Exploring How Mobile Technologies Impact Pedestrian Safety

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Summary

Consumer adoption of mobile devices has skyrocketed, changing the way people behave in many environments, including on city streets. Much of the emphasis of governments, advocacy organizations, researchers and technologists concerned with the safety implications of mobile device use in traffic has rightly focused on the behavior of drivers, and, in particular, the dangers of texting while driving.

Research examining texting while driving is bountiful and the findings unequivocally demonstrate hazards. More recently, there is also a growing body of research and evidence that supports the claim that pedestrians may be increasing traffic safety risks by walking in traffic while focused on their smart phone.

This paper provides software and mobile device developers with an overview of recent applications of mobile technologies addressing traffic safety. It also spotlights potential solutions mobile technologies can contribute to improving safety conditions on New York City streets.

This paper outlines the impact of vehicle-pedestrian crashes, provides a synopsis of the city’s approach to traffic safety, examines research on hazards of mobile device use by distracted pedestrians, and reviews technologies leveraging smart phones and wireless networks that aim to empower pedestrians and reduce driver distraction.

The research team approached smart phone use and traffic safety from a technological perspective: How might mobile technologies make pedestrians in urban areas safer, especially to mitigate smart phone distraction and to increase pedestrians’ environmental connectedness and what opportunities exist for technological solutions to complement the efforts of governments, advocacy organizations and businesses to reduce injuries and deaths.
The number of mobile phones in the U.S. has increased from 340,000 in 1985 to 302.9 million in 2010. Rapidly increasing mobile phone use has been linked with dangerous, distracted driving. According to the U.S. Center for Disease Control and Prevention, nine people are killed and more than 1,060 are injured every day in the U.S. due to distracted driving. The CDC defines three types of distraction – visual, manual, and cognitive. It recognizes that texting while driving is "especially dangerous because it combines all three types of distraction." While fatalities attributed to texting while driving is imprecise, the category “driver inattention” was cited by the New York City Police Department as the cause of about a third of all crashes, beating the next category by more than 2 to 1.

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Figure 1: CPSC National Estimates (total from 2004-2010) of injuries related to cellphone use by pedestrians (n=5482) and drivers (n=5879).
In 2011, Transportation Alternatives and the Drum Major Institute for Public Policy co-authored a report, “Walking in Traffic Violence: Pervasiveness of Motor Vehicle Crashes with Pedestrians in New York City,” to draw attention to the overall dangers faced by pedestrians. The report argued that, in New York City, pedestrian injuries and fatalities due to crashes with cars remain high compared to rates in similar, densely populated cities. “New Yorkers are twice as likely to be killed in a car crash as in Berlin, Tokyo, or Paris.” The New York State Department of Motor Vehicles reports little change in recent years in the rates of pedestrian injuries and deaths in New York City resulting from crashes with cars, with a significant increase in the number of crashes in 2013 (Table 1).

To reduce injuries from distracted driving, states and the federal government have passed legislation banning phone use while driving. In 2010, the Federal Motor Carrier Safety Administration banned commercial vehicle drivers from texting while driving. And, in 2009 AT&T launched the “It Can Wait” campaign to spread awareness about the dangers of mobile device use while driving and to encourage teen drivers to sign the “It Can Wait” pledge. Sprint, T-Mobile and Verizon joined AT&T’s effort, which has yielded over 4 million pledges and a widespread education campaign throughout high schools across the United States. Working together, these companies have deployed social media, multimedia content production and mobile apps to maximize the campaign’s reach.

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Table 1: Car/Pedestrian Crashes, 2006-2013

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*Not released
What Sets New York City Apart

New York City is the only U.S. city where over half of all households do not own a car.13 With the exception of Portland, Oregon, pedestrians in New York City are safer here than in any other major city in the United States.14 Despite the city’s prominent pedestrian culture and history of strategic transportation planning designed to empower pedestrians and ensure their safety, pedestrian safety remains a critical issue. In 2012, New York City experienced 10,925 crashes between pedestrians and cars.15

Although the New York City Department of Transportation reported a reduction in traffic fatalities of 35% from 2001 to 2012, a recent study of vehicle-pedestrian crashes between 2007 and 2010 by researchers at Hunter College suggests that injuries of this kind in New York City are, in fact, grossly underreported, and that pedestrians face more danger than the numbers may indicate.16

Researchers have begun to investigate the direct relationship between mobile device use and pedestrian injuries in New York City. In one study, researchers found that of the 1,400 pedestrian and cyclist injuries treated at New York’s Bellevue Hospital Center between 2008 and 2011, “[a]bout 8 percent of both pedestrians and cyclists said they were injured while using an electronic device, including a cellphone or music player.

For victims ages 7 to 17, the numbers climbed to more than 10 percent of pedestrians and nearly 30 percent of cyclists.”17 According to American College of Surgeons, “nearly one in five patients ages 13 to 17 were sending text messages, listening to music, or otherwise distracted by a mobile device at the time of their accident.”18
New York City’s Response

The relatively consistent number of pedestrian injuries and fatalities in New York City between 2006 and 2012 comes despite the Bloomberg administration’s numerous pedestrian-friendly projects, programs, and research around traffic and pedestrian safety in the City during this time. In August 2010, Mayor Bloomberg, along with then City Council Speaker Christine Quinn and then DOT Commissioner Janette Sadik-Khan, issued a comprehensive study of street safety in New York, based on data gathered pursuant to the amendment of Local Law 11 in April 2008. This report examined 7,000 vehicle-pedestrian crash records and concluded that “...speeding, running red lights and failure to yield” were main causes of serious pedestrian crashes with vehicles in New York City.

Based on these findings, the DOT undertook numerous steps to calm traffic in neighborhoods in midtown Manhattan. Left-turn visibility was improved, countdown signals were installed at pedestrian crossings, and streets and intersections were comprehensively re-engineered with the goal of improving pedestrian safety. The city at this time also launched an anti-speeding campaign to raise safety awareness among motorists and restricted traffic in some residential neighborhoods to a 20 mile-per-hour speed limit.

Again, in September 2012, in response to growing awareness of pedestrian distraction, the New York City Department of Transportation launched the LOOK! Safety Campaign. Through outdoor advertising and messages on crosswalks, this campaign aimed to influence pedestrian behavior by providing visual cues at intersections.

The campaign was modeled after a similar campaign in London that was designed to alert tourists to traffic hazards. The London campaign, like New York City’s, deployed simple, clear messaging to mitigate risk-taking behavior on the part of pedestrians when in proximity to vehicular traffic. Contextual research around the London campaign focused on a series of key findings around “risk-taking” behavior. In its research, Transport for London, distinguished between behaviors based on intent and perception of risk. They found that “intentional risk-taking as a pedestrian is... more likely if people
do not believe that there is a high likelihood of any undesirable consequences happening. The end result is that they perceive their behavior as being relatively low risk.”

These intentional, high-risk actions are highly influenced by social cues, e.g. tourist areas where jaywalking behavior is highly present, or safety barriers are routinely ignored.

Figure 2: Intentionality and Perception of Risk. Transport for London Report.25
Mayor Bill de Blasio took office and reaffirmed his intention to make pedestrian safety a “central focus” of his newly-elected administration and quickly produced a “Vision Zero” Action Plan that outlined a series of policy initiatives directly aimed at improving pedestrian safety on New York City streets.

LOOK! complements other DOT campaigns on road safety that have been launched since 2006 (“Heads Up”, “That’s Why It’s 30”, “You The Man”).26 These campaigns are intended to work in tandem with engineering-oriented approaches recommended by the 2010 DOT action plan, including approaches such as:

- Crossing countdown signals;
- Barriers at high-risk intersections;
- Road engineering for maximum bilateral visibility;
- Multi-modal solutions (e.g., auditory feedback as a crossing indicator).27

As a candidate for office in 2013, Mayor Bill de Blasio signed onto the “Vision Zero” traffic safety project to reduce traffic fatalities by 100%.28 Weeks after he took office, and prompted by widely publicized pedestrian fatalities in early 2014, the Mayor reaffirmed his intention to make pedestrian safety a “central focus” of his newly-elected administration29 and quickly produced a “Vision Zero” Action Plan that outlined a series of policy initiatives directly aimed at improving pedestrian safety on New York City streets.30

The “Vision Zero” proposals supplement the 2010 New York City DOT plan with additional law enforcement initiatives, legislative measures, engineering proposals, and city government response protocols, as well as a new series of outreach, education, and engagement initiatives to improve pedestrian safety. The proposal calls for a permanent task force in the Mayor’s Office of Operations to synchronize and promote these initiatives. The “Vision Zero” plan promotes a multi-agency, synergistic effort to combat pedestrian injury and fatality through a wide variety of comprehensive mitigation strategies.
As vehicle-pedestrian crashes are overwhelmingly attributed to driver-caused hazards such as speeding, intoxication and distraction, policymakers, traffic safety advocates, and mobile carriers have rightly focused on mobile phone use and texting as a lethal source of distraction for drivers. Yet, pedestrian smart phone distraction has recently attracted attention and led researchers to explore the relationship between pedestrian mobile device use and injury. Some recent research includes:

- A proposed New York law that would have made it a crime to “enter and cross a crosswalk while engaging in the use of an electronic device.”
- A 2009 study in the Journal of the American Academy of Pediatrics examined the influence of talking on a cell phone for pedestrian injury risk in youths, and found that participants aged 10-11 were less attentive to traffic, did not leave a safe amount of time to cross, and experienced more collisions and close calls when using a cell phone than test subjects who did not.
- A 2011 study by researchers in the Department of Psychology at the University of Alabama at Birmingham considered how talking on the phone, texting and listening to music impact crossing the street, using college students as test subjects. This study found in particular that “texting, which involves not only communication interchanges but also reading and typing, may be more cognitively distracting and demanding than talking.” It also found that all of these behaviors distract from the crossing environment and lead to higher risk of injury.
• A similar 2012 study examined the ways in which gait velocity and trajectory changed for walkers when interacting with the screen on a mobile device. This small-scale experiment measured the movement of 33 university students as students texted on smart devices while moving through an obstacle course. The participants who texted while walking moved 33 percent slower and deviated from their intended course 61 percent more often than those who did not use their phones.

• A 2013 study by researchers at Ohio State University examines the causal relationship between pedestrian use of mobile devices and pedestrian injuries. These authors use data from 2004 to 2010 from the National Electronic Injury Surveillance System (NEISS), a database of hospital data maintained by the U.S. Consumer Products Safety Commission. They sampled injury reports from 100 national hospitals and produced estimates of pedestrian mobile phone use-related injuries reported at 3,800 hospitals throughout the U.S. They found that the number of pedestrian injuries due to pedestrian mobile phone use had increased from 506 injuries in 2004 to 1,506 injuries in 2010. If injuries continue to increase at the same rate, the researchers predicted over 3,000 injuries per year by 2015. Researchers also noted that injuries are likely greater than reported by the NEISS data. “Many people who suffer an injury may not go to the emergency room; they may go to their primary care doctor, not go to a doctor, may not report the cell phone as the cause, or may die (newspapers report incidents of pedestrian mobile phone users getting hit and killed by cars, busses and trains).” Sixteen to twenty-five year olds were most impacted by distracted walking.

Opportunities to Improve Traffic Safety with Mobile Technologies

New smartphone-based approaches to improve traffic safety using technological and design-based solutions have the potential to reduce smart phone distraction and increase pedestrian safety in urban areas. Some solutions complement increased enforcement and penalties for using mobile devices while driving by integrating the mobile device into the city’s dynamic street traffic ecosystem.

New smartphone-based approaches to improving traffic safety [have] the potential to reduce smart phone distraction and increase pedestrian safety in urban areas.
These technologies have the potential to increase environmental awareness, yet each presents opportunities and shortcomings:

- Apps that rely on camera technology to increase ability to see ahead;
- Velocity-detectors that silence alerts from incoming texts when a smart phone is in motion;
- Apps and wearable devices deploying Natural User Interface principles;
- Sensor-based technologies to warn pedestrians of oncoming traffic;
- Enabling communication between mobile devices and vehicles;

By enabling the user to see more, camera-based and motion-sensing Kinect-based technologies in their current formats may actually increase distraction by demanding more focus on the device. (Kinect is a motion-controlled technology used in gaming consoles and smart phones.) For example, Type N Walk, and Walk N Text for Android, use a mobile device’s camera to replace the full screen background image on a smart phone with live video of the environment ahead. The texting surface is displayed on top of the live video. Scientists at the University of Manitoba used Kinect to create CrashAlert, a tablet that warns texters of obstacles that are within six feet. Critics of these apps note that pedestrians still must look up to see obstacles.
Velocity-sensing technology can effectively reduce distraction for drivers but cannot distinguish between drivers and passengers in a vehicle, nor can it ascertain smart phone users riding public transportation. AT&T’s DriveMode app for Android and Blackberry uses a smart phone’s velocimeter to detect motion greater than 25 mile-per-hour. When exceeding this speed, the app sends a customizable auto-reply away message in response to incoming texts and email messages and can be set to disable the phone’s touch screen and audio alerts. This approach is positive since it eliminates sensory cues that invite distraction but users may avoid the inconvenience of disabling the app to adjust to diverse traffic conditions encountered in urban areas.

Another approach to ensure pedestrians are connected with their surroundings is deploying Natural User Interface (NUI) design principles so the smart phone interface does not interfere with walking and negotiating intersections.

To better understand users and the functionality that users expect of the smart phone interface, developers should consider four elements that influence design: (1) the user; (2) the task; (3) the device; and (4) the environment. Instead of the device separating people from
NUI solutions can help pedestrians stay alert and use their smart phone by incorporating wearable devices that extend smart phone functionality to apparel and gesture based technologies that require swipes and not keystrokes.

NUI solutions can help pedestrians stay alert and use their smart phone without engaging with the mobile device itself by incorporating wearable devices that extend smart phone functionality to apparel and gesture based technologies that require swipes and not keystrokes.
Perhaps the most promising traffic safety technology under development deploys wireless communications to directly connect drivers with pedestrians. General Motors developed vehicle technology that communicates with smart phones within 200 yards using the WiFi Direct protocol. The system is integrated with vehicle sensors, and when triggered, will alert the driver to oncoming pedestrians.51 Honda is developing similar vehicle and smart phone linking systems using dedicated short-range communications (DSRC).52 These vehicle-to-pedestrian technologies originated with the U.S. Department of Transportation Connected Vehicle research and development initiative53 that aims to tap existing wireless networks, network connected vehicles and smart phones to give drivers a “360-degree awareness of hazards and situations they cannot even see.”54

Vehicle-to-pedestrian technologies [aim] to tap existing wireless networks, network connected vehicles and smart phones to give drivers a “360-degree awareness of hazards and situations they cannot even see.”
Conclusion

The rapid ascent of smart phones in every corner of daily life has positively and adversely changed the way people move through urban spaces. For drivers, using a smart phone in a vehicle is irresponsible and increasingly regarded by policy makers and the public as criminal. Pedestrians, whose life can depend on the behavior of drivers, are unquestionably safer at New York City intersections when they heed the New York City DOT’s advice and LOOK! Yet, as researchers and most smart phone users know, despite mounting evidence of the hazardous impact of smart phone use in traffic, mobile devices can prove irresistible, and for use by pedestrians on streets, may demand natural user interfaces that enable pedestrians to stay alert and focused on their surroundings. Conversely, smart phone technology itself may facilitate improved traffic safety when integrated with the diverse ecosystem of New York City streets since the smart phone is frequently a common denominator among pedestrians, cyclists and drivers alike. These technologies deserve further refinement, demand new innovation and depend on public acceptance and wide-scale adoption for the promise of technological smart phone based solutions to meaningfully contribute to reducing traffic injuries and fatalities.
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