This document contains excerpts from the report:
Pedestrian/Vehicle Crash Mapping Project, New York City, 1998
prepared by Michael King, et al while at NYC-DOT

New York City Department of Transportation

Pedestrian Network Development Program

PEDESTRIAN/VEHICLE CRASH MAPPING PROJECT

June 1998

INTRODUCTION

New York City is the most pedestrian oriented city in the United Sates. Over 64 percent of the city's eight million residents do not drive to work, and only 44 percent of its households own or have access to an automobile. [U. S. Census, 1990] Coupled with the 69 percent of commuters who daily enter Downtown and Midtown by train, bus, ferry, bicycle, and on foot the amount of walking trips taken is staggering. [1996 Hub-Bound Travel]

Research comparing factors including percent of people walking to work and population density has shown that New York is relatively safe. According to a joint evaluation by the Environmental Working Group and the Surface Transportation Policy Project, New York is the fifth safest city in the United States in which to walk.

Table 1: Safest US Cities to Walk

	Average Annual Pedestrian Fatalities	Pedestrian Fatalities Per 100,000 People	Pct. Of Commuters Who Walk to Work	Pedestrian Fatality Index
Pittsburgh	33	16	51	8 (safest)
Milwaukee	19	1 3	4 0	10
Boston	22	0 8	6 5	10
Rochester	1 7	17	4 3	11
New York	310	3.6	9.7	12
Minneapolis-St. Paul	35	1.4	3.2	14

[Source: New York Times, April 9, 1997]

This Pedestrian/Vehicle Crash Mapping Project seeks to explore pedestrian injuries from a geographic standpoint. Through mapping and analysis, one can better predict and address conflicts between cars and people. All injuries are treated equally, and effort is given to identify driver behavior which contributes to crashes.

DESCRIPTION

Trail of a Pedestrian Accident

Pedestrian accidents are reported either by the NYPD [see Appendix 1: NYPD accident report form], insurance, hospital or individual to New York State Department of Motor Vehicles (NYS-DMV). The common form, MV-104N DMV, transmits this data to NYSDOT, through which their Centralized Location Accident Surveillance Project (CLASS) [see Appendix 2: Accident Data Key] locates the accidents geographically. NYCDOT produced the maps in this report from this data.

Mapping Requirements

Data Sets

- Pedestrian Crash Data (NYSDOT, DMV)
- NYC Department of City Planning Street Lion Maps

Applications

- ArcView, MapInfo, Access and Excel

Methodology

The Pedestrian Crash Data was geocoded upon: X-Y coordinates. The data was divided into intersection (X-Y) for all boroughs and mid-block (street segment) data for Manhattan and Staten Island. All crashes occurring at the same location were grouped creating a series of thematic maps by Community District of Pedestrian Crashes in the City of New York and Pedestrian Injuries and Fatalities by Borough.

We used NYCDCP Street LION files that geocode spatial data according to their GeoSupport System which gives nodes X and Y coordinates. GeoSupport is a data processing product designed to support many of the geographic processing needs of NYC agencies. It identifies and validates various types of geographic locations. [NYC DCP. The GeoSupport System General Overview: Concepts and Facilities, 1995.]

NYSDOT CLASS coordinates are not compatible with the LION coordinates from NYCDCP. Therefore, NYCDOT MIS normalized the pedestrian crash data from CLASS (node-link) into records geocoded by the GeoSupport System (intersection-segment). A CLASS node is defined as within 30 feet of the intersection curb-line; a link is between two nodes.

Manhattan mid-block crashes were normalized and mapped with 99.5% accuracy (319 errors, i.e. Park Av. South divided road, Bleecker Street superblocks). Staten Island mid-block records were normalized and mapped to the nearest intersection.

We used 1989 - 1994 data available at the time the project started. At least three years of data are necessary in order to make significant observations. The downloads from NYSDOT require an initial conversion from mainframe to PC. Once these files are received, a database design and creation starts followed by a spatial database development. NYSDOT latest crash data is for September 1996. The spatial database development is in progress for 1995 to 1996 data due to the normalization requirements from CLASS to GEOSUPPORT explained above.

DEFINITIONS

Crash vs. Injuries/Fatalities

A Pedestrian/Vehicular Crash is defined as an incident between a motor vehicle and a pedestrian which causes bodily harm to that pedestrian. In any given crash, there can be one or more pedestrians injured or killed. These outcomes depend on non-geographic factors, such as health of pedestrian, seat belt use, etc. Therefore, the number of injured is usually higher than the number of crashes.

Another discrepancy is date of death. The State records fatalities at crash time only. NYCDOT tracks crashes that result in severe injuries for a longer period. This explains differences in State vs. City reports. Because we are more interested in the number of crashes at a particular location, we have only mapped frequency based on NYSDOT records.

Crash vs. Accident

The National Highway Transportation Safety Administration announced in 1997 that they would be removing "accident" from their lexicon and replacing it with "crash." The reason for the change is to, in a subtle way, get motorists, pedestrians, bicyclists, traffic engineers, law enforcement officers, politicians and the media to think of traffic incidents as something they can help to avoid and reduce through their own behavior, not as unexplained phenomena.

Under-reporting

Under-reporting of pedestrian crashes with motor vehicles is common according to various studies. In one study of California children under 15 years old, it was conservatively estimated that police reports cover only 80% of injuries sustained as a result of crashes between motor vehicles and pedestrians. [Agran, P.F., et al. 1990. "Limitations of data compiled from police reports on pediatric pedestrian and bicycle motor vehicle events." *Accident Analysis Prevention*. 22(4). pp. 361-370] Another study found that only 46% of pedestrian/motor vehicle crashes were reported and summarized a number of studies showing that total traffic accidents are underreported to police in Great Britain.

Table 2: Under-reporting in Great Britain

Vehicle Occupants	Percent Reported	Pedestrians	Percent Reported
Fatal	100	Fatal	100
Serious	89	Serious	85
Slight	77	Slight	67
All Injuries	81	All Injuries	77

[Source: James, Helen. 1991. "Under-reporting of Road Traffic Accidents". *Traffic Engineering and Control*. December. pp. 574-583]

A large study conducted in the former West Germany, and published in 1993 by the German Federal Road Research Institute, found the following: [Hautzinger, et al. 1993. "Dunkeiziffer by Unfaellen mit Personenschaden" (Unreported Proportion of Personal-Injury Accidents). Bundesanstalt fuer Strassenwesen: Helf M13]

- Of major-injury victims (requiring in-patient treatment), only 50% of pedestrian injuries were reported.
- Of minor-injury victims (requiring out-patient treatment), only 35% of pedestrian injuries were reported.
- The highest numbers of unreported cases were found among child and - juvenile bicyclists, especially where single-vehicle crashes occurred.

The problem seems, in part, to relate to reporting requirements. For example, injury severity scales often correlate poorly with scales used by hospital monitoring systems for medical diagnosis. The result is a substantial underreporting, ranging of up to 80 percent.

Severity

Crashes are classified according to severity. NYCDOT developed a severity factor from crash cost research. Each type of severity was associated with a cost value. The cost value was reduced by the lowest crash class to arrive at a relative weight. Below are the relative weight values used by NYCDOT based on NYSDOT cost estimates of each CLASS. [see Appendix 2: Accident Data Key]

Table 3: NYC-DOT Severity Factors

Injury	C	76
	B	303
	A	1214
Fatality	K	2729

The relative weights are multiplied by the number of crashes for each severity type and summed. One can use this chart to determine the relational cost to society of any crash, for example, a pedestrian death costs society 36 times more that a "C" injury where the person walks away.

Crosswalk

According to NYSDMV Vehicle and Traffic Law a crosswalk is:

- That part of a roadway at an intersection included within the connections of the lateral lines of the sidewalks on opposite sides of the highway between the curbs or in the absence of curbs, between the edges of the traversable roadway.
- Any portion of a roadway at an intersection or elsewhere distinctly indicated for pedestrian crossing by lines or other markings on the surface.

ANALYSIS

From maps and summaries, we offer the following cursory analyses.

Five Year Average

The annual average rate crashes fell from 15,949 in 1990 to 14,565 in 1995. During the same period, the population of New York City grew by 15,000. Taken together, we see that the crash rate as percentage of population fell from 0.22 percent to 0.20 percent. These pedestrian/vehicle crashes make up about 14 percent of all crashes involving vehicles.

The annual average rate of pedestrian fatalities fell from 339 in 1990 to 236 in 1995 for an absolute drop of 103. As a percentage of population, the fatality rate dramatically fell from 0.0046 percent to 0.0032 percent. These pedestrian fatalities make up about 52 percent of all people killed in vehicle crashes.

Table 4: Pedestrian and Vehicular Injuries and Fatalities by Population

		Ped Injuries	Veh Injuries	Ped Fatalities	Veh Fatalities	NYC Population
1990	Number	15,949	102,603	339	294	7,322,000
	%	0.2178	1 .4013	0.0046	0.0040	
1991	Number	15,366	99,591	276	276	7,302,000
	%	0.2104	1.3639	0.0038	0.0038	
1992	Number	15,613	105,996	260	26S	7,303,000
	%	0.2138	1.4514	0.0036	0.0037	
1993	Number	15,140	106,237	254	220	7,327,000
	%	0.2066	1.4547	0.0036	0.003	
1994	Number	14,538	105,308	223	207	7,339,000
	%	0.2066	1.4349	0.0030	0.0028	
1995	Number	14,565	105,940	236	209	7,337,000
	%	0.1985	1.4439	0.0032	0.0028	

[Source: U.S. Bureau of the Census, NYSDOT and NYSDMV
Note: 1991-1995 are Population Estimates.]

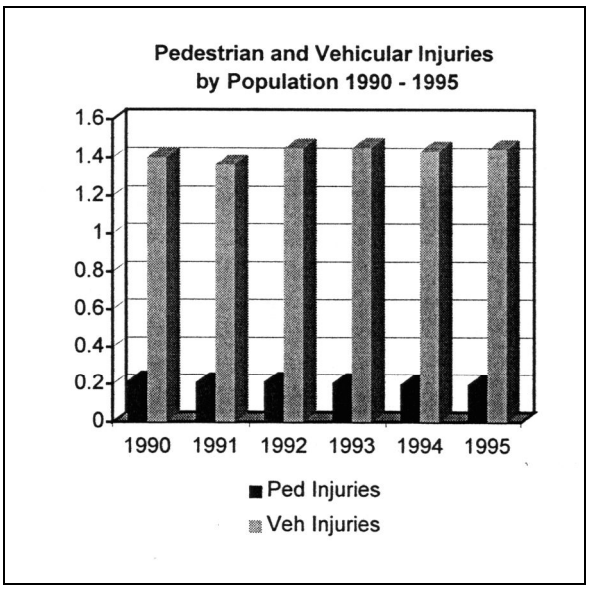


Figure 1: Pedestrian and Vehicular Injuries by Population 1990 -1995

[Source: U.S. Bureau of the Census, NYSDOT and NYSDMV]

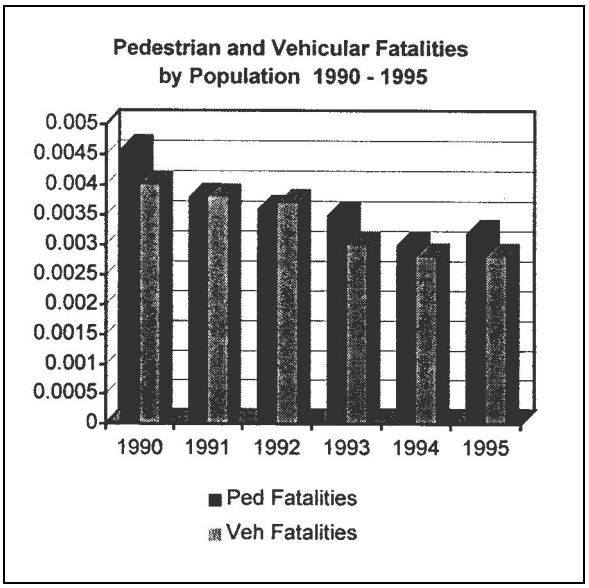


Figure 2: Pedestrian and Vehicular Fatalities by Population 1990 -1995

[Source: U.S. Bureau of the Census, NYSDOT and NYSDMV]

Borough vs. Borough

Except for three slight rises (Bronx from 1990-91, Manhattan from 1991-92 and Brooklyn from 1992-93), pedestrian fatalities as a percentage of population has fallen in

all five boroughs between 1990 and 1994. Within this general trend was a halving of the rate in Staten Island (1992-93), and a one third drop in Manhattan from 1990-91.

Table 5: Pedestrian Fatalities by Borough Population, 1990-1994

		Bronx	Brooklyn	Manhattan	Queens	Staten Island
1990	Fatalities	63	113	94	85	10
	Population	1,204,000	2,301,000	1,468,000	1,952,000	379,000
1991	Fatalities	66	87	67	75	9
	Population	1,198,000	2,268,000	1,482,577	1,949,000	385,000
1992	Fatalities	50	86	69	72	8
	Population	1,193,000	2,284,000	1,486,000	1,957,000	394,000
1993	Fatalities	43	104	66	67	4
	Population	1,196,000	2,285,000	1,495,000	1,965,000	395,000
1994	Fatalities	43	76	61	56	4
	Population	1,194 000	2,280 000	1,507,000	1,965,000	395,000

[Source: U.S. Bureau of the Census, NYSDOT and NYSDMV
Note: 1991-1995 are Population Estimates.]

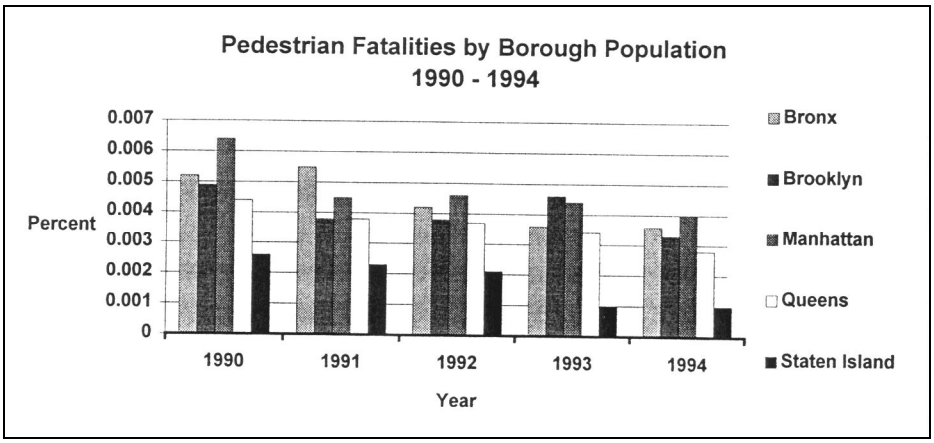


Figure 3: Pedestrian Fatalities by Borough Population 1990 - 1994

[Source: NYSDOT and NYSDMV]

Injuries and Fatalities Distribution

Pedestrian/vehicle crashes are more likely to occur at intersections because that is where the majority of the people cross the street. In two out of three pedestrian crashes that occur in crosswalks, the pedestrian had the signal. This can be caused by three factors: the platoon [According to the Highway Capacity Manual, "Platoon" refers to a number of pedestrians walking together in a group, usually involuntarily, because of signal control and other factors.] extending out of the crosswalk, turning vehicles not yielding to pedestrians or cars stopping within the crosswalk. Studies have shown that

up to eight times as many pedestrians were hit on marked crosswalks as on unmarked ones. [Todd, Kenneth. *The Pedestrian and the Law*, 1997]

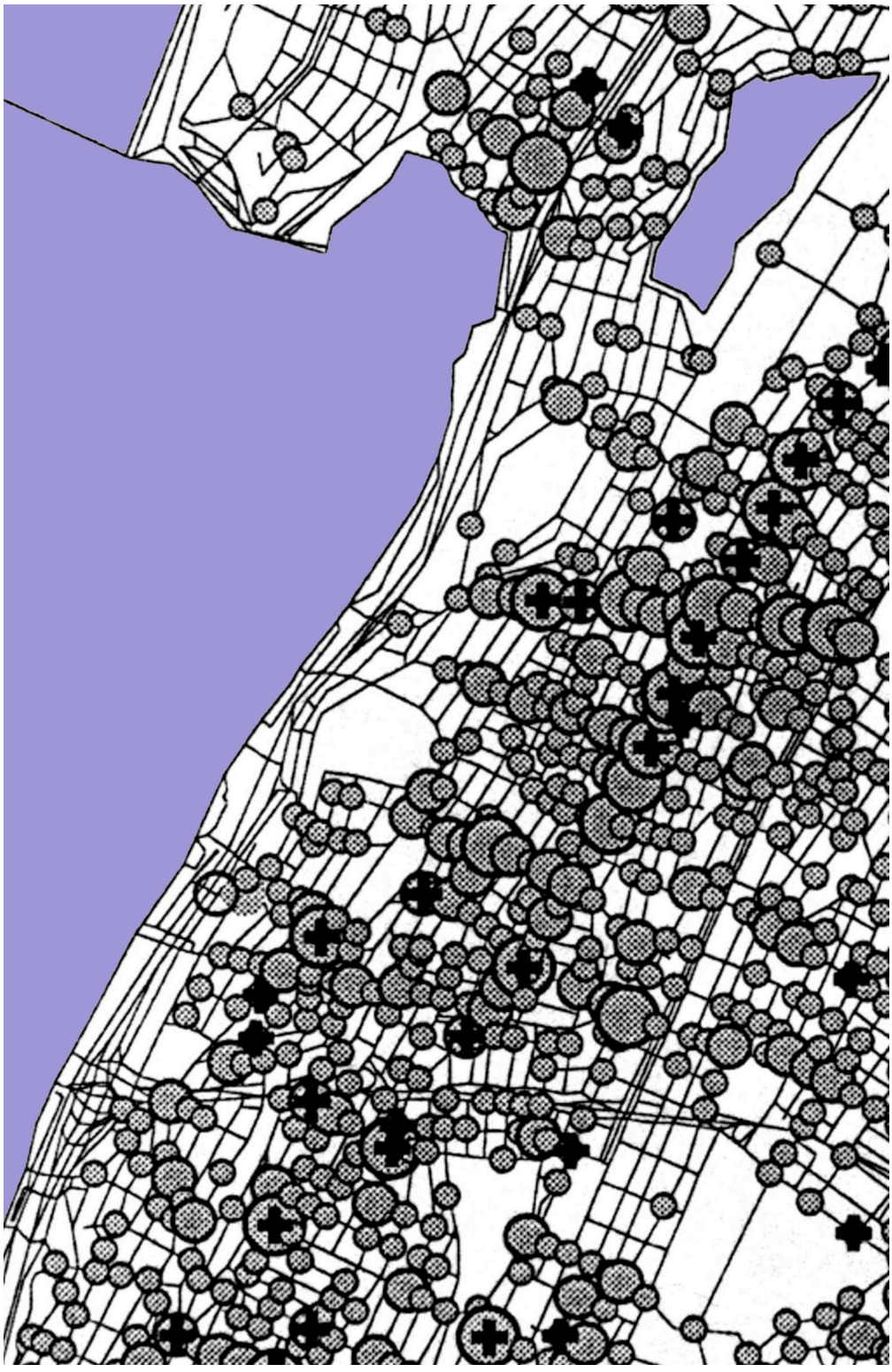
The highest risk groups are seniors, children and 40 year old males. Senior pedestrians (persons 65 years and over) are at the highest risk of accidents. The elderly comprise 13 percent of the total New York City population yet accounted for 10 percent of pedestrian injuries and 36 percent of all pedestrian fatalities in 1995. [NYC DOT, Pedestrian Mobility Group. 1997. *Senior Pedestrians Safety Survey*] "As a group seniors are particularly dependent on safe streets for walking because many of them no longer drive or own a vehicle." [*Mean Streets, Pedestrian Safety Reform on the Nation's Transportation Law - New York* by Surface Transportation
Policy Project, Executive Summary]

The distribution of injuries and fatalities reveals patterns and provides a picture of injury and fatality incidences in New York City. Fatalities are random and are found in specific neighborhoods, arterials and major avenues where speeding is likely to occur. Injuries are scattered throughout each borough, but concentrated in areas with high pedestrian and vehicular activity, especially commercial strips. Higher injuries and fatalities are also found along cross-town two way streets and around bridges/tunnel entrances. There are fewer injuries at intersections in residential areas with long streets and high vehicle ownership but more injuries and fatalities at mid-block.

CONCLUSION

New York City's streets are an attraction to New York residents and visitors from all over the world. Pedestrian activity mitigates delinquency and crime on streets. "A well-used city street is apt to be a safe street. A deserted street is apt to be unsafe." [Jacobs, Jane. 1992. *The Death and Life of Great American Cities*. Vintage Books, New York.] Pedestrians play a major role in New York City's life. Its streets are invigorated by its many pedestrians who keep it vibrant, dynamic and safe for residents and visitors.

Sample map showing pedestrian injuries and fatalities at intersections in a section of the Bronx. Circles denote injuries (larger circles = more injuries), crosses show fatalities.



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Sample map showing pedestrian injuries at intersections and midblock in a section of Manhattan. Stares denote injuries at intersections (larger stars = more injuries), lines show injuries between intersections.