Public Transit Riders in New York City:
Using Area-level Data to Identify Neighborhoods with Vulnerable Riders

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Abstract

- Exploratory use of the American Community Survey (ACS)
  - Yearly U.S. Census instrument (previously 10-year long form)
  - Travel-to-work (mode and time) & demographic information linked to area of residence
- Informative use of reported serious crime (by police precinct) as area backcloth (measures of actual crime)

Abstract (cont.)

- Aim was to identify areas with high percentages of "vulnerable" public transit rider residences
  - With "vulnerability" defined by theory and previous research, and identified through use of exploratory principle component analysis (PCA)
  - Self-consciously pragmatic approach to exploring datasets for use by other U.S. transit systems that may have very limited public funds for more resource-intensive approaches

Abstract (cont.)

- Once areas are identified as having high concentrations of vulnerable riders, then resources can be directed at these specific areas
- Can find out more about areas' riders (and non-riders)
- May then look primarily to increasing guardianship and improving place management

Method in a nutshell

- Look for areas with the highest concentrations of likely vulnerable riders

- Explore making these areas safer for users (or others in these areas who may not now be riding public transit due to security concerns)

Value of the method

- Can be used where the ACS data are available
- May be able to link actual reported crime to these areas (depending on local police data practices)
- Likely to be cheaper than starting from scratch in terms of identifying vulnerable riders (and non-riders) and allocating crime prevention resources

Routine Activity Theory Framework

- Crime events cannot occur if there is not a convergence (in time and space) of:
  - A motivated offender
  - A suitable target
  - In the absence of a capable guardian

(Cohen and Felson, 1979)

Expansion of Routine Activity Theory

- Focus on place as well
- Look to prevent crime by:
  - Focusing on those who control offenders (handlers) , targets (guardians) and places (managers)
  - Prevent a convergence of the necessary elements

(Felson, 1986; 1987) and Eck (1997)

Some of the Applications of This Approach for Public Transit Operators

- Can focus on:
  - Places where past crimes occurred – opportunity structure for crimes existed there
  - Look at potential targets (transit riders) and see where they cluster:
    - On the system,
    - At stations and stops, and
    - Along their "whole journey" from home to the transit node, to their destinations, and back again.

Advantages of Focusing on Transit Riders as Potential Victims

- Shows concern for the social welfare of riders
- Riders' perceptions of personal safety along the "whole journey" may affect their decisions to use public transit
- Overall effect may be to lessen use of public transit and affect economic viability of the services

Public Transit Riders and Their Vulnerabilities

- Past victimization – patterns vary by type of crime, place of occurrence, and mode of travel
- Limited availability of alternative modes – “transit captives” or “transit dependent”
- One dimension of fear of crime
- Fear of crime can have effects on transit use
- In relation to other vulnerabilities in society – beyond the scope of the current paper

Who is Vulnerable?

- In terms of past victimization, the patterns vary by type of crime, place of occurrence and mode of travel.
- In terms of the other types of vulnerability (e.g., related to fear of crime and transit captivity):
  - women, the elderly, Hispanics (and other members of racial and ethnic minority groups), and the poor have been reported to be actually or probably vulnerable across a number of studies, modes of public transport, and countries.

Study area

- New York, NY, USA (NYC)
- The NYC MTA is the 7th largest in the world
  - Over 20 subway lines, and 468 subway stations
  - 235 local and 64 express bus lines
  - 8.4 million trips daily
- NYC MTA operates 24 hours a day

Datasets

- The American Community Survey (ACS) 2006-2010, a 5-year average dataset
  - Census tract (N=2,166)
  - ACS conducted annually and it is used to inform policymakers about how to distribute more than $400 billion in federal and state funding
- New York Police Department (NYPD) (Compstat) crime data for 2010
  - Police precinct (N=76)

Analysis

- 1. Examine profiles of commuters by mode of travel
- 2. Exploratory Principal Component Analysis (PCA) of commuters at census tract level
- 3. Examine spatial distribution of PCA results
  - Compare them with NYPD crime maps

Reconciling different spatial units: Possible analysis

- Problem: Different spatial units
  - Census tract (n=2,166) ≠ NYPD precinct (N=76)
- Areal weighting of crime data to census tract
  - Within-area heterogeneity
  - Size differences census tracts
- Hierarchical linear modeling (HLM)
  - No theoretical reason supporting census tracts being nested within police precinct
- Conclusion: We decided not to present analysis - results not framed or supported by theory

RESULTS

Percent by means of travel in NYC (N=3,627,850)

Public Transit	Private vehicle*	Walking	Home Office	Taxi
55.3%	28.4%	10.0%	3.8%	2.3%

* Private vehicle includes carpool.

Demographic profile of commuters by means of travel

	Number	Public transit	Private vehicle	Walk	Home	Taxi
Female	1,763,954	59.3	24.0	11.2	3.8	1.7
Male	1,877,451	51.3	32.5	10.5	1.8	3.9
White, Non-Hispanic	1,360,007	48.3	29.8	13.0	5.5	3.5
Black	842,756	60.7	30.0	5.5	2.5	1.4
Hispanic	935,175	60.6	24.5	9.7	3.2	2.1
Asian	488,963	55.2	28.8	11.4	2.7	1.9

Demographic profile of commuters by means of travel

	Number	Public transit	Private vehicle	Walk	Home	Taxi
Age:16 to 24	400,548	63.9	18.2	13.8	2.1	2.1
Age:25 to 44	1,861,633	57.4	26.9	9.8	2.5	3.4
Age:45 to 54	1,064,849	50.4	33.7	9.1	2.4	4.4
Age: 55and plus	608,042	48.3	32.8	10.4	2.6	4.6
Native: Citizen	1,962,574	53.7	28.5	10.8	2.7	4.3
Foreign born: Naturalized	867,930	52.5	34.9	7.8	1.6	3.1
Foreign born: Not naturalized	810,901	61.6	21.1	11.2	3.4	2.6

Economic profile of commuters by means of travel

	Number	Public transit	Private vehicle	Walk	Home	Taxi
Below poverty	522,416	59.4	19.1	13.8	5.3	2.3
Income: Under $25,000	1,235,131	57.8	22.4	12.7	4.9	2.2
Income: $25,001 - $49,999	1,126,346	56.6	30.6	8.0	3.1	1.8
Income: $50,000 - $74,999	616,029	52.5	34.7	7.9	3.1	1.8
Income: $75,000 and more	663,571	50.3	30.0	11.3	3.9	4.5

Ownership of commuters by means of travel

	Number	Public transit	Private vehicle	Walk	Home	Taxi
Own a vehicle	1,994,685	41.3	46.7	6.6	1.8	3.6
No vehicle available	1,624,005	72.3	6.1	14.3	4.1	3.2
Renter	2,273,876	61.8	19.9	12.0	3.7	2.6

Descriptive statistics of public transit riders by census tract (N=2,166)

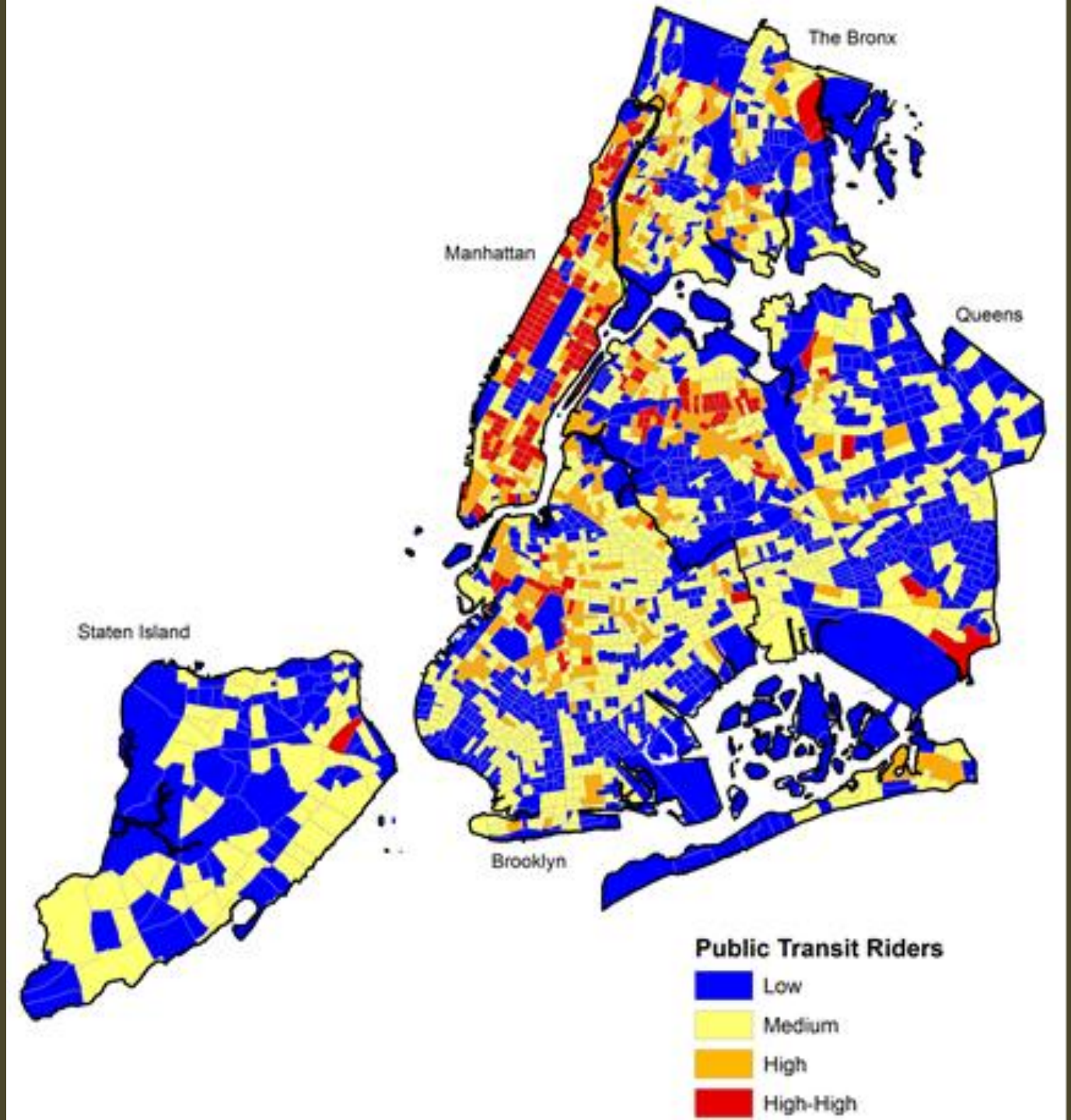
Characteristics	Mean	Median	SD	Max
Female	483.05	396	380.03	3,543
White, Non-Hispanic	303.09	131	489.66	4,869
Black	236.08	80	339.53	3,373
Hispanic	261.46	131	357.97	3,487
Asian	124.67	50	191.08	1,650
Age: 55 and older	135.52	106	127.22	1,808
Foreign born: Not citizen	230.51	151	260.86	2,466
Below poverty	143.33	89	155.82	1,013
Income: Under $25,000	329.77	248	293.69	2,543
No vehicle available	542.21	536	582.65	4,646
Renter	648.55	464	627.09	6,098

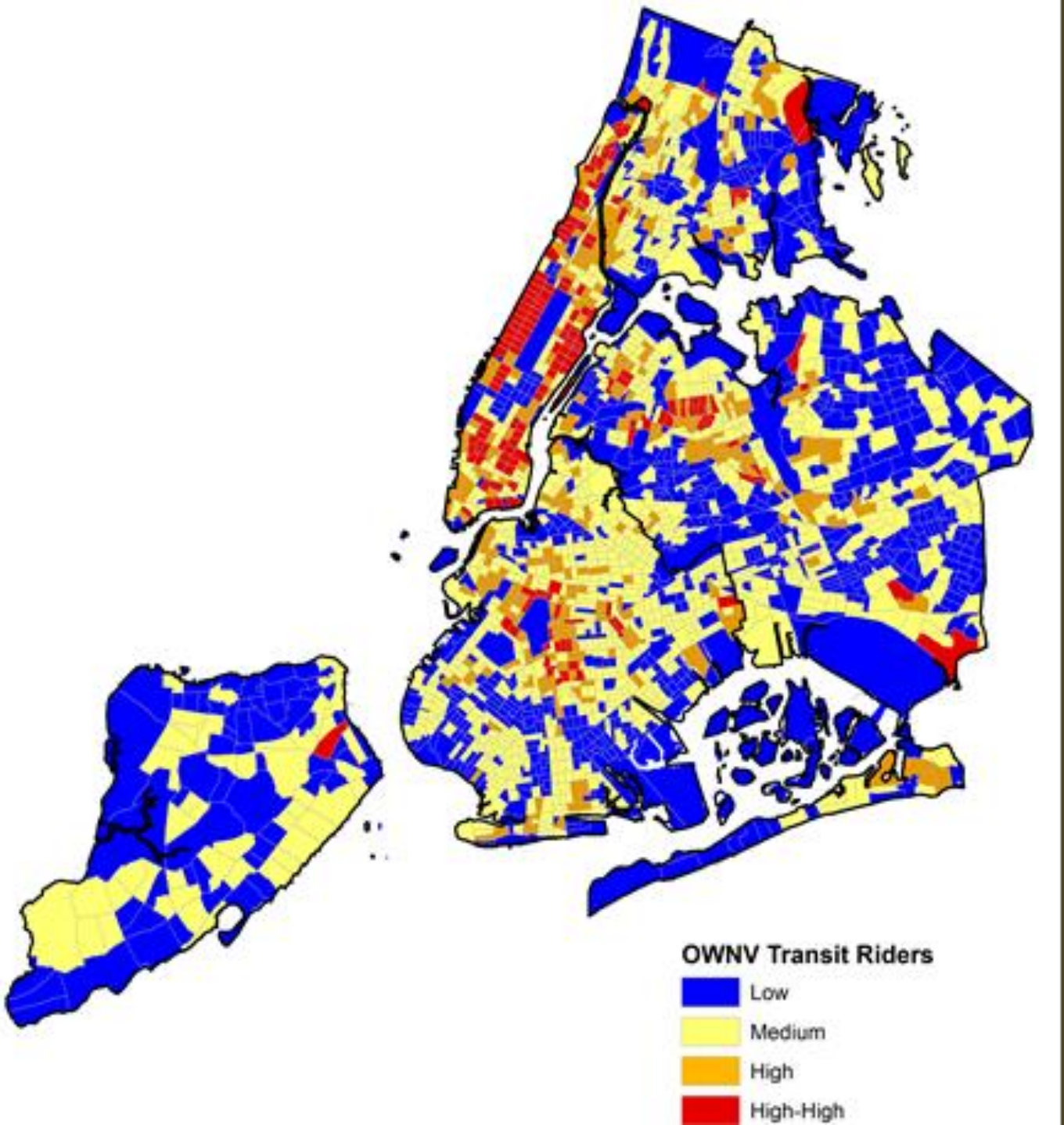
Results of exploratory Principal Component Analysis using census tract (N=2,166)

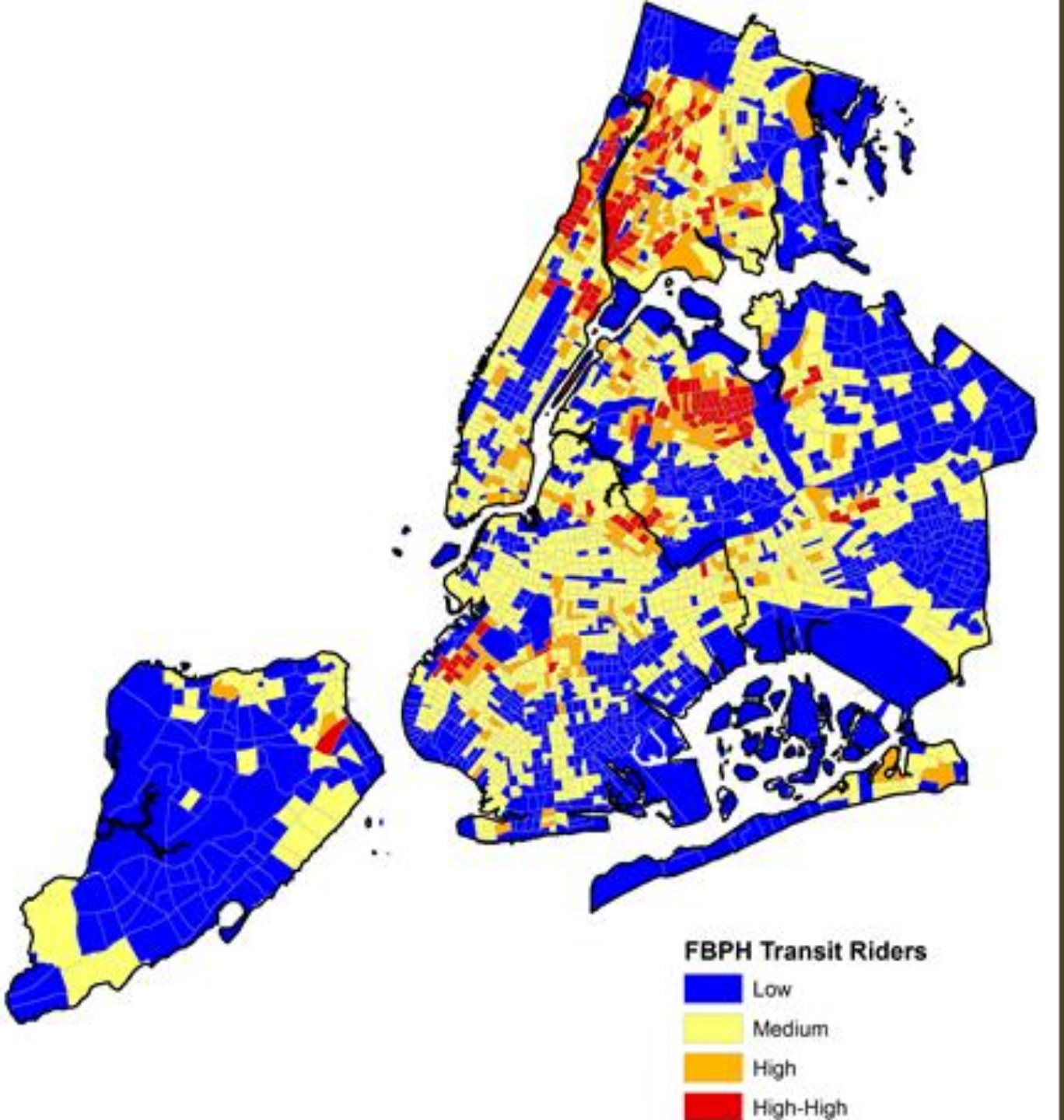
Characteristics	FBPH concentration	OWNV concen.
Hispanic	.972	
FB: Not naturalized	.865	
Below poverty	.925	
Income under $25K	.902	
Age: 55 and older		.998
Female		.905
No vehicle available		.745
% of variance explained	70.56	17.47

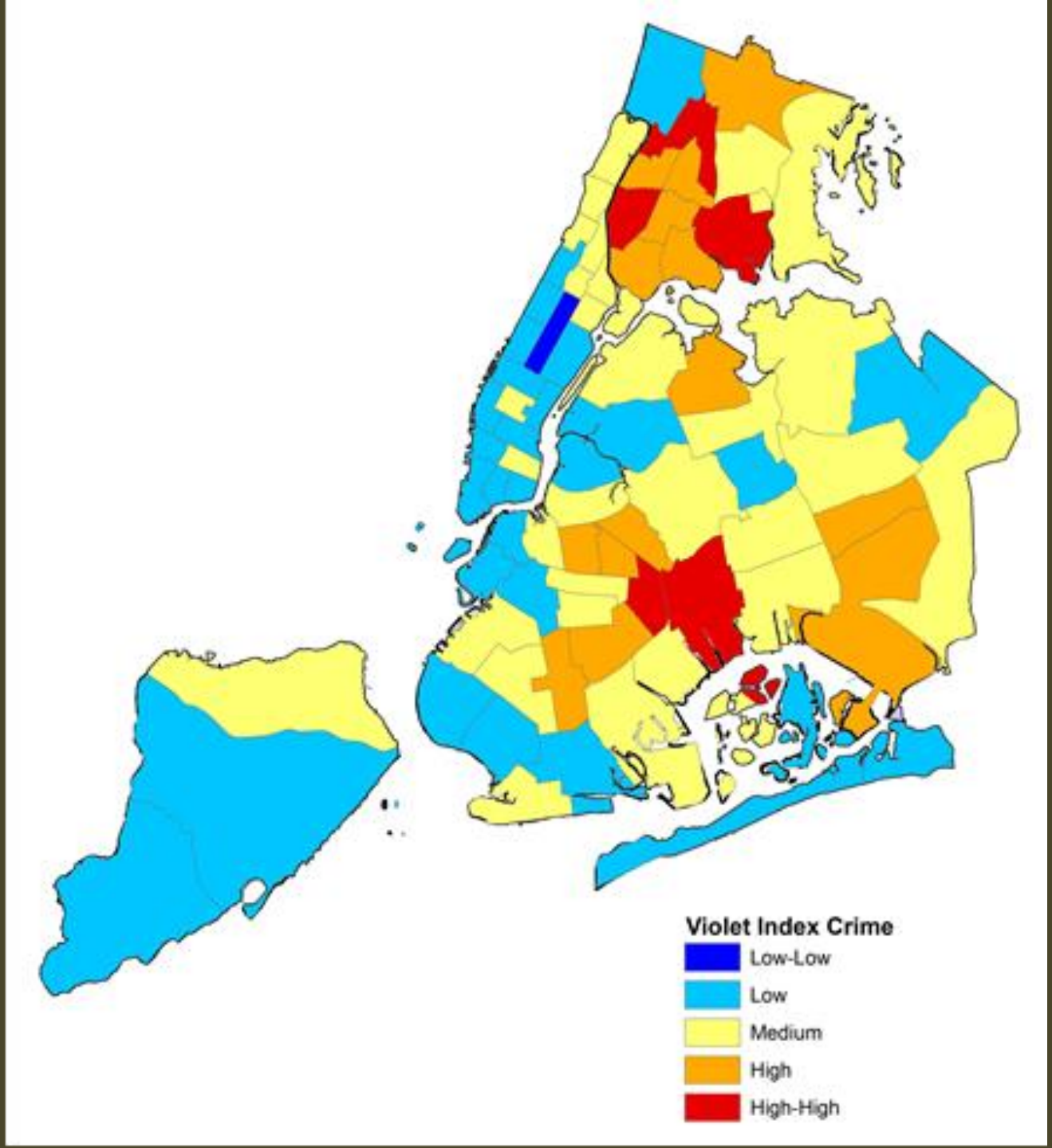
Note. Three race-related variables (Non-Hispanic white, black, and Asian) were dropped due to low correlations. Renters displayed complex structure, and the variable was excluded.

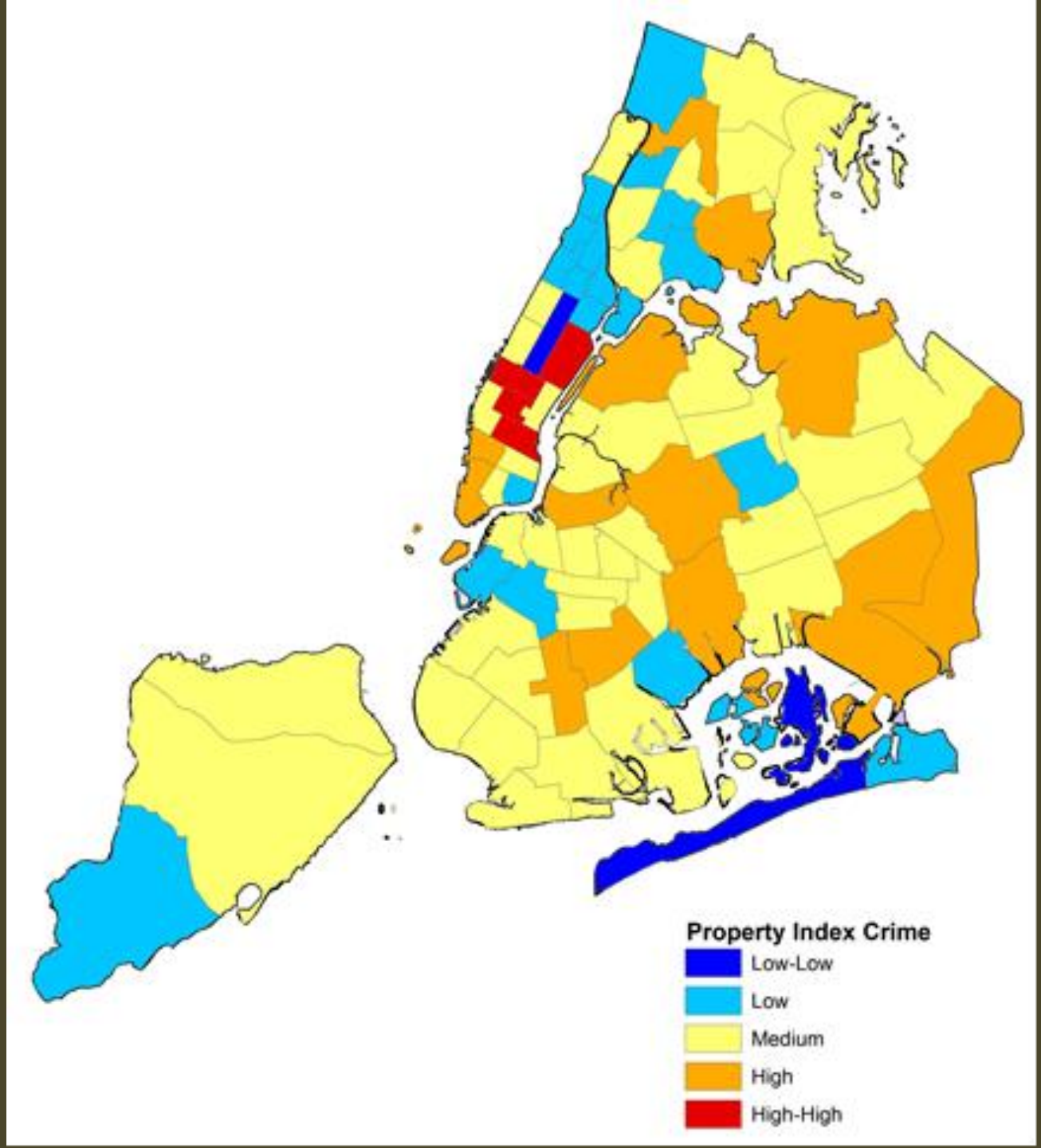
SPATIAL LOCATIONS OF VULNERABLE TRANSIT RIDERS IN NEW YORK CITY


The Bronx
Manhattan
Queens
Staten Island
Brooklyn
Public Transit Riders
Low
Medium
High
High-High


OWNV Transit Riders
Low
Medium
High
High-High


FBPH Transit Riders
Low
Medium
High
High-High


Violet Index Crime
Low-Low
Low
Medium
High
High-High


Property Index Crime
Low-Low
Low
Medium
High
High-High

Policy Implications

- Look at areas with the highest concentrations of OWNV and FBPH riders – 20 % of census tracts in NYC (over 400 areas, 200 of each type)
- This is a two-pronged approach – look at each type separately as they live in geographically distinct areas that are also different in terms of ridership, crime levels and types of crime

Policy Implications (cont.)

	High OWNV Areas – Visually Overlap with High Transit Use Areas (Examine in more detail)	High FBPH Areas – Visually Overlap with High Violent Crime (Examine in more detail)
Site Surveys (e.g., Safety Audits)	- May not need to carry out if operator regularly monitors high-volume areas well	- Presumptively in need of analysis of environmental conditions ---around transit nodes ---high-use paths to transit identified in surveys of riders & non-riders
Surveys about Local Conditions (Riders, non-riders & local community leaders)	- May not need to conduct a large number of surveys if operator regularly monitors high-volume areas well	- Enquire about factors that influence ridership & and route-to-transit decisions

Policy Implications (cont.)

- Use this information to focus on two aspects that may affect vulnerable riders (although other methods may lower crime and fear of crime too)
  - Increased guardianship - such as by walking with others, having paratransit available for use between home and stop or vice versa.
  - Better place management – such as implementing changes that increase risks of offending at stops or stations or make it more difficult to reach vulnerable riders

Limitations of the Data

- Data provided limited information about vulnerability factors among this group of riders (i.e., only on car ownership, which is related to being transit captive)
- Data only discussed transit use in relation to travel to work – No information on transit use in general
- Crime figures were aggregated at a different area level than census tract (ACS aggregation level) so no good statistical comparisons of areas were possible

Implications for Future Research

- NYC has a high volume of transit users so findings may not be generalizable to other cities with
  - 1. More homogeneous ridership populations or
  - 2. More prevalent car ownership
- Guidance on potential problems related to dealing with differential levels of aggregation may assist operators in other areas working with the ACS and local police crime figures

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