PEDESTRIAN SAFETY AND PHYSICAL ENVIRONMENT: WHERE DID SEVERE COLLISION HAPPENS?

YUANYUAN **SHEN** | SHEN **XIN** | HANZHANG **YANG**

PROF. BOYEONG **HONG**   INTRODUCTION TO URBAN INFORMATICS

Introduction
According to the Borough Pedestrian Safety Action Plans's update in 2019, 293 priority intersections, which represented less than 1% of intersections of the whole NYC, are associated with 15% of killed and severely injured pedestrians, and 12% of pedestrian fatalities from 2012 to 2016. For the purpose of lowering the future pedestrian "Killed or Severely Injured" (KSI) accidents, we want to know what physical environment improvement should be prioritized.

Research Question
What physical environment factors make these intersections dangerous to pedestrians?
What area have higher severe collision rate?

Literature Review
Borough Pedestrian Safety Action Plans (NYC DOT & NYPD, 2019) pointed out the danger behind intersections.
Mooney (2016) pointed out that infrastructures like bus stops are associated with elevated counts of pedestrian injury in New York City.
Kang (2018) stressed the relationship between pedestrian plaza and collision reduction.

Methodology
We decided a 200ft buffer around highlighted intersections and visualized the spatial and temporal distribution of severe collisions in New York City and the study area. After identifying 6 potential environment factors, we performed spatial join and averaging within study areas and investigated the correlation between the number of incidents and the physical environment factors. Factors include bus stop density, average sidewalk width, appearance of Pedestrian Plaza, Land Use category by percentage of area, street pavement rating, street lights and traffic signals complaint numbers. We tested the significance of the factors by constructing a linear regression model (OLS). Besides, we also analyzed the spatial pattern of each factor.

Data
Bus Stops. GIS Lab, Newman Library, Baruch CUNY
DOT Street Lights and Traffic Signals (311 Service Requests from 2010 to Present). New York City 311 and New York City Department of Information Technology & Telecommunications
Land Use from MapPLUTO. New York City Department of City Planning
Motor Vehicle Collisions. New York City Police Department
Pedestrian Plaza. New York City Department of Transportation
Sidewalk Widths NYC. Meli Harvey & Chris Whong
Street Pavement Rating. NYC Department of Transportation
VZV_Street Improvement Projects (SIPs) intersections. NYC Department of Transportation
VZV_Priority Intersections. NYC Department of Transportation
OpenStreetMap. OpenStreetMap Contributors

Reference
Kang,B.(2019).Identifying street design elements associated with vehicle-to-pedestrian collision reduction at intersections in New York City.Accident Analysis & Prevention, 122, 308-317. https://doi.org/10.1016/j.aap.2018.10.019
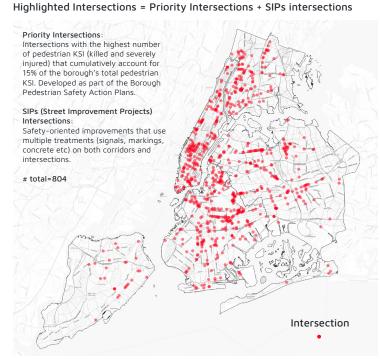Mooney,S. J., DiMaggio,C. J., Lovasi,G. S., Neckerman,K. M., Bader, M. D. M., Teitler, J. O., Sheehan,D. M., Jack,D. W. and Rundle,A.G.. (2016). Use of Google Street View to Assess Environmental Contributions to Pedestrian Injury. American Journal of Public Health, 106, 462-469. https://doi.org/10.2105/AJPH.2015.302978
NYC DOT & NYPD. (2019). Borough Pedestrian Safety Action Plans. https://www1.nyc.gov/html/dot/html/pedestrians/ped-safety-action-plan.shtml

See Interactives
https://output.jsbin.com/woxomel

Mapping and Spatial Analysis

Highlighted Intersections in New York City
Highlighted Intersections = Priority Intersections + SIPs intersections

Priority Intersections:
Intersections with the highest number of pedestrian KSI (killed and severely injured) that cumulatively account for 15% of the borough's total pedestrian KSI. Developed as part of the Borough Pedestrian Safety Action Plans.

SIPs (Street Improvement Projects) Intersections:
Safety-oriented improvements that use multiple treatments (signals, markings, concrete etc) on both corridors and intersections.

total=804

Intersection

Land Uses in Highlighted Intersections
NYC Planning's MapPLUTO provided tax lot level land use information

Severe Vehicular Collisions in New York City
2019, by Borough and ZIP Code. Size equals to count of severe collisions

Bus Stops Density in Highlighted Intersections
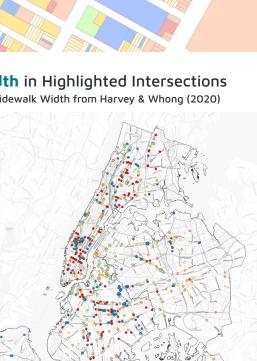CUNY GIS Lab's shapefile (2020) recorded every bus stop location in NYC

Bus Stops
Less • • • More

Sidewalk Width in Highlighted Intersections
Weighted Average Sidewalk Width from Harvey & Whong (2020)

Sidewalk Width
Narrow • • • Wide

Pavement Rating in each selected intersection
Weighted Average Pavement Rating from DOT's dataset

Rating
Low • • • High

% Severe Collision in Highlighted Intersections
%Severe Collision = #Severe Collision / Total Vehicular Collision

% Severe
Less • • • More

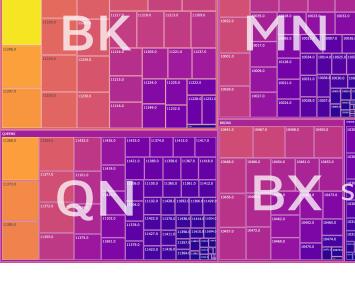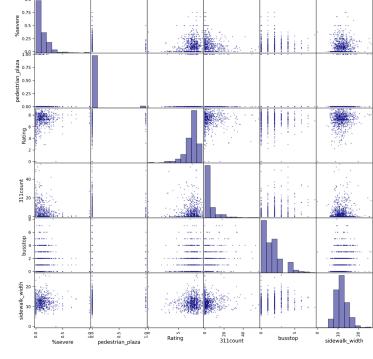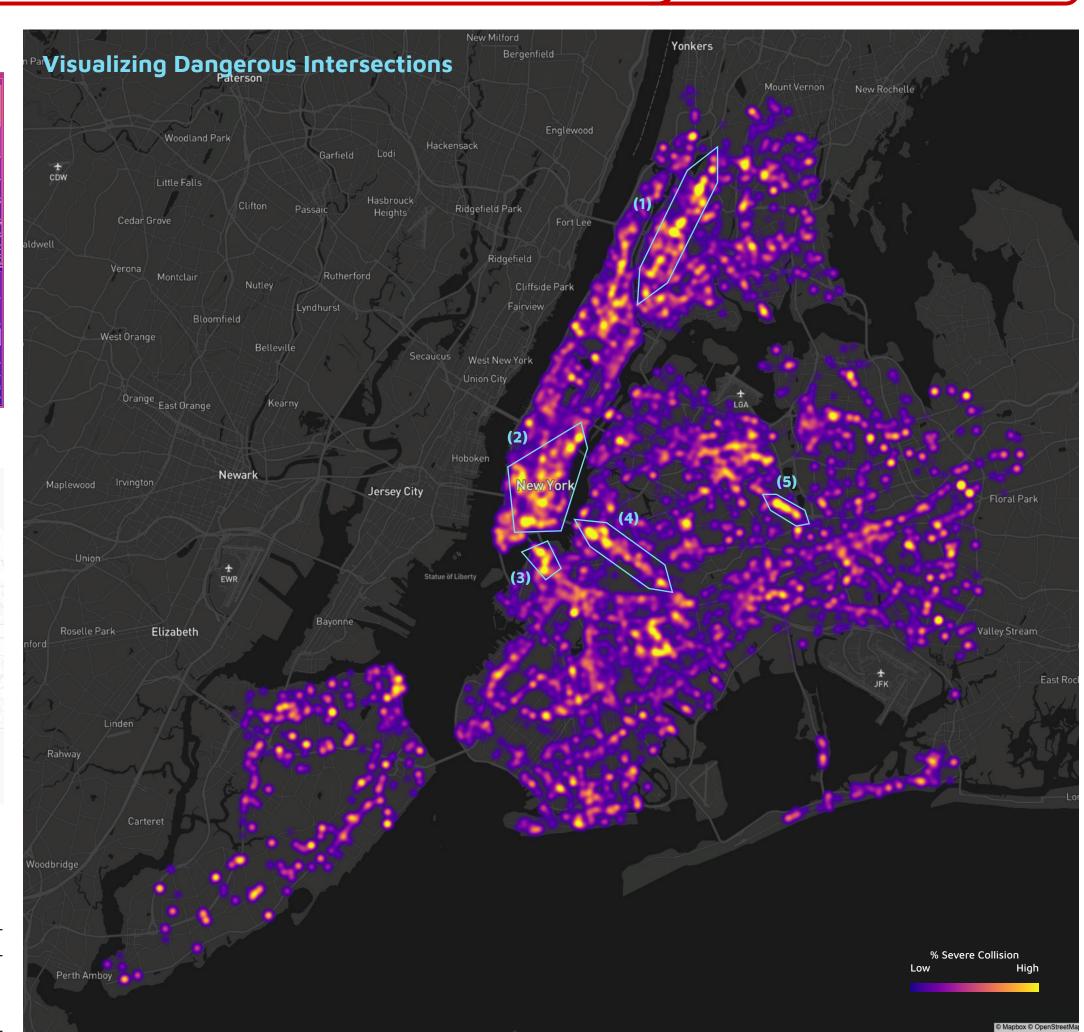### What physical environment factors make these intersections dangerous to pedestrians?
Weighted Average Pavement Rating from DOT's dataset

OLS Regression Results

	coef	Std err	t	P>|t|	[0.025	0.975]
Dep. Variable: %severe			**R-squared:** 0.024			
Model: OLS			**Adj. R-squared:** 0.021			
const	0.0113	0.030	0.371	0.710	-0.048	0.071
Pavement Rating	0.0109	0.004	2.644	0.008	0.003	0.019
# Bus Stop	0.0113	0.003	3.499	0.000	0.005	0.018

Regression Result
Our OLS regression shows there is a positive relationship between density of bus stop and severe collisions with a coefficient of 0.0113, p<<0.01. Between pavement rating and severe collisions, the coefficient is 0.0109, p<0.01. In this regression, the Adj. R-squared = 0.021, which means the relationship is weak as it can not be easily observed from these maps.

Visualizing Dangerous Intersections

% Severe Collision
Low   High

Visualizing Dangerous Intersection
After knowing the result from regrssion model, we moved to creating visualization for "Dangerous Intersections." The intersections (n=50,334) were OpenStreetMap street segments' start and end points. The heat map indicated serval area with high percentage of vehicle collisions invovle with pedestrian and cyclist death and injury. We can find four area with dangerous intersections:
(1) Grand Concourse, Bronx, (2) Lower Manhattan, (3) DUMBO, (4) Willisamburg's Broadway, and (5) Queens Blvd, Forest Hill, Queens

Limitation
804 observations used in the regression test might be a biased selection, since they are from two curated list released by DOT: Priority Intersections and SIPs Intersections. Second, the choice of the size of the buffer introduces a modifiable areal unit problem which could dramatically influence both the dependent and independent variables. Additionally, linear regression has failed to give meaningful results from the data, we suggest future research to implement other models or other tools of data science.