – 2nd Ave)- Curbside White

(upper right)
B1: Lower Broadway (Bowling Green – Houston St) -Offset White
B2: Church St (Battery Pl – Warren St) - Curbside White
B3: Livingston St (Boerum Pl – Flatbush Ave) - Offset/Curbside Red
B4: Fulton Mall/Street (Boerum Pl – S Oxford St) - Curbside White

(lower left)
C1: Fordham Rd (Sedgwick Ave – Southern Blvd) – Curbside Red

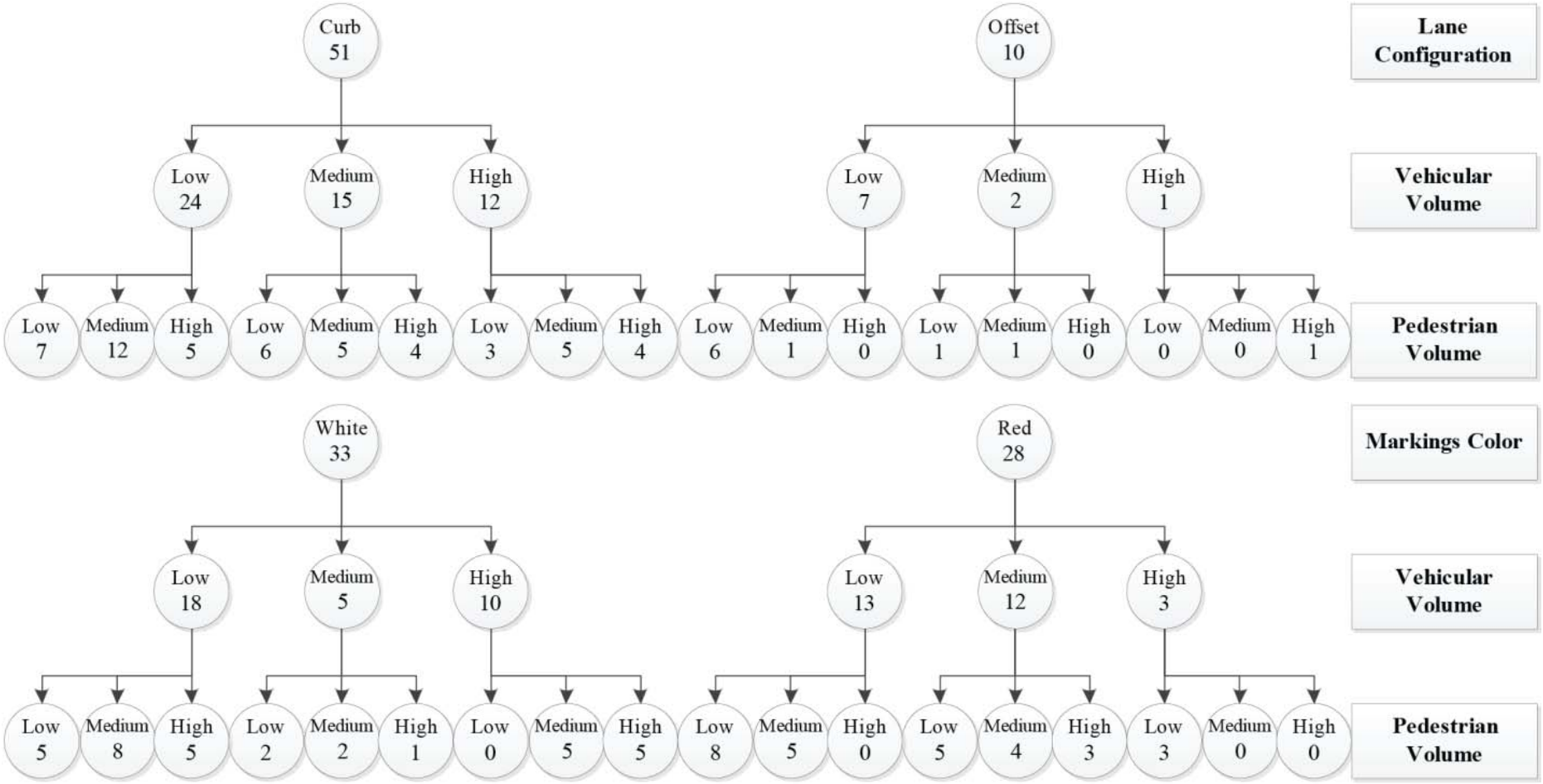
(lower right)
D1: Archer Ave (Sutphin Blvd – Merrick Blvd) – Offset/Curbside Red
D2: Jamaica Avenue (Sutphin Blvd – 168th St) – Curbside Red
D3: Hillside Ave (Merrick Blvd – Francis Lewis Blvd) – Curbside White

Field Coding Process

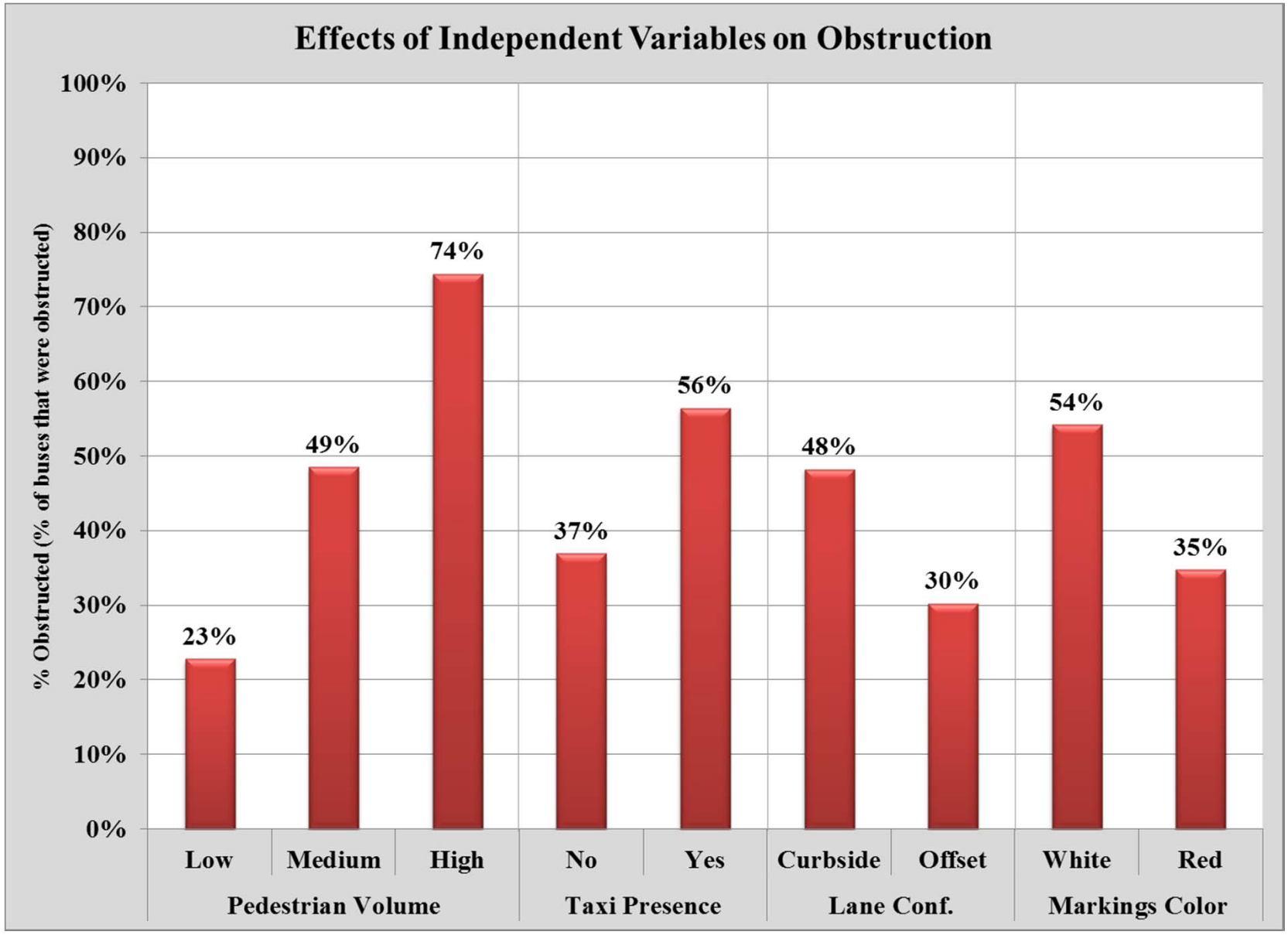
Example of field observation coding

- (a) Left, Curbside red bus lane segment on Archer Avenue between 160th St. & Union Hall St. was observed on 11/29/2012 to have a medium level of vehicular volume, a low level of pedestrian volume, and no taxi presence.
- (b) Right, A Q83 local bus fully using the bus lane, and facing no obstruction.

Design and Traffic Variable Distribution



Obstruction Findings - Descriptive

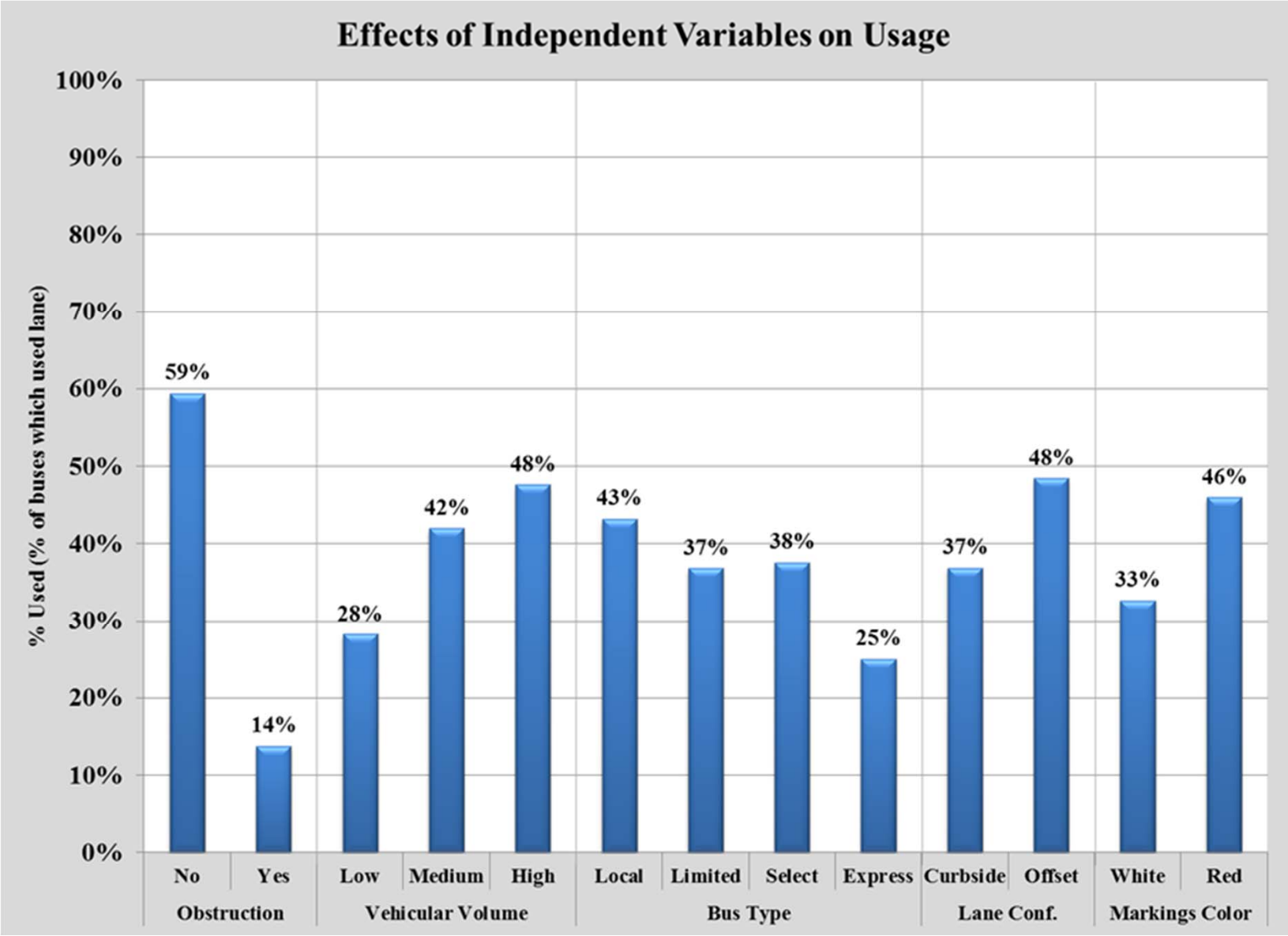


Obstruction Findings - Regression

Predictor Variable	Category	Odds Ratio	P value
Pedestrian Volume	Low	1	--
	Medium	2.54	.000*
	High	7.75	.000*
Taxi Presence	No	1	--
	Yes	1.36	.032*
Bus Type	Local	0.92	.701
	Limited	1.13	.655
	Select	1	--
	Express	0.93	.794
Lane Configuration	Curbside	1.39	.049*
	Offset	1	--
Markings Color	White	1.07	.642
	Red	1	--

- The obstruction model was found to be statistically significant (N= 1699, df= 8, $\chi^2 = 261.443$, p= .000), explaining 19.1% of the variation in obstruction (Nagelkerke's R).
- Buses passing curbside segments were 1.39 times more likely to be obstructed than buses passing offset segments (p= .049). Markings color did not significantly affect obstruction.

Usage Findings - Descriptive



Usage Findings - Regression

Predictor Variable	Category	Odds Ratio	P value
Obstruction	No	9.21	.000*
	Yes	1	--
Vehicular Volume	Low	1	--
	Medium	1.93	.000*
	High	4.42	.000*
Bus Type	Local	2.39	.000*
	Limited	2.06	.004*
	Select	1	--
	Express	1.24	.363
Lane Configuration	Curbside	1	--
	Offset	1.97	.000*
Markings Color	White	1	--
	Red	1.52	.002*

- The usage model was found to be statistically significant (N= 1699, df= 8, $\chi^2 = 645.964$, p= .000), explaining 36.2% of the variation in usage (Nagelkerke's R).
- Offset lanes were 1.97 times more likely to be used than curbside lanes (p= .000), and red-painted lanes were 1.52 times more likely to be used than white-marked lanes (p= .002).

Study 1 Conclusions

- Traffic variables had their expected large effects on bus lane obstruction and usage.
- Irrespective of traffic effects, offset configuration significantly decreased obstruction and increased usage, while red paint significantly increased usage.
- Obstruction and usage are measuring roughly the same thing on different geographic scales. Usage can be seen as a multi-segment measure of obstruction, whereby both design and environmental variables that may have discouraged obstruction on previous blocks then pay dividends in the form of usage downstream on the observed block
- Better-designed lanes are less likely to be obstructed and more likely to be used, increasing the likelihood of conferring actual performance benefits to buses.

STUDY 2

Impact of Bus Lanes on Bus Speed

Variables & Hypotheses

Dependent Variables

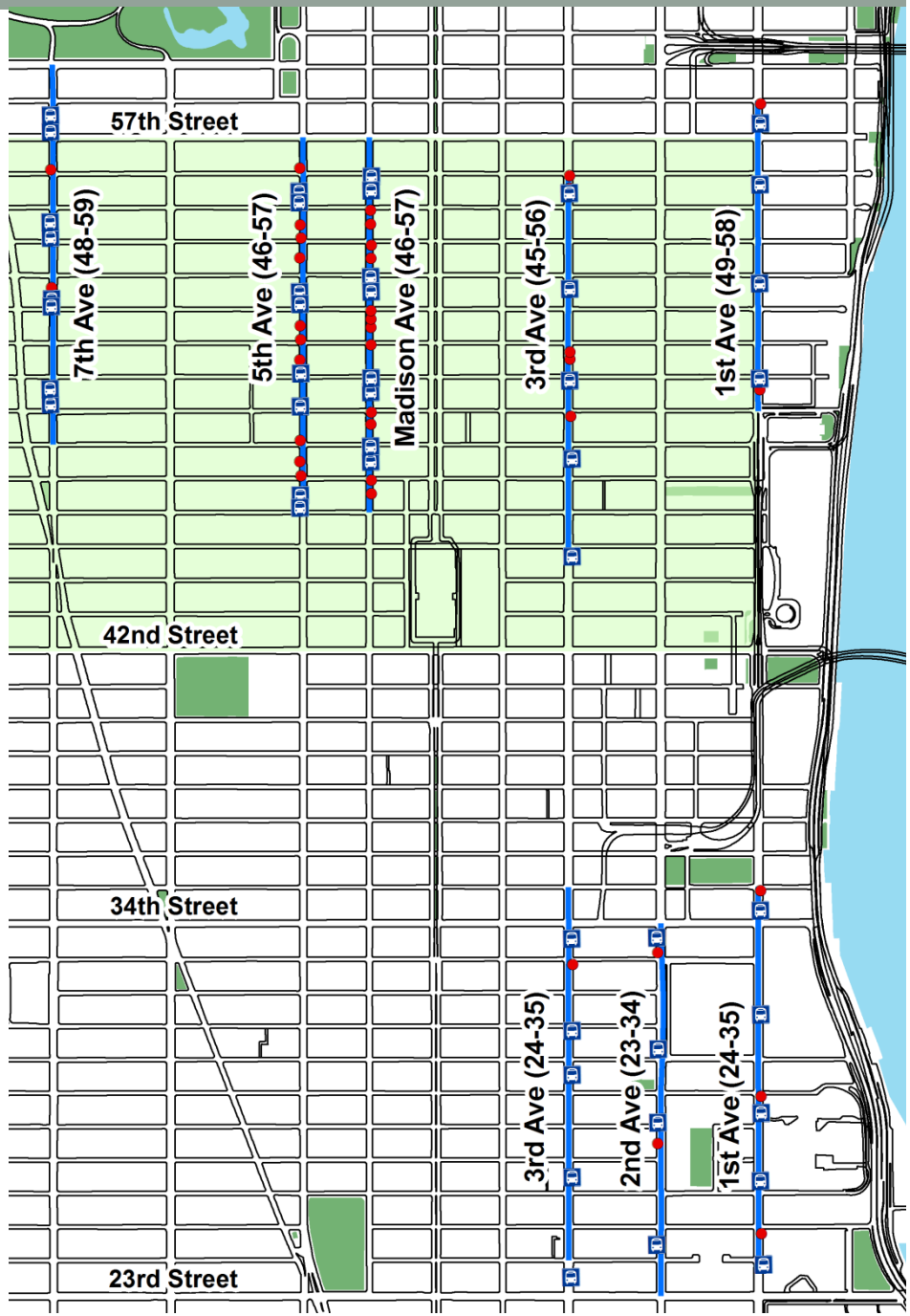
- Bus travel time – (# of stops * dwell time) = non-dwell travel time
- Distance/non-dwell travel time = non-dwell bus speed
- Non-dwell bus speed / general traffic speed = non-dwell bus speed ratio

Independent Variables

- Lane Configuration, Markings Color, Traffic

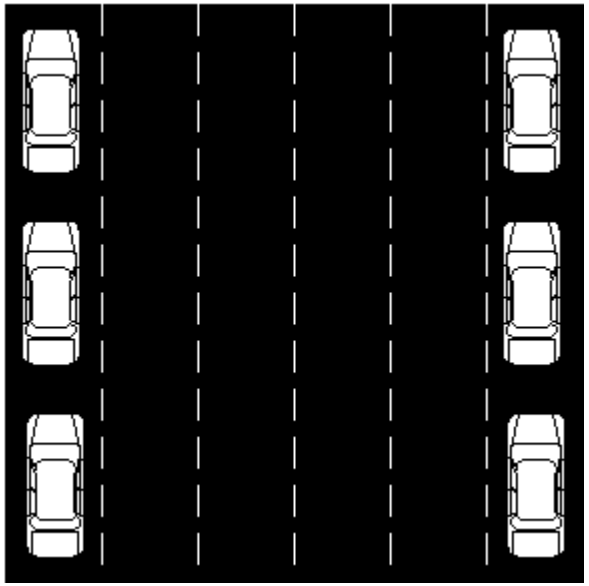
Hypotheses

- Offset & red-painted lanes will show larger non-dwell bus speed ratios.

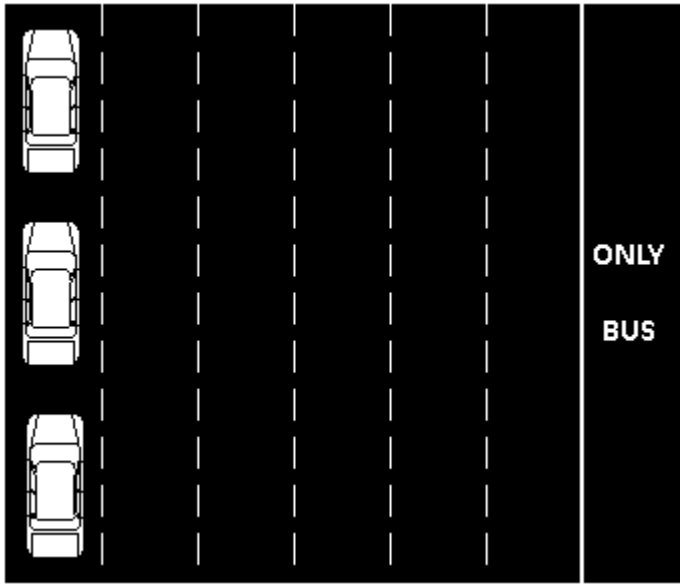


Upper Midtown Corridors

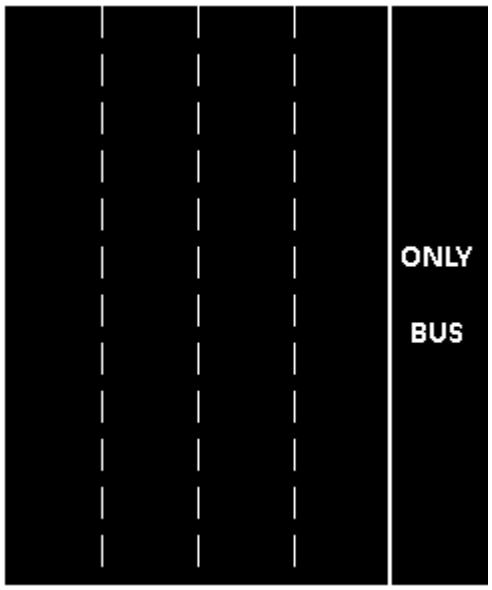
7th Avenue



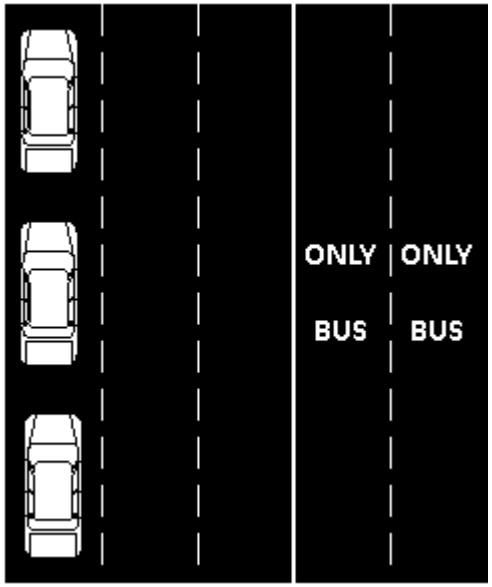
3rd Avenue



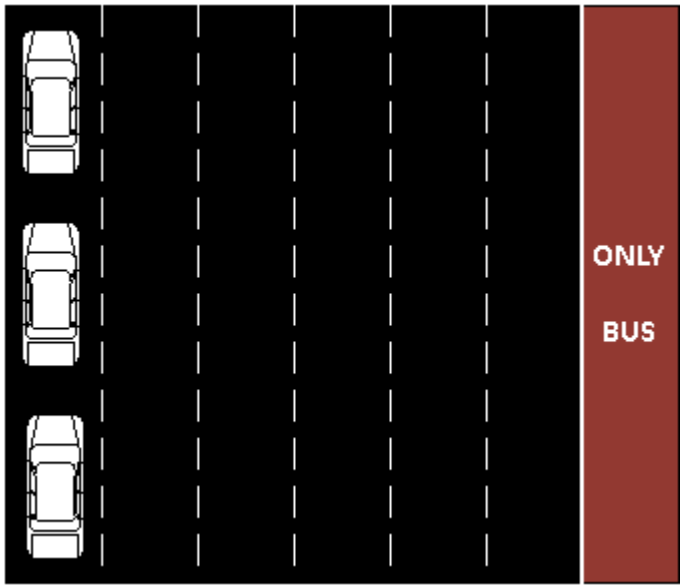
5th Avenue



Madison Avenue



1st Avenue



Data Sources

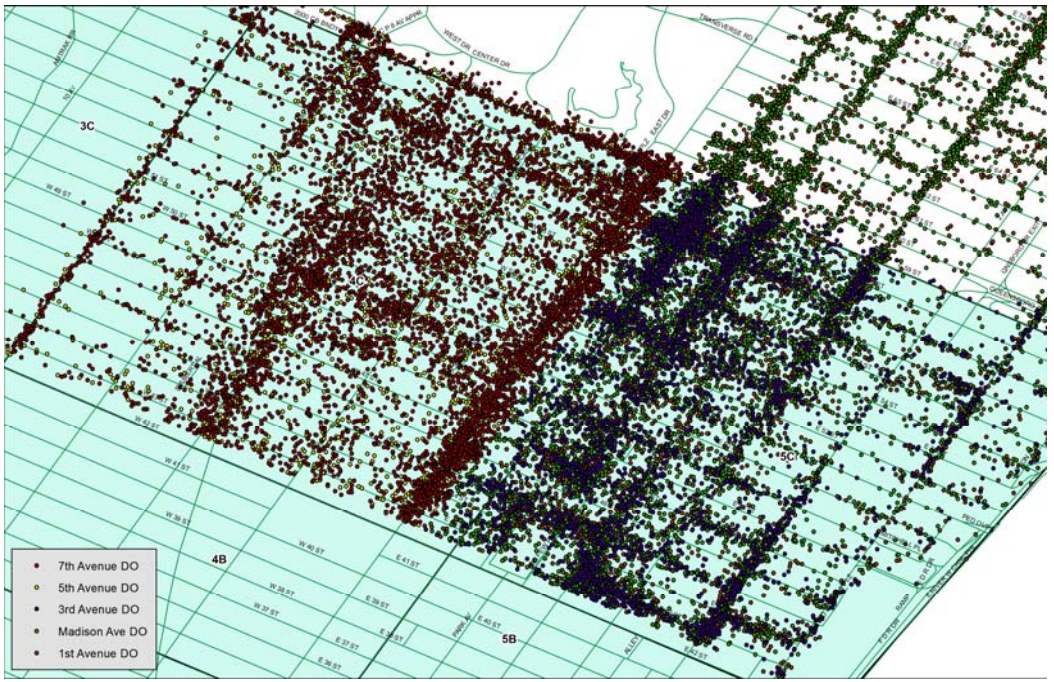
Schedules (Bus Speed)

M1 WEEKDAY SERVICE

From Harlem to East Village

	Harlem W 146 St/ Mlcolm X Blvd	Harlem 5 Av/ 109 St	Upper E Side 5 Av/ 72 St	Midtown 5 Av/ 42 St	E Village Cooper Union 8 St/Lafayette St
	4:50	5:01	5:10	5:16	5:28
	5:15	5:26	5:35	5:41	5:53
	5:35	5:46	5:55	6:01	6:15
	5:50	6:01	6:15	6:23	6:37
	6:02	6:21	6:35	6:43	6:57
	6:17	6:36	6:50	6:58	7:12
	6:32	6:51	7:05	7:13	7:27
	6:47	7:06	7:23	7:31	7:49
LTD	6:59	7:17	7:30	7:38	7:50
	6:59	7:21	7:38	7:49	8:07
LTD	7:09	7:30	7:47	7:55	8:07
	7:11	7:35	7:57	8:08	8:26
LTD	7:19	7:40	7:57	8:05	8:23
	7:23	7:47	8:09	8:20	8:38
LTD	7:29	7:52	8:09	8:19	8:37
	7:35	7:59	8:21	8:32	8:53
LTD	7:39	8:03	8:23	8:33	8:53
LTD	7:48	8:12	8:32	8:42	9:02
	7:50	8:14	8:36	8:47	9:08
LTD	7:57	8:22	8:42	8:52	9:12
	8:05	8:29	8:51	9:02	9:23
LTD	8:06	8:31	8:48	8:58	9:18
LTD	8:15	8:40	8:57	9:07	9:27
	8:20	8:44	9:06	9:17	9:38
LTD	8:24	8:47	9:04	9:14	9:34

Taxi GPS (Traffic Speed)



Cameras (Bus Speed)

Fieldwork (Dwell Time)

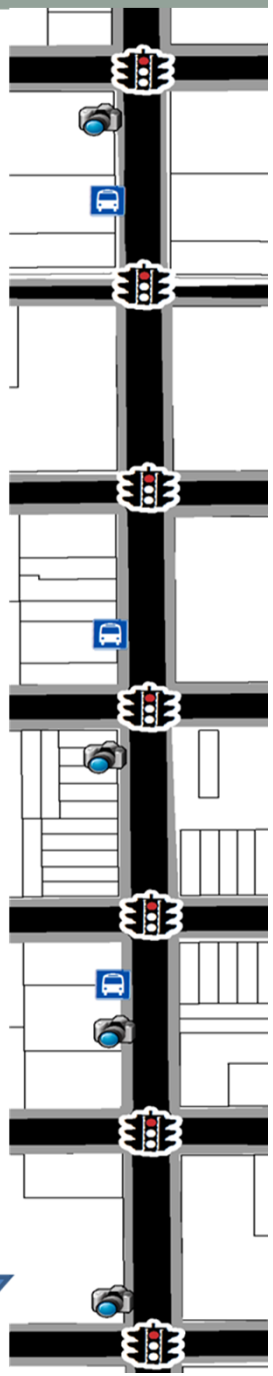
Midtown-in-Motion (Traffic Speed)

Time-Lapse Observations

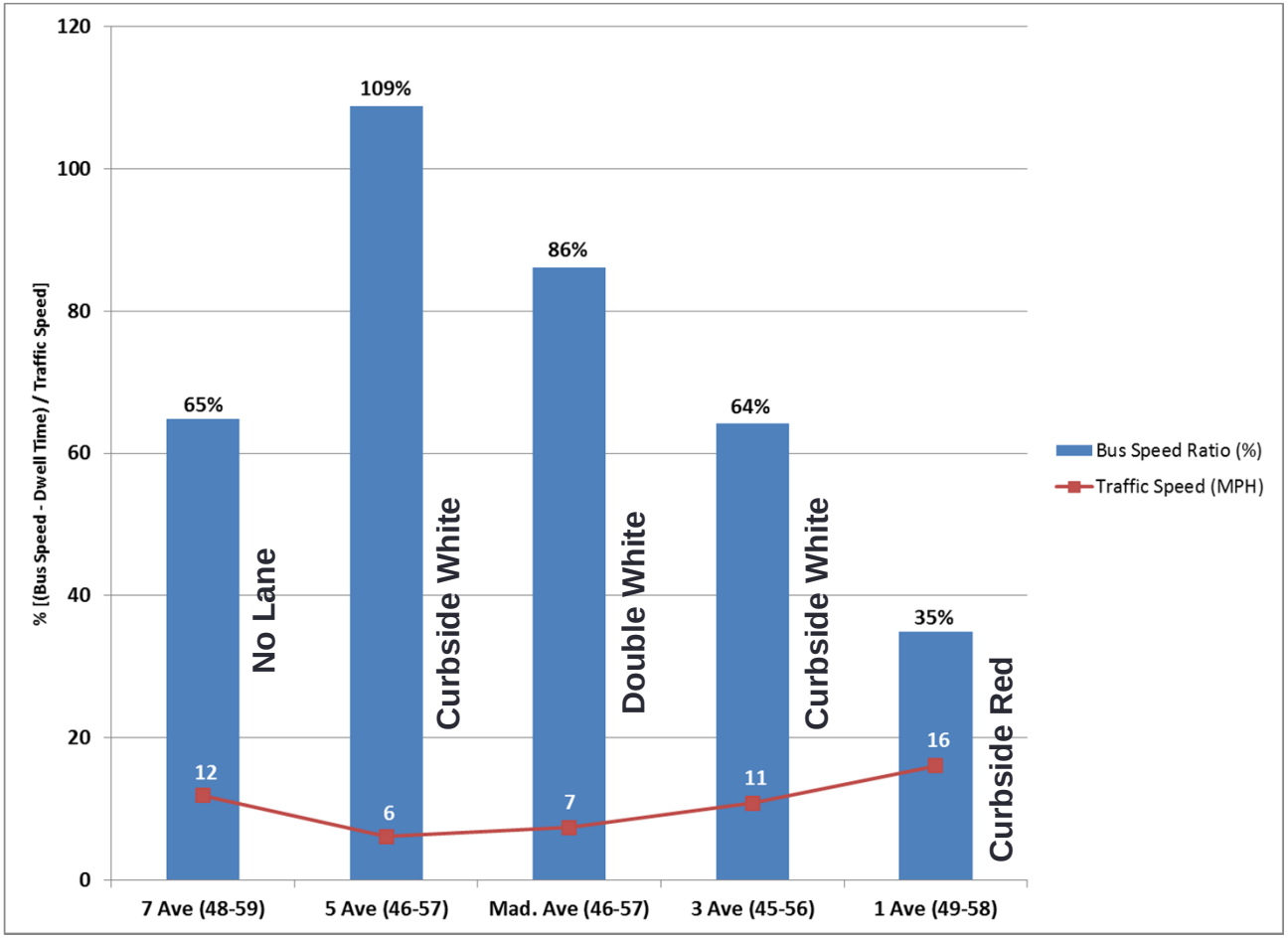
Start @
7:35:13

Travel Time:
06:14 / 5.4
MPH

End @
7:41:27

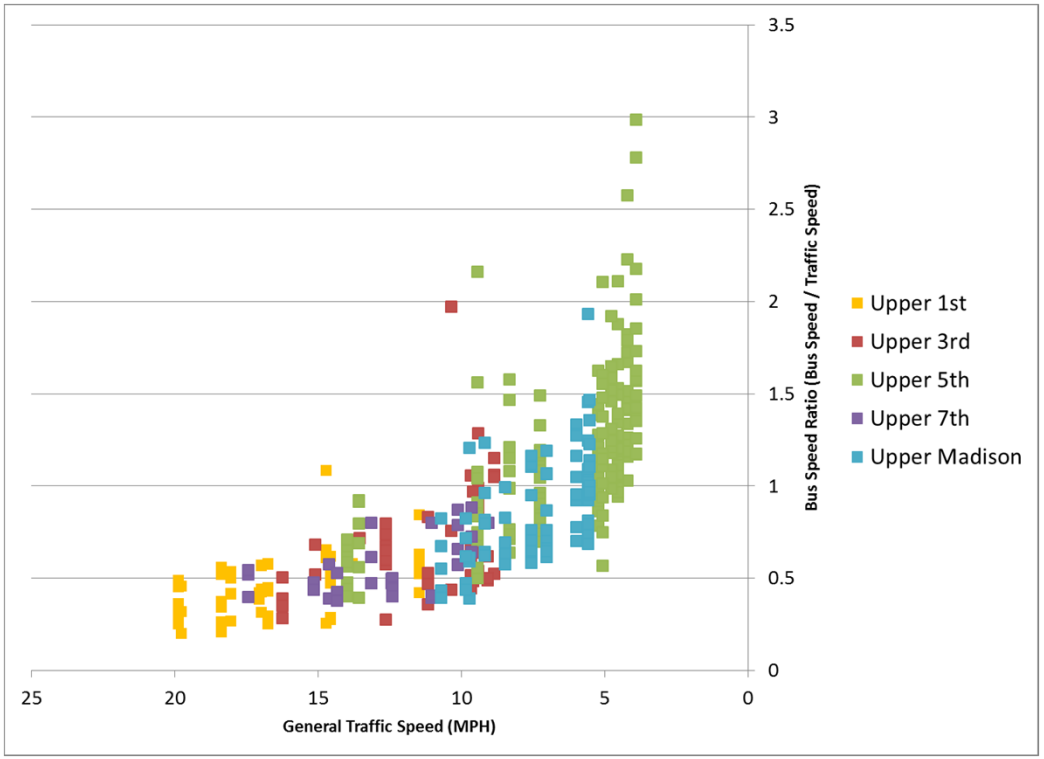


Bus Speed Ratio Findings 1



- The prevailing trend is that as general traffic speed decreases, non-dwell bus speed ratio increases, indicating that buses moved faster relative to general traffic when general traffic was slower.

Bus Speed Ratio Findings 2



- Different stretches occupy different regions along the curve, and by definition, wouldn't be expected to have similar bus speed ratios
  - 5th Avenue has slower traffic speeds, and therefore has higher bus speed ratios.
- To compare corridors with different bus lane designs, similar ranges of general traffic speeds should be captured, and the slopes of those curves could be compared.

Study 2 Conclusions

- The slower the traffic speed, the faster buses travel relative to general traffic (higher non-dwell bus speed ratios).
- This traffic effect subsumed the effect of bus lane presence/design in this study because the range of sampled traffic speeds across corridors was not uniform.
  - Larger sample size is needed with more days of observation
- The question we sought to answer was if traffic on 7th Avenue (with no bus lane) is going 5 MPH and traffic on Madison Avenue (with double bus lanes) is going 5 MPH, which corridor has the faster bus speeds (irrespective of dwell time). Still can't answer that yet.

THANK YOU

Any questions?