

Discriminatory by Design

A senior citizen focused study of
streets and intersections
on New York City's Upper East Side.



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Executive Summary

New York City's streets and intersections expose elderly pedestrians to unacceptable risks. As a result, many senior citizens are not as mobile as they want to be, do not get the physical activity they need to maximize their health, and are often the victims of crashes with motor vehicles. Pedestrians 65 years and up are disproportionately injured or killed by motor vehicles as they make up 13% of the city's population but 33% of pedestrian fatalities (NYCDOT, 2004).

The built environment, which includes streets and sidewalks, can impact senior pedestrian behavior and driver behavior, and can influence the quality of life of senior citizens. Minor, low-cost improvements to the built environment can make streets safer for all pedestrians and in turn reduce injuries, disabilities, and fatalities to senior citizens from motor vehicle crashes.

This study was conducted at 18 locations on the Upper East Side neighborhood of New York City, an area with a number of crashes between motor vehicles and senior citizens each year. The research sought to determine what, if anything is unique for senior citizens about crossing streets of 60 feet or over in width versus crossing streets of 30 feet in width, and what aspects of these streets might be modified for better safety based on examining vehicle-environment-senior pedestrian interactions at 18 intersections involving various streets. Six of the intersections were within the wide streets, and 12 intersections were the control streets of 71st, 73rd, 78th and 80th Streets.

Key Findings

- Senior citizens utilizing an assisted walking device like a cane or a wheelchair walked at an average speed of less than 3 feet per second;
- Senior citizens speed up their natural pace when crossing wider streets;

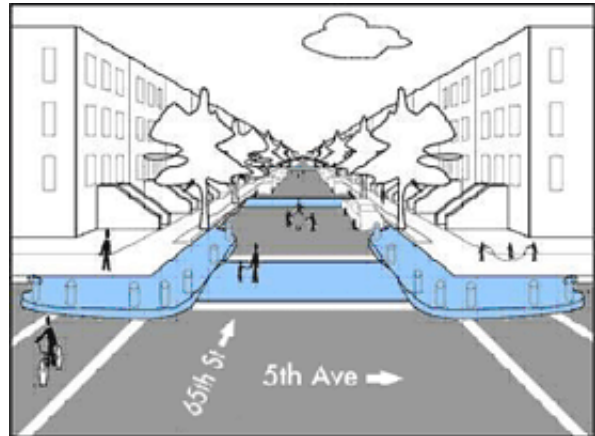
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- 56% of senior citizens stood in the street rather than on the curb before crossing the street;
 - The intersections of **72nd Street at 2nd Avenue**, **79th Street at 2nd Avenue**, and **79th Street at 1st Avenue** are the top three most dangerous intersections for senior citizens to cross in terms of crash statistics. These intersections are remarkably similar in that senior pedestrians walk faster than the average rate of their peers at these streets, over 40% of the observed seniors walked unsteadily or were hunched over at these intersections, and 40% of the senior citizens began to cross the street before the walk signal had changed at these places.

Recommendations

- Give pedestrians priority over motorists at all intersections
- Get people across the street safely:
 - Retime traffic signals to allow people of all abilities to safely cross the street without rushing or prematurely leaving the curb to shorten the crossing distance.
 - Install leading pedestrian intervals (L.P.I.s) at all intersections. This system dedicates at least 5 additional seconds exclusively to pedestrians to begin their crossing before vehicles from any direction can make any movement.
 - Install pedestrian ramps flush with the street to make ascending and descending the curb possible for all users.
 - Repair street imperfections like potholes and utility cuts to prevent falls.

- Slow vehicles down. Because the speed at which vehicles are traveling is one of the most significant factors in extent of injury from motor vehicle crashes it is essential to bring down vehicular speeds at intersections.

- Extend the curbs into the intersection to slow down motor vehicles and make pedestrians more visible. Place bollards at the edge of each of these curb extensions to prevent trucks and buses from driving up onto the curb while turning. This prevents pedestrians from being overtaken by the rear wheels (see Figures 1 and 2).



Figures 1. Sidewalk extensions at corners called “neckdowns” force motorists to make slower, more accurate, safer turns.

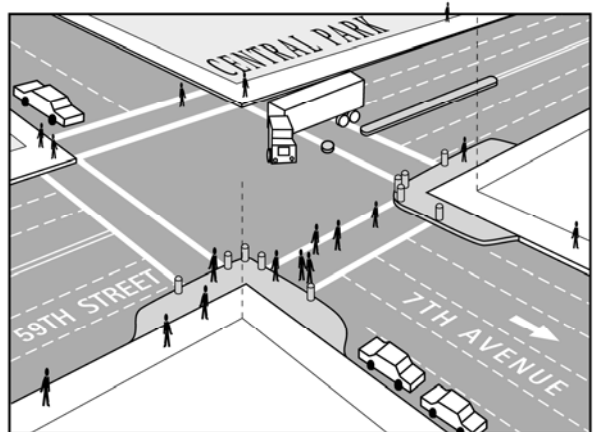


Figure 2. Flexible bollards or median tips on the inside line of each crosswalk force vehicles to make slower, safer turns.

- Modify unsafe driving behavior:
 - 95% of motor vehicles did not yield to pedestrians in the crosswalk. Placing flexible plastic bollards or median tips on the inside line of each crosswalk forces vehicles to slow down and make safer turns (see Figure 2).
 - Create a public awareness campaign to educate drivers on what crossing a street looks and feels like to a senior pedestrian.

Background

New York City's streets and intersections expose elderly pedestrians to unacceptable risks. Pedestrians 65 years and up are disproportionately injured or killed by motor vehicles as they make up 13% of the city's population but 33% of pedestrian fatalities (NYCDOT, 2004). These trends are reflected nationwide, as according to the United States Department of Transportation (1997), persons 65 years and up make up 13% of the population and account for 23% of all pedestrian fatalities.

It is critical to address this disparity in injury and fatality, particularly as the older population continues to grow. According to the 2000 U.S. Census there are an estimated 1.25 million senior citizens in New York City. Projections indicate that the population of people aged 60 and older living in New York City will increase by approximately 20% by 2015 and will represent approximately 18% of the City's population. In addition, it is estimated that between 30-50% of trips seniors take are on foot (OECD, 2001). Walking is a prevalent mode of transportation in older adulthood due to decreased physical ability to drive a car and decreased affordability of a car. In fact, about 20% of American women over the age of 65 do not drive (Wallace and Franc, 2006). High rates of on foot travel increase seniors exposure to vehicles, and may contribute to the disproportional number of crashes with senior pedestrians.



Figure 3. 79th Street at 1st Avenue



Figure 4. 72nd Street at York Avenue

Additionally, older adults are often frail, and their bodies cannot withstand the impact of motor vehicle collisions, so a larger percentage of collisions with older adults lead to fatality (Oxley and Fildes, 1999). This fact may explain some of the discrepancies seen in fatality statistics, although it also emphasizes the danger older pedestrians subject themselves to when moving about their community.

Mobility, defined as “the ability to move from one place to another for purposes of meeting personal, social, employment or recreational needs and desires,” is central to life in older adulthood (Wallace and Franc, 2006). Negotiating intersections and motor vehicles is an everyday task for many seniors, and involves a variety of physical and cognitive skills. These skills are likely to decline with the normal aging process, impairing seniors’ judgment and coping skills. Such impairments may lead to disability, that is, the inability to perform activities of daily living. Disabilities may be exacerbated by structural barriers of the built environment (Clarke and George, 2005). Some common impairments that may influence older adults’ behavior include:

- Walking slowly or walking with a walker, cane, or crutch
- Pushing a cart or wheelchair
- Carrying bags or groceries
- Blindness or low vision
- Deafness or hard of hearing
- Mental or cognitive health

It is important for public health to understand pedestrian behaviors as pedestrianism is inherently tied to mobility in later life. Indeed, the World Health Organization (WHO) believes that the development of age-friendly standards for the built environment will be essential if older people are to remain active and independent. There is an urgent need for planning focused on the senior citizen as the design standard. In Oakland, California, for instance, they have found that “a substantial group of senior citizens are intimidated by the traffic environment to such a degree that they are not able to walk in their communities and as

a result, miss out on the physical and mental benefits of an active lifestyle (Oakland Pedestrian Safety Project, 2006).” A safe and supportive built environment may make the difference between ability and disability in later life.

Objectives

72nd and 79th streets are especially wide corridors in Manhattan. The intersections of these streets with York, 1st Avenue, and 2nd Avenue were of particular interest to the researchers, due to their high volumes of traffic, service as access roads to the FDR drive, and their location in a residential neighborhood. Transportation Alternatives researchers sought to:

- Determine what, if anything, is unique about crossing 60 foot-wide corridors such as 72nd and 79th street by examining pedestrian and vehicle behavior at 18 intersections involving these streets. Six of these intersections were within the main corridors, and 12 of these intersections were control streets of 30 feet in width involving 71st, 73rd, 78th, and 80th streets.
- Analyze walking behaviors and times of older pedestrians, including older adults with mobility impairments.
- Evaluate the safety of several intersections for older adult pedestrians by evaluating vehicle - environment - pedestrian interactions.

Methods

Data were collected on older adults walking speeds and behaviors while they were crossing 18 intersections in the Upper East Side of Manhattan. Intersections involving 72nd and 79th street were considered intersections of interest due to their width of 60 feet, and those involving 71st, 73rd, 78th, and 80th were considered controls at 30 feet. A trained social observer spent a total of 60 hours in the field conducting these observations.

Subject Selection

Any adult appearing age 65 and older that passed the observer during the specified observation period was included no matter what their disability or walking status. Age was not verified but indicated by a combination of personal features such as wrinkles, white hair, stooping stance, or use of an assisted walking device. Due to the subjective nature of these criteria, it is possible that some adults included in this study were less than 65 years old. However, the researchers do not consider this a problem as if an adult appears elderly; they may be at similar risk to a person who truly is over 65.

Measurements

- **Time Crossing the Street:** Time spent crossing the street was measured by stop watch. The stop watch was initiated as soon as the older adult stepped off of the curb and was ceased the moment the older adult ascended the opposing curb.
- **Pedestrian Behavior:** Most pedestrian behaviors that were observed had straightforward and visible indicators. Behaviors involving physical characteristics and walking behavior were noted, such as the use of a

walking device. Additionally, distress signals such as flailing of the arms were recorded. Safe behaviors, such as walking in a group or walking in the crosswalk were also documented. Finally, unsafe behaviors, such as crossing at a red light were observed.

- **Vehicle Behavior:** Additional data were collected on vehicular behavior. Observers counted the total number of vehicles, the number of vehicles turning left, and the number of vehicles not yielding to pedestrians.
- **The Environment:** The land uses at each of the corners surrounding the intersection under investigation was documented by determining if surrounding buildings were commercial, retail, residential, community facility, public space, or vacant.
- **Crash Statistics:** Frequencies of crashes at each intersection under investigation were counted using the Transportation Alternatives database crashstat.org. This data comes from the New York City Police Department and the New York State Department of Motor Vehicles.

Results

Demographics

A total of 360 observations were made. 200 (55%) of the 360 observations were women. 50 of the 360, or 13.9%, of the elders observed used an assisted walking device such as a cane, crutch, or cart and 23.9% had a difficulty such as a gait disorder, difficulty ascending or descending the curb, or using an assisted walking device. 303 seniors were walking alone, while 57 were walking in a group of two or more.

Walking Speeds

Most seniors walk at a slower pace than the rate of 4 feet per second, which is the standard used by the New York City Department of Transportation's engineers for timing New York City traffic controls. Indeed only 91 seniors (25.2%) in the sample walked at 4.0 feet per second or greater. This indicates that three quarters of the sample observed walked at less than 4 feet per second, which is the average walking speed for most pedestrians.

Figure 5. Many seniors did not have enough time to cross the street in one signal length.



Table 1: Average Speed by Intersection and Level of Difficulty

Intersection	Average Speed	Persons with Difficulty Average Speed (N with	Persons with No Difficulty Average
72nd and York	5.85	4.66 (n=4)	6.15
79th and York	3.98	3.32 (n=8)	4.41
79th and 2 nd	3.92	3.78 (n=8)	4.02
79th and 1 st	3.74	3.50 (n=6)	3.85
72nd and 2 nd	3.64	2.69 (n=6)	3.81
80th and 2 nd	3.63	3.26 (n=3)	3.69
78th and 2 nd	3.58	2.89 (n=2)	3.65
73rd and York	3.55	2.96 (n=2)	4.07
72nd and 1 st	3.53	3.38 (n=4)	3.57
71st and 2 nd	3.52	2.48 (n=6)	3.86
80th and 1 st	3.46	2.37 (n=7)	3.81
78th and 1 st	3.45	3.00 (n=4)	3.78
73rd and 2 nd	3.43	2.44 (n=4)	3.67
73rd and 1 st	3.28	2.39 (n=4)	3.63
80th and York	3.28	2.28 (n=4)	3.53
71st and 1 st	3.21	2.67 (n=4)	3.35
78th and York	3.21	1.97 (n=5)	3.63
71st and York	2.97	2.53 (n=6)	2.91
All Streets	3.62 (.91)	3.01 (.757) (n=86)	3.82 (.875)

Seniors walk significantly faster when crossing bigger streets. All intersections with 72nd and 79th Streets have 0 -10% of observed adults walking at less than 3 feet per second, while control streets have 15 -55% of observed older adults walking at less than 3 feet per second. People walked the fastest at 72nd Street and York Avenue (averaging 5.85 feet/second), but the slowest at 71st Street and York Avenue (averaging 2.97 feet/second). The mean speed for all 72nd and 79th Street intersections is 4.11 feet per second (1.02) while the mean speed for all control streets is 3.38 feet per second (.7423).

From Table 1, we see the average speeds for the streets under investigation, and note that the 5 streets seniors walked fastest at were 60 foot crossings, instead of 30 foot crossings. Table 1 also shows differences in mean walking speed for adults with difficulty and adults without difficulty at each intersection. Seniors who walk with difficulty when crossing the street walk at a much slower speed than seniors who do not overtly appear to have difficulty crossing. The average crossing speed for those with difficulty is 3.01 feet per second (SD=.757) versus 3.82 feet per second (SD=.875) for those without difficulty. An independent sample t-test (unequal variances) reveals that the difference in these means is significant at the .000 level ($t=-8.27$ $df=162.26$ $p=.000$). Having difficulty crossing and speed are therefore significantly correlated ($r=-.3756$, $p=.000$).

Crossing with an assisted walking device

A sub-group of seniors with difficulty is those that utilize an assisted walking device. Indeed, having an assisted walking device is also strongly correlated to having a slower speed ($r=-.3424$ $p=.000$). The average speed with a walking device is 2.85 ft/sec (SD=.727) while it is 3.75 ft/sec (SD=.879) for those without assisted walking devices. An independent sample t-test (unequal variances) reveals that the difference in these means is significant at the .000 level ($t=-7.90$ $df=74.14$ $p=.000$).

Unsafe Behaviors

Several senior citizens (n=105 or 29.2%) engaged in unsafe behaviors while crossing the street. For instance, 40 seniors crossed during the red light phase. Interestingly, those who crossed at the red light on average walked significantly faster (with a mean of 3.88 feet per second) than those who did not (with a mean of 3.59 feet per second). The correlation between speed and crossing at a red light supports this data, as $r=.1011$ ($p=.055$). Additionally, from those who crossed at a red light, 59 (16.4%) seniors stood in the street before they began to cross. Differences in speed were not significant for individuals who stepped off the curb before they were able to maneuver a crossing. Other common unsafe behaviors included crossing after the “don’t walk” signal began, and blindly following other pedestrians. Table 2 displays the breakdown of these observed behaviors.

Table 2. Unsafe Behaviors of Senior Pedestrians

Behavior	Number	Percent of Total Seniors Observed	Percent of Total Unsafe Behavior
Standing in the Street	59	16.4%	56%
Crossing at a Red Light	40	11.1%	38%
Crossing after the Don’t Walk Signal	15	4.2%	14%
Blindly Following other Pedestrians	14	3.9%	13%

A median of 30% (Range: 5-45%) of older adults engage in unsafe behavior such as standing in the street before beginning to cross, or crossing at a red light when crossing 71st through 73rd Streets. A median of 35% (Range: 20-45%) of older adults engage in unsafe behavior when crossing 78th through 80th Streets.

Older adults do not necessarily take more care when crossing larger intersections as at 72nd and 79th Street intersections, as 35-45% of adults observed at these larger intersections engaged in one or more unsafe behavior.



Figure 6. 72nd Street at York Avenue



Figure 7. 72nd Street at 2nd Avenue

Dangerous Intersections

The most dangerous intersections according to crash statistics from the New York Police Department are 72nd Street and 2nd Avenue, 79th Street and 2nd Avenue, 79th Street and 1st Avenue. These intersections are remarkably similar in that 0-10% of pedestrians walk at less than 3 feet per second. 30-40% of people crossing these streets have some difficulty (they are hunched, using a cane, walking unsteadily) which is higher than average. Two out of the three of these intersections had at least one pedestrian overtly show distress. 35-40% of pedestrians at these crash sites engage in unsafe behavior, mostly standing in the street before beginning to cross.

Discussion

Although the sample of senior pedestrians observed is not representative in the traditional sense of statistical sampling, demographics indicate that the sample reflects the senior population in general. The majority of observations were women, which is not unusual as there are twice as many older women as older men. Also, most seniors were walking alone, which is fitting with statistics that the majority of the senior population lives alone. Therefore, the researchers believe that the observed adults are a good representation of mobile seniors on the Upper East Side. Some findings indicated in the results section above include:

- **Seniors walk more slowly than the average pedestrian.** Consistent with the literature, most adults in the observational study (75%) walk at a pace slower than 4 feet per second, which is the assumed rate of pedestrians in most city planning. This illustrates that senior needs are not considered when crosswalk signals are timed for walkers moving at 4 feet per second.
- **Seniors walk faster on wider corridors.** It is unclear from the observed data why this may be the case. Are seniors scared to go slow? Are they more likely to get caught in the flow of pedestrians at intersections where there is a larger volume of pedestrians? Perhaps only those who are able to walk quickly, despite physical decline are willing to travel on these streets. It is unlikely that disabled seniors are simply avoiding these streets, as similar percentages of older adults had difficulty at both 60 foot and 30 foot intersections (between 10 and 40 percent of adults had difficulty at any given intersection).
- **Seniors with difficulty or assisted walking devices walk at significantly slower speeds than seniors who do not appear to have walking challenges.** This finding is consistent with the literature, as Perry (1992) notes speeds of

elders with assisted walking devices or arthritic impairments at around 2 feet per second. Seniors with impairments may move slower since they are afraid of slipping, cannot see adequately, must move around physical barriers, and cannot handle gradients (Oxley and Fildes, 1999). They may also be coping with pain, stiff joints, and other physical ailments.

- **A large number of older adults (n=105 or 29.2%) engaged in unsafe behaviors while crossing the street.** It is unclear if this is because older pedestrians are unaware that these types of behaviors increase their risk of accidental crash. Perhaps older adults feel the need to engage in the behavior of standing in the street before beginning to cross due to a streets width, or feeling like they want to get a head start so they can complete the crossing before cars begin to turn into their crossing space. The reasons behind engaging in hazardous behaviors should be explored and educational efforts should promote behavior change.
- **Crash statistics support the researchers notion that the wide intersections of 72nd and 79th Streets are more dangerous than the 30 foot control streets,** due to the large number of pedestrian-vehicle crashes that have occurred at these sites in the past two years. Again, perhaps because these streets are considered dangerous, older adults feel the need to walk quickly when crossing at these intersections. The majority of distress signals observed (such as flailing arms to increase visibility) occurred at these wide corridors.

Further Research

Further research examining why pedestrians make safe and unsafe decisions is necessary to fully understand senior mobility. For instance, pedestrian's perceptions of vehicle speeds could be collected to estimate the extent to which older adults perceive oncoming traffic as a threat. Understanding why seniors may make unsafe decisions will help to educate them about efficient and reliable crossing behaviors.

Planning research emphasizing the role of the built environment should also be conducted to determine what other (besides signal retiming) physical features could be modified to benefit seniors and vulnerable pedestrians. For instance, a leading pedestrian interval has been shown to be effective in reducing pedestrian-vehicle conflicts when vehicles have the potential to turn into crossers (Oxley and Fildes, 1999).

Conclusion

The effort to reduce senior injury and fatality due to pedestrian-vehicle crashes must be multidisciplinary and involve efforts by City Agencies and health educators. The built environment must be adjusted to take care of older adults' needs, while older adults themselves take charge and lookout for dangerous situations. As our society ages, issues involving older adult pedestrians will surely arise. The City must be willing to challenge established practices to make streets safe for senior pedestrians.

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