Walking Around the World

Pedestrian Safety Countermeasures in the United States and Abroad

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Abstract

Pedestrian safety and rates of travel are not a point of pride in the United States. Public policy has favored an automobile-centric transportation system that neglects and endangers pedestrians and leaves little choice but for automobile ownership as a means to fully participate in society. As comfort, convenience, and safety for pedestrians has declined in accordance with American policy and culture, so too have the rates of people who actually walk as a means of transportation. The result is a lamentable state of affairs concerning walking in America: comparatively low numbers of pedestrians and comparatively high rates of pedestrian injury and death due to automobile crashes.

As the United States has fallen farther and farther behind in this regard, other countries have been earnest leaders in pedestrian safety and have become the proving grounds for highly effective pedestrian safety countermeasures. This paper identifies and examines the types of pedestrian safety countermeasures being used in the United States and around the world, with a particular focus on pedestrian safety interventions in Europe. An analysis of the most common types of countermeasures was performed and an assessment of the potential benefits and challenges of each was completed. The latter was conceived as a means of aiding citizens and leaders in identifying appropriate pedestrian safety-improving projects in their communities. Across all countermeasures examined, a strong theme emerged: the importance of collective and political will in the implementation of pedestrian safety countermeasures.
I. Introduction

Walking is an ideal way to get around. It has been humans' primary means of transportation for virtually the entirety of human existence. For all of walking's positive attributes, it is—for all practical purposes—bereft of negative externalities in and of itself as a mode of transportation. Walking doesn't create noise or air pollution. It requires no special equipment or “fuel” other than that which is ingested by the walker in the form of food and drink, and which is essentially plant-based, solar energy. Moreover, the exertion of energy by simply walking provides valuable health benefits to the walker. Walking makes economical sense, both in terms of the direct costs to walkers and in terms of the costs associated with the construction and maintenance of infrastructure. The mere act of walking is capable of bringing joy to the traveler and enlivening neighborhoods that would otherwise feel “dead.”

Unfortunately, in the United States, public policy has turned walking—that most natural and universally beneficial of all transportation modes—into one of the most inconvenient, uncomfortable, and dangerous ways to travel. From 1997 to 2006, 49,128 pedestrians were killed by motorists in the United States, or 12 percent of all fatalities (424,840) due to motor vehicle crashes during that time (Chang 2008, p. 11). Though still unacceptably high, the number of pedestrian fatalities has trended downward over time, creating a false sense of improvement in pedestrian safety. Regrettably, the most prominent underlying cause of this decrease has been the shrinking number of people who actually walk to get around; fewer pedestrians means fewer pedestrian crash fatalities.
In writing this paper I decided to explore the various types of pedestrian safety countermeasures found in the United States and abroad with an eye toward identifying what might be lacking in the approach to pedestrian safety in the United States. The goal of this paper is to examine some of the means by which pedestrian safety can be improved and strengthened in the United States and to assess these means in terms of their potential positive characteristics as well as potential challenges or obstacles to their implementation.

To this end, the paper consists of two principal, complimentary segments. The first segment is a review of academic literature and official government reports concerning various approaches to improving pedestrian safety. Through the review process, the primary types of countermeasures were identified, quantified (according to how many reviewed works recommended each type), and discussed using examples of real-world application. The second primary segment is meant to be used as a guide for decision-makers and citizens in selecting which countermeasures might be the right fit for improving pedestrian safety in their communities. In this “countermeasure selection guide,” each countermeasure was assessed in terms of level of financial investment necessary (minimal or significant), the role that collective and political will has to play, and the ability of each countermeasure to produce short-term and/or long-term results.
II. Literature Review

Research Processes and Methods

Definition of “Pedestrian”

For the purposes of my research, a “pedestrian” was defined as any individual who is traveling about—whether engaged in utilitarian transportation or in recreation—on foot (or with the assistance of a wheelchair or the like) outdoors within a streetscape that includes sidewalks, roadway surfaces, and designated paths. Although pedestrians are sometimes included in a cohort of road-users known as “vulnerable road-users” (VRU), which also includes bicyclists and motorcyclists, these two modes of transportation were not included under the umbrella of “pedestrian” for reasons both obvious and less so. As bicyclists and pedestrians are taken as a whole in many studies, plans, and research—these modes being the two primary modes of non-motorized transportation—the selection of works that profiled both modes together was, in some cases, unavoidable. For this reason, many of the studies and reports reviewed included bicyclists as well as pedestrians in their analyses.

Mode of Research

In order to undertake a thorough examination of issues that bear on pedestrian safety in the United States, I conducted a search of the academic and scientific literature and research on the subject. A combination of approaches was put to use, including the utilization of the online library search tool of the University at Albany, State University of
New York ("Minerva") as well as the use of Google's academic search feature ("Google Scholar"). Search terms used included pedestrian safety, pedestrian crash, road safety, vulnerable road users, pedestrian planning, and complete streets. Inevitably—and what was especially the case with Google Scholar—each search returned results that numbered in the hundreds and even thousands. Thus, a process for conducting comparative analysis and identifying works deserving of further consideration became a point of great assiduity. Further details of this process are forthcoming in the proceeding section.

Additional credible sources of which I had prior knowledge as a graduate student of transportation planning were sought on an individual basis. These included the Journal of the American Planning Association, the Transportation Research Board of the National Academies, and the Federal Highway Administration of the United States Department of Transportation. Search terms identical to those previously mentioned were also used to search within the websites of these individual organizations. Details of my selection process will follow, but in all cases, a digital copy of the final printed version of the article was downloaded, most often in portable document format (PDF).

Selection of Works

As mentioned, computer searches using the online library search tool of the University at Albany, State University of New York ("Minerva"); Google's academic search feature ("Google Scholar"); and searches within the individual websites of selected organizations (Journal of the American Planning Association, the Transportation Research
Board of the National Academies, and the Federal Highway Administration of the United States Department of Transportation) were conducted. In all cases, only English-language sources, articles, and reports were considered for selection and possible inclusion in my research. Upon identifying a keystone piece of literature or research in the field of pedestrian safety data and countermeasures, the bibliography was consulted for additional pertinent works. Logically, any additional pertinent works were subjected to the same process: a consultation of the work’s bibliography and selection of yet further additional pertinent works for consideration. This procedure was repeated until a sizable pool of germane literature was amassed.

As a general rule, studies and works were not further considered if they turned out to be the work of certain types of advocacy organizations with a specific agenda and/or represented individual work of a non-peer-reviewed nature. Though these works were taken out of consideration for inclusion in this paper, the efforts and passionate narratives of the authors, nonetheless, contributed to the emergence of a valuable contextual backdrop to the subject under investigation. For example, one report by the Surface Transportation Policy Project (STPP), a non-profit pedestrian advocacy organization, presented a discussion of pedestrian safety issues in a more frank and straightforward manner than that which would be exhibited by an academic or peer-reviewed article (Ernst 2004). Though this report did not factor directly into my analysis, it nevertheless contributed to a better understanding of the “on-the-ground” experience that affects real people everyday.
In all, 21 articles and reports were selected for inclusion in this review. The identified works formed a diverse collection of sources. Some articles were drawn from peer-reviewed journals and publications in the fields of urban and regional planning, public health, medicine, and transportation. Others were official reports commissioned by the United States Government and completed by research institutions that function under the auspices of the Federal Highway Administration (FHWA) and the National Highway Traffic Safety Administration (NHTSA), both of the United States Department of Transportation (USDOT). In a number of instances, official reports on pedestrian safety data and countermeasures in other countries, commissioned and/or published by national or regional governments in each country, or by multinational non-governmental organizations (NGO), were consulted.

**Recording and Organization of Works**

For each article that emerged from the vetting process, the following were identified and recorded: (a) first author and year; (b) whether the article or report pertains only to pedestrians, or includes bicyclists as well as pedestrians; (c) the country, countries, or region featured or profiled in the article or report; (d) the methodology used by the researchers and/or a description of the article or report; and (e) the types of countermeasures recommended by each article or report, if any (see Table I, pp. 10-13).

In carefully reading and re-reading each article or report, I identified the prominent types—or categories—of pedestrian safety countermeasures being recommended. The salient types of countermeasures identified were:
<table>
<thead>
<tr>
<th>First Author</th>
<th>Year</th>
<th>Region</th>
<th>Methodology/Description</th>
<th>Types of Countermeasures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avenoso</td>
<td>2005</td>
<td>Europe</td>
<td>Report on the safety of vulnerable road users (VRU) and the effort to create</td>
<td>Roadway Design/Engineering/Automobile Design</td>
</tr>
<tr>
<td>Cairney</td>
<td>1999</td>
<td>Australia</td>
<td>Synthesis report on pedestrian safety data and countermeasures in Australia</td>
<td>Education/Outreach/Federal Highway Administration</td>
</tr>
<tr>
<td>Chang</td>
<td>2008</td>
<td>USA</td>
<td>Report on trends and data concerning pedestrian fatalities</td>
<td>None</td>
</tr>
<tr>
<td>Davies</td>
<td>1999</td>
<td>UK</td>
<td>Synthesis report on pedestrian and bicyclist safety data and countermeasures in the United Kingdom</td>
<td>Education/Outreach/Enforcement/Psychological/Way of Thinking</td>
</tr>
<tr>
<td>Dumbaugh</td>
<td>2005</td>
<td>USA</td>
<td>Study of the conflicts and contradictions that exist between conventional transportation safety practices and the effort to create safe, attractive, livable streets in urban environments</td>
<td>Roadway Design/Engineering</td>
</tr>
</tbody>
</table>

Table 1: Characteristics, descriptions, and countermeasure types for studies and papers reviewed.
<table>
<thead>
<tr>
<th>First Author</th>
<th>(Year)</th>
<th>Region</th>
<th>Pedestrian</th>
<th>Methodology/Description</th>
<th>Countermeasure(s) Type</th>
<th>Countermeasure(s) Countermeasures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dumbaugh</td>
<td>(2009)</td>
<td>United States</td>
<td>Bicyclists/Pedestrians</td>
<td>Study of the association between community design and crime</td>
<td>Land-use</td>
<td></td>
</tr>
<tr>
<td>Ekman</td>
<td>(1999)</td>
<td>Netherlands</td>
<td>Bicyclists/Pedestrians</td>
<td>Synthesis report on pedestrian and bicycle safety data and enforcement</td>
<td>Psychological/Way of Thinking</td>
<td></td>
</tr>
<tr>
<td>Fischer</td>
<td>(2010)</td>
<td>Denmark, Germany, Sweden, Switzerland, United Kingdom</td>
<td>Bicyclists/Pedestrians</td>
<td>Synthesis report on bicycle and pedestrian safety and enforcement</td>
<td>Education/Outreach, Enforcement, Roadway Design/Engineering</td>
<td></td>
</tr>
<tr>
<td>Hummel</td>
<td>(1999)</td>
<td>Netherlands</td>
<td>Bicyclists/Pedestrians</td>
<td>Synthesis report on pedestrian and bicycle safety data and enforcement</td>
<td>Automobile Design</td>
<td></td>
</tr>
<tr>
<td>Jensen</td>
<td>(1999)</td>
<td>United Kingdom, Scandinavia</td>
<td>Bicyclists/Pedestrians</td>
<td>Synthesis report on pedestrian and bicycle safety data and enforcement</td>
<td>Land-use</td>
<td></td>
</tr>
</tbody>
</table>

Table I: Characteristics, descriptions, and countermeasure types for studies and papers reviewed.
<table>
<thead>
<tr>
<th>First Author</th>
<th>Year</th>
<th>Country(s)</th>
<th>Methodology/Description</th>
<th>Types of Countermeasures Recommended</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knoblauch</td>
<td>2000</td>
<td>United States</td>
<td>Study of the effect of crosswalk markings on motor vehicle speeds under various circumstances involving the presence or absence of a pedestrian prepared for the United States Department of Transportation, Federal Highway Administration</td>
<td>None</td>
</tr>
<tr>
<td>Koepsell</td>
<td>2002</td>
<td>United States</td>
<td>Study of the effectiveness of crosswalk markings at intersections posing a high risk to older pedestrians compared to matched unmarked control intersections</td>
<td>None</td>
</tr>
<tr>
<td>Pucher</td>
<td>2000</td>
<td>Germany, Netherlands, United States</td>
<td>Synthesis report on bicyclist and pedestrian safety data and countermeasures in Germany and the Netherlands with recommendations for application in the United States</td>
<td>Education/Outreach, Enforcement, Psychological/Way of Thinking, Roadway Design/Engineering</td>
</tr>
<tr>
<td>Retting</td>
<td>1987</td>
<td>United States</td>
<td>Report on pedestrian safety and related data in New York City presented to the Committee on Public Health of the New York Academy of Medicine</td>
<td>Education/Outreach, Enforcement, Psychological/Way of Thinking, Roadway Design/Engineering</td>
</tr>
<tr>
<td>Pucher</td>
<td>2003</td>
<td>Germany</td>
<td>Synthesis report on bicyclist and pedestrian safety data and countermeasures in Germany and the Netherlands framed in a public health context with recommendations for application in the United States</td>
<td>Education/Outreach, Enforcement, Psychological/Way of Thinking, Roadway Design/Engineering</td>
</tr>
<tr>
<td>Koepsell</td>
<td>2002</td>
<td>United States</td>
<td>Study of the effectiveness of crosswalk markings at intersections posing a high risk to older pedestrians compared to matched unmarked control intersections</td>
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<td>Pucher</td>
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<td>Synthesis report on bicyclist and pedestrian safety data and countermeasures in Germany and the Netherlands with recommendations for application in the United States</td>
<td>Education/Outreach, Enforcement, Psychological/Way of Thinking, Roadway Design/Engineering</td>
</tr>
</tbody>
</table>
### Table I: Characteristics, descriptions, and countermeasure types for studies and papers reviewed

<table>
<thead>
<tr>
<th>First Author</th>
<th>Year</th>
<th>Country, Countries</th>
<th>Methodology/Description</th>
<th>Recommended Countermeasure Types</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bicyclists/Pedestrians</td>
<td></td>
<td>United States, Canada, China</td>
<td>Review of engineering countermeasures to improve pedestrian safety data and countermeasures</td>
<td></td>
</tr>
<tr>
<td>Van Houten (1999)</td>
<td></td>
<td>Canada</td>
<td>Synthesis report on pedestrian safety data and countermeasures</td>
<td>Education/Outreach, Enforcement</td>
</tr>
<tr>
<td>Yuan (2009)</td>
<td></td>
<td>China, United States</td>
<td>Analysis of five years of pedestrian crash data at 1,000 marked crosswalks</td>
<td>Roadway Design/Engineering</td>
</tr>
<tr>
<td>Zegeer (2005)</td>
<td></td>
<td>United States, Canada</td>
<td>Analysis of five (5) years of pedestrian crash data at 1,000 marked crosswalks</td>
<td>Roadway Design/Engineering</td>
</tr>
<tr>
<td>Zegeer (2010)</td>
<td></td>
<td>United States, Canada, China, Denmark, Germany, India, Netherlands, Norway, Switzerland, United Kingdom, United Kingdom</td>
<td>Synthesis report on pedestrian crash trends and countermeasures from around the world</td>
<td>Automobile Design, Education/Outreach, Enforcement, Roadway Design/Engineering</td>
</tr>
</tbody>
</table>

Note: The table above summarizes the characteristics, descriptions, and recommended countermeasure types for studies and papers reviewed in the context of pedestrian safety. The entries indicate the authors, years of publication, countries of focus, methodologies, and types of countermeasures recommended.
(a) automobile design; (b) education and outreach; (c) enforcement; (d) infrastructure maintenance; (e) land-use; (f) psychological or “way of thinking”; and (g) roadway design and engineering. In some cases, it was observed that reports focused strictly on data, trends, or research results, recommending no mitigating countermeasures (Chang 2008; Knoblauch & Raymond 2000; Koepsell et al. 2002).
Recommended Pedestrian Safety Countermeasures

Automobile Design

Recommendations pertaining to automobile design appeared in five of the 21 works reviewed, or 24 percent (see Figure 1 on page 16 for a breakdown of the percentage of articles and reports recommending each countermeasure type) (Avenoso & Beckmann 2005; Hummel 1999; Jensen 1999; Retting et al. 2003; Zegeer & Bushell 2010). No works that reviewed pedestrian safety countermeasures in the United States indicated that automobile design was a prominent pedestrian safety countermeasure there. Per contra, automobile design represents an area of growing emphasis for improving pedestrian-automobile crash safety and fatality rates in Europe. Retting et al. (2003, p. 1) illuminate the trend thus:

Modification of car fronts and other vehicle features to reduce the severity of injuries to pedestrians is a focus in Europe, where approximately 20 percent of all road user fatalities are pedestrians and cyclists; however, this approach has not been a priority in the United States despite research showing potential benefits.

Many standard, if not at least familiar, safety features found in American cars, although conceived primarily with vehicle-drivers and other motorists in mind, have improved pedestrian safety in the aggregate. Features such as daytime running lights, alcohol ignition interlock devices, and anti-lock braking systems improve the safety of all
road users, including pedestrians, by making automobiles and their drivers somewhat less
dangerous.

Figure I: Percentage of works recommending each countermeasure type

Note: percentages do not total 100% due to works recommending multiple types of countermeasures

In many European countries, however—where densely packed, historic city centers
team with pedestrians, bicyclists, automobiles, and other road-users all vying for highly
constrained street space—practice has been to take technologies and innovation in
automobile design even further in the effort to prevent or lessen the severity of pedestrian-
automobile crashes. In the Netherlands, where casualty rates of pedestrians and bicyclists
have consistently decreased even as those modes increase their share of trips, the road
safety of pedestrians and bicyclists has been a top priority for decades. The Dutch Ministry
of Transport has had no small part in this trend and has been a strong supporter of policies to regulate the design of automobile front ends to increase pedestrian crash safety (Hummel 1999).

Among new technologies being developed and tested in Belgium and France are intelligent speed adaptation (ISA) systems (Avenoso & Beckmann 2005). ISA systems consist of technologies incorporated into the automobile that “know” what the permitted maximum speed is for a particular roadway segment. ISA systems are able to use this knowledge to make recommendations to drivers and/or intervene in the vehicle’s control to prevent it from exceeding legal speed limits.

Another innovation that is seeing development in Europe is vision enhancement technology. These are systems designed to assist drivers in detecting objects in the road—including vulnerable road-users—through the use of radar, infrared cameras, image recognition technologies, and “head-up” displays (Avenoso & Beckmann 2005). Although these systems could prove exceedingly helpful in preventing nighttime and bad weather pedestrian crashes, there is, however, some concern that the new technologies could encourage drivers to negatively adapt their behavior, for example by speeding when visual conditions are not impaired.

One study of pedestrian safety in Denmark focused on the adoption of audible warning devices for vehicles that are moving in reverse (Jensen 1999). These devices, though not compulsory in Denmark at the time of the report’s publication, are commonly installed on trucks and other commercial vehicles as a means of cutting down on crashes
involving pedestrians and vehicles that are backing up. In the report, Jensen estimates that the devices have reduced these types of crashes by about 34 percent in Denmark. Use of audible warning devices on trucks and commercial vehicles in the United States has become widespread.

There has been, of late, renewed interest in audible warning systems in response to the proliferation of “quiet” hybrid and electric vehicles. For several years, advocates for the blind as well as the National Highway Traffic Safety Administration (NHTSA) have raised concerns about the increased risk of these vehicles to pedestrians. The NHTSA will be writing a standard, to be put into effect no later than July 12, 2012, that will require that all new hybrid and electric vehicles be outfitted with an alert sound that does not require any action on the part of drivers or pedestrians to be activated (Kollipara & Ohnsman 2011). NHTSA Administrator David Strickland has said of the new safety measures, “Even as we make giant leaps forward with hybrid and electric vehicles, we must remain laser focused on safety; with more and more quiet vehicles on the road, we have to consider their effect on pedestrians” (quoted, Kollipara & Ohnsman 2011). One of the articles reviewed (unsurprisingly, one of the more recent articles) recommended such audible alert systems in newer hybrid and electric vehicles to increase the safety of vulnerable road-users, especially those with visual impairments (Zegeer & Bushell 2010).
**Education and Outreach**

Nearly half of all articles and reports reviewed—10 of the 21—recommended pedestrian safety countermeasures involving education and/or outreach programs. With 48 percent of the works reviewed recommending it, this type of countermeasure was tied with enforcement as the second most frequently recommended countermeasure type of all (see Figure 1, p. 16). In contrast to automobile design, education and encouragement programs were a salient countermeasure recommended across a broad spectrum of countries, including the United States.

In consulting the literature, it became clear that the broad category of education and outreach countermeasures could be broken down into several subsets. These include educational programs aimed at children (which are most often carried out in schools); educational and training programs aimed specifically at drivers; and general public awareness and outreach campaigns. In general, education and outreach programs were lauded for their budget-friendly nature (when compared to costly capital and infrastructure projects) as well as the ability of these programs to increase safety for all road users, not just pedestrians and other vulnerable road-users.

90 percent of works recommending education and outreach programs as countermeasures to help mitigate unsafe roadway conditions for pedestrians included programs geared toward children and schools among their recommendations (Avenoso & Beckmann 2005; Cairney 1999; Davies 1999; Fischer et al. 2010; Hummel 1999; Pucher & Dijkstra 2000; Pucher & Dijkstra 2003; Van Houten & Malenfant 1999; Zegeer & Bushell...
It seems to be a fairly universally accepted assumption that reaching out to children about traffic safety at an early age, and indeed throughout childhood and adolescence, not only improves their safety as vulnerable road-users, but is also likely to instill values, insight, and knowledge that will continue to inform their behavior into adulthood.

Avenoso and Beckmann (2005) mention several countries within the regions of southern, eastern, and central Europe (collectively known as the “SEC Belt”) that have integrated programs into elementary school education. Programs in Malta, Hungary, Poland, Cyprus, Slovenia, the Czech Republic, Italy, France, and Greece utilize a range of methods that may involve interactive games, special visits to schools by police officers to talk about pedestrian safety, and, in some cases, the provision of special “mini-road” facilities that allow children to practice being safe pedestrians (and bicyclists) in a non-threatening setting.

Among the more rigorous educational programs is that of France, which requires a “certificate of first education” in road safety—attained at school through special training programs—before beginning training at a driving school. Similarly, in Switzerland, municipalities are actually required by law to educate children about traffic behavior (Fischer et al. 2010, p.35). Avenoso and Beckmann (2005) note that, even with the implementation of these programs in the SEC Belt countries, there are still doubts and concerns as to the quality and quantity of these programs and the effectiveness of training meant to prepare teachers and school staff to administer them.
In Canada, a series of pedestrian safety pilot programs have been initiated that target older elementary school children as well as those in junior high school (Van Houten & Malenfant 1999). One such program utilized a 20-minute section of students' home room time for them to learn about safe pedestrian skills through demonstration, role playing, and practice. One unique aspect of this program is that it also aimed to reach students' parents; students were routinely sent home with educational pamphlets and items like “I Yield To Pedestrians” bumper stickers meant to grab parents' attention.

50 percent of works recommending education and outreach programs as countermeasures to help mitigate unsafe roadway conditions for pedestrians prescribed programs aimed at existing drivers—generally adults who have already graduated high school (Avenoso & Beckmann 2005; Davies 1999; Fischer et al. 2010; Pucher & Dijkstra 2000; Pucher & Dijkstra 2003). The articles and reports reviewed often emphasized the vulnerability of children and the desire to create safe roadway environments for them as being key motivators behind education and outreach programs geared toward adult drivers.

Many campaigns made appeals to drivers—sometimes through the use of imagery and/or language designed to shock—to recognize their own individual responsibility for the safety of pedestrians, especially children. In the United Kingdom, a series of television advertisements and billboards, known as the “Kill Your Speed” campaign, utilized home video footage and imagery of children who had been struck and killed by motorists (Davies 1999). Also utilized in the United Kingdom were community-led “speed pledge” programs that invited drivers to pledge to obey speed limits and drive safely, sometimes distributing
bumper stickers and other apparel that advertised the pledge. In some cases, local law enforcement agencies were active participants, distributing the materials to drivers who were stopped for speeding and asking them to sign the pledge on the spot (Davies 1999).

Finally, 50 percent of works recommending education and outreach programs as countermeasures to help mitigate unsafe roadway conditions for pedestrians spoke of more general public awareness campaigns that were designed to appeal to a broad range of road-users and focused on a broad range of safety issues, including drunk driving (Avenoso & Beckmann 2005; Burr 2009; Fischer et al. 2010; Retting 1987; Van Houten & Malenfant 1999). In many cases, it was noted that it is difficult, if not impossible, to measure the success of public outreach and education campaigns; unlike roadway design and engineering projects, for example, there is no practicable way to link programs to any potential decrease in pedestrian injuries and fatalities. As such, it proves difficult to complete cost-benefit analyses for outreach and education programs.

Figure II: Examples from Transport for London’s road safety campaign aimed at teenagers

Source: Presentation by Nick Baker, Transport for London (Fischer et al. 2010)
In the United Kingdom, the Department for Transport produces a national media campaign known as Think!, spending £17.6 million on the program from 2007 to 2008 (Burr 2009). The campaign focuses on an array of traffic safety issues. Of 12 campaigns that were produced under the Think! brand in 2008, two were focused directly on improving road safety for pedestrians and bicyclists. The Department for Transport has expressed interest in conducting surveys of people’s attitudes about road safety before and after the implementation of public awareness media campaigns in an effort to assess the value of such programs.

Fischer et al. (2010, p. 33) also reference the U.K.’s Think! campaign, calling that country’s media outreach efforts “the most extensive motorist education and awareness programs among all the countries [studied].” They found the use of a single brand to be highly effective and recognizable, and that it aided in making the public aware that all traffic safety issues are interconnected and important. A recent Transport for London road safety campaign created under the Think! brand uses shocking imagery that is meant to grab the attention of teenagers (see Figure II, p. 22). The campaign utilizes television spots, billboards, online advertising, and an interactive website. Avenoso and Beckmann (2005) identify additional European countries with significant road safety programs at the national level including Belgium, Portugal, Spain, Estonia, Latvia, Poland, Hungary, and Italy.
Enforcement

Nearly half of all articles and reports reviewed—10 of the 21—recommended enforcement as an effective and necessary countermeasure to improve pedestrian safety (Avenoso & Beckmann 2005; Cairney 1999; Davies 1999; Fischer et al. 2010; Pucher & Dijkstra 2000; Pucher & Dijkstra 2003; Retting 1987; Retting et al. 2003; Van Houten & Malenfant 1999; Zegeer & Bushell 2010). With 48 percent of works reviewed recommending it, enforcement was tied with education and outreach as the second most frequently recommended countermeasure type of all (see Figure I, p. 16). Enforcement was also a common countermeasure recommended across a broad spectrum of countries, including the United States.

Enforcement was widely viewed as an absolute necessity in the effort to keep streets safe. Not only is enforcement a cost-effective countermeasure when compared to costly infrastructure projects, but it is also unique among other types of recommended countermeasures in its ability to actually generate revenue through fines for traffic violations. Revenues generated through effective law-enforcement can be re-invested into additional safety programs, maintenance and construction of new infrastructure, or the hiring of additional law-enforcement officers.

Enforcement is not confined only to motorists; to the contrary, it represents the effort to compel all road-users—pedestrians, bicyclists, motorcyclists, skateboarders, rollerbladers, motorists, etc.—to obey traffic laws. In some cases it was noted that “non-punitive” measures were preferred by law-enforcement agencies and municipalities, though
it was unclear if this was an indication that the parties concerned were of the opinion that regulations and laws should not be enforced, or if they simply favored education and encouragement programs as opposed to tickets and fines.

When it comes to pedestrian safety, the most germane and consequential forms of negligence on the part of motorists are speeding, running red lights, and failure to yield to pedestrians at designated crossings. Of these three, speeding and running red lights tend to receive the most attention from law enforcement.

In recent years, there has been a growing interest in automated enforcement among municipal governments and law enforcement agencies, primarily through the use of camera and speed-detection technologies installed at intersections and on highways to catch and ticket speeders and red light-runners. The idea of traffic law enforcement is still unpalatable in the United States, it would seem. In the United States, controversy often arises over the use of automated enforcement methods, inflamed by citizens who see these technologies as part of a conspiracy to increase revenue for municipalities and law-enforcement agencies by forcing drivers to obey the law (Copeland 2012). Fischer et al. (2010) note that, of the European countries examined, “...photo enforcement of traffic signals and speed limits was common in most countries.”

Fischer et al. (2010, p. 35) further elaborate on their observations of traffic enforcement in Denmark, Germany, Sweden, Switzerland, and the United Kingdom; the description that follows may come as a baffling, stupefying shock to the average American.
Infrastructure Maintenance

Of the 21 works reviewed, only one article (representing five percent of all works reviewed) recommended the maintenance of current infrastructure as a countermeasure to improve pedestrian safety (see Figure I, p. 16) (Davies 1999). This came as a bit of a surprise as it would seem that simply maintaining existing infrastructure put in place to improve pedestrian safety would be a cost-effective and obviously practical method to maintain, if not improve, pedestrian safety. It's almost a case of “not being able to see the forest through the trees”; that is, it seems so obvious that maintenance should be kept up that we forget to include it in our plans and programs. The same could be said of enforcement. In other words, we've made immense previous investments in road infrastructure (some of it safe for pedestrians, some of it not), and, in the case of enforcement, we have existing laws meant protect road-users. Just as existing laws should be enforced to protect pedestrians

Anecdotal observations in most host cities indicated high levels of pedestrian and bicyclist compliance with traffic signals and other traffic control devices. In fact, several scan team members frequently commented on how orderly the traffic was compared to the typical U.S. experience. For example, pedestrians typically crossed with pedestrian signals at intersections, bicyclists obeyed traffic signals even when no crossing traffic was present, and motorists were courteous and attentive at intersections and other pedestrian crossings. The scan team did not see motorists encroaching on bike boxes or pedestrian crosswalks, or bicyclists encroaching on pedestrian crosswalks.
and other vulnerable road-users, so, too, should current infrastructure meant (and proven) to improve pedestrian safety be maintained.

Davies’ (1999) focus was specifically on “footways” (sidewalks) in the United Kingdom. He notes that, in many cases, local authorities and municipalities were spending more for injury compensation claims related to the poor repair of sidewalks than they were spending to maintain the sidewalks in safe, functional condition. Davies also focused on the increasing importance of infrastructure maintenance in an era (even in 1999) of budget cuts as well as on the need to take a “whole-life” approach when calculating cost projections.

Land-Use

Of the 21 works reviewed, only one article (representing five percent of all works reviewed) referred to the effects and consequences of land-use on traffic and pedestrian safety (see Figure I, p. 16) (Dumbaugh & Rae 2009). A discussion of land-use as a potential countermeasure to help mitigate unsafe roadway conditions for pedestrians was conspicuously absent from all other works reviewed.

Dumbaugh and Rae's analysis focused generally on the effects of the built environment on pedestrian safety—specifically, on the type of built environment. Their analysis went beyond mere roadway design to look at the ability of certain land-use types and/or intensities, and the spacial arrangements thereof, to affect pedestrian safety—both real and perceived. They discuss the work of Clarence Perry and Clarence Stein on the design of Radburn, New Jersey and their influence on American suburban development in
the post-WWII period. Perry and Stein were pioneers in an effort to ensure pedestrian safety by keeping pedestrians and automobiles as separated as possible (a concept that came to be known as the “Radburn principle”). Perry’s “neighborhood unit”—a self-contained residential community with various civic structures and a school at its center—further developed the concept by promoting the reconfiguration of land-uses to minimize traffic impacts in residential areas. In some ways, what Perry and Stein envisioned has become the description of the typical modern American suburb, which, as history has played out, has come with a host of negative, unintended consequences.

In conjuring Perry and Stein’s principles, Dumbaugh and Rae are not suggesting that neighborhoods should be developed or redeveloped according to the Radburn principle. To the contrary, they attempt to examine the critical implications of land-use type, location, and intensity on pedestrian safety, arguing that the development paradigm that emerged from these principles has proven detrimental to pedestrian safety. They explain (p. 327):

...many of the community design practices that became conventional responses to [the traffic safety concerns of the early 20th century], such as the development of functionally designed streets and street networks and the relocation of commercial and retail uses to arterial thoroughfares, are practices that have substituted one set of safety problems for another.

One of Dumbaugh and Rae’s primary findings has to do with the positive effect of “pedestrian-scaled” retail on pedestrian safety. They found this type of land-use to be associated with reductions in all categories of crashes and at significant levels for both
injurious and total crashes. They conclude that, “the pedestrian-scaled nature of these environments communicates to motorists that greater caution is warranted, leading to increased driver vigilance, lower operating speeds, and thus a better preparedness to respond to potential crash hazards that may emerge” (p. 323).

Psychological/“Way of Thinking”

Five of the 21 articles and reports reviewed—roughly a quarter—spoke at length about the profound affect that the ways in which we think about traffic and road safety can have on pedestrian safety, or lack thereof (see Figure I, p. 16) (Davies 1999; Ekman & Hyden 1999; Pucher & Dijkstra 2000; Pucher & Dijkstra 2003; Retting 1987). In discussing the psychology of—or the ways in which cultures think about—pedestrian safety issues, the authors of the above works were not explicitly recommending a wholesale change in paradigm among the cultures in question; nor, indeed, were they suggesting that it would be entirely possible. However, in calling attention to the ways in which cultures think about these issues, and in framing this as contributing to the problem of pedestrian safety in various countries, it was implicit that, somehow (such as through some of the other countermeasures discussed in this paper), a change in collective attitudes is necessary. It is through this chain of logic that I identified changes in psychology/“way of thinking” as an important countermeasure for improving pedestrian safety.

Ekman and Hyden (1999) focused on pedestrian safety in Sweden and more broadly in Scandinavia. They note that, even as Sweden has a relatively good pedestrian safety
record when compared to other countries, transportation planning is still largely thought of as being a matter pertaining only to automobiles. They explain in their conclusion that, “insight into the basic problems for pedestrians could either be used to further blame and restrict the pedestrians or it could be used to understand the conditions under which traffic planning has to be done.” Although more than a decade has passed since these observations were made, and although there seems to be a growing awareness of the need to incorporate a consideration for non-motorized modes and vulnerable road-users into transportation planning, the fact that automobiles continue to be the primary concern in these matters remains a very real impediment to improving pedestrian safety.

Much of the paradigm concerning pedestrians and pedestrian safety in the United States can be attributed to the fact that such a miniscule percentage of the population actually gets around by walking (or bicycling). This phenomenon becomes exceedingly clear when the United States is compared to Europe and Canada (see Figure III, p. 31). Even Canada has nearly twice the percentage of non-motorized trips compared to the United States.

Pucher and Dijkstra (2000, p. 5) point out that, even in the sprawled metropolitan areas of the United States, many trips are reasonably walkable (or bikable); 49 percent of all trips are under three miles in length, 40 percent of trips are under two miles in length, and 28 percent are under one mile in length. This being the case, they explain, the spectacularly low levels of walking (and bicycling) in the United States can not be explained solely by long trip distances. Pucher and Dijkstra (2000, p. 5) take their argument beyond implication,
explicitly indicting “American culture and lifestyle” as being primary contributors to the poor rates of walking and of pedestrian safety in the United States, as they are “almost entirely oriented to the car.”

Figure III: Modal shares of walking and bicycling in North America and Europe, 1995

Note: These distributions are approximate due to differences in trip definition among the featured countries

In terms of American culture, perhaps of paramount consequence is the way Americans view fault and responsibility when it comes to pedestrian injuries and deaths. Retting (1987) illuminates the pernicious nature of the American way of thinking about pedestrian safety thus:
Despite the chronic public health problem caused by pedestrian injuries, injury control has not been given high priority. Injury is typically regarded as an unavoidable byproduct of motor vehicle travel, and considerable blame is assigned to the injury victim. The belief that the pedestrian is mostly responsible for incidents between vehicles and pedestrians is disturbingly prevalent among professions and government agencies empowered to devise injury prevention programs.

Retting goes even further, making an explicit policy recommendation that the blame typically assigned to pedestrians in accident reports should be kept to an absolute minimum. At least one author of a reviewed work, Davies (1999), had a positive outlook on the levels of tolerance of traffic accidents involving pedestrians, though not in the United States; he found that attitudes in the United Kingdom have been changing and that tolerance of pedestrian-involved accidents was lower than it had been.

Beyond discussing the way in which blame is treated and assigned, Pucher and Dijkstra (2000, p. 27) point to the extreme leniency shown by American traffic laws and law-enforcement officers toward motorists involved in injurious or fatal accidents in the United States. They cite a study (p.27) finding that, of all pedestrian and bicyclist fatalities involving motorists in New York City between 1994 and 1997, only one out of four drivers were issued citations by police despite the fact that drivers were unquestionably at fault greater than half the time. “Clearly,” they explain, “such leniency with even the most deadly of driving behavior only encourages more of it and puts pedestrians and bicyclists at much higher risk in the United States...” (p. 28).
The way in which roadways are designed and engineered, and the built environment that results, were overwhelmingly the most frequently recommended type of countermeasure, featuring in 18 of the 21 articles and reports reviewed, or 86 percent (see Figure I, p. 16) (Avenoso & Beckmann 2005; Burr 2009; Cairney 1999; Davies 1999; Dumbaugh 2005; Dumbaugh & Rae 2009; Ekman & Hyden 1999; Fischer et al. 2010; Hummel 1999; Jensen 1999; Pucher & Dijkstra 2000; Pucher & Dijkstra 2003; Retting 1987; Retting et al. 2003; Van Houten & Malenfant 1999; Yuan et al. 2009; Zegeer et al. 2005; Zegeer & Bushell 2010). In fact, every single article or report that made countermeasure recommendations (three did not) featured a discussion of the physical design of the built environment.

The types of countermeasures discussed and recommended ran the gamut of state-of-the-practice design and roadway engineering interventions pertaining to pedestrian safety, convenience, and comfort. Certain works featured studies of the effectiveness of conventional pedestrian treatments (various types of crosswalks, walk signals at controlled intersections, timing of pedestrian signal cycles, speed limits, etc.), while others acknowledged the conventional treatments but homed in on more “innovative” or newfangled design and engineering interventions that are only beginning to take hold among state and municipal planning offices and traffic engineering divisions in the United States.
In consulting the literature, it became clear that the category of roadway design and engineering countermeasures was vast and immense in breadth, and that it could be broken down into several distinct sub-categories. The primary sub-categories identified were separation of pedestrians and vehicles in time and/or space; increasing pedestrian conspicuousness; and traffic calming and vehicle speed management.

Fischer et al. (2010) focused on pedestrian safety countermeasures in several European countries including Denmark, Germany, Sweden, Switzerland, and the United Kingdom. They identified and observed a broad range of engineering and design solutions for improving pedestrian safety that they deemed to be appropriate for consideration in the United States. Several of the countermeasures identified had to do with the placement and orientation of traffic lights and signals, for both pedestrians as well as for motorists.

The United Kingdom has been phasing in “near-side” pedestrian signals (see Figure IV, p. 35) (Fischer et al. 2010, p. 19). This treatment features pedestrian signals that are oriented to pedestrians on the side of the street where they are originating, not the destination side. Not only does this arrangement improve the visibility of the signal for those with partial or impaired vision, but the signal is also oriented so as to make pedestrians look toward oncoming traffic, as opposed to looking across the street.

Fischer et al. (2010, p. 20) also found near-side traffic signals for motor vehicles to be a common practice in all the European countries they profiled. Similar to the near-side pedestrian signal, the near-side traffic signal for motor vehicles is located on the side of the intersection where motorists will come to a stop at a red light (see Figure V, p. 35). Being on
the near-side, these traffic signals give approaching motorists a visual “target” of where to stop. Additionally, if motorists pull up too far, they will be unable to effectively see the light to know when it turns green. The dual effect is that motorists were observed to encroach less into the crosswalk space and were less inclined to run red lights (p. 21).

Figure IV: Near-side pedestrian signal in Bristol, United Kingdom

![Near-side pedestrian signal in Bristol, United Kingdom](image1)

Source: Fischer et al. 2010

Figure V: Near-side traffic signal for motor vehicles in Bern, Switzerland

![Near-side traffic signal for motor vehicles in Bern, Switzerland](image2)

Source: Fischer et al. 2010
Several design treatments pertaining to the arrangement and layout of pedestrian crossings were also identified by Fischer et al. (2010). Some of the treatments observed in the European cities they visited, such as raised crosswalks and pedestrian “refuge” islands, have become relatively common, if not widespread, in the United States. One observed treatment, however, seems to have not quite made its debut on the American stage: the offset, or “staggered,” pedestrian crossing (see Figure VI). The staggered pedestrian crossing consists of a refuge island with offset entry and exit points. The primary safety benefit of this configuration is that it forces pedestrians crossing the street to briefly walk longitudinally in the refuge island, putting potential oncoming traffic directly in a pedestrian's line of sight before he or she decides to finish crossing the street.

Additional observations and recommendations pertaining to pedestrian street crossings were made by Zegeer et al. (2005). Among their recommendations for crosswalk

Figure VI: Staggered pedestrian crossing in Bristol, United Kingdom

Source: Fischer et al. 2010
treatments are pedestrian warning signs at crossings and/or on the approach; advance stop
lines with “stop here” signs; rumble strips on approaches to crosswalks; in-pavement
flashing lights; flashing beacons; crosswalk lighting; and overhead pedestrian crossing
signage. Their study also indicated that the presence of a raised crossing island (“refuge”
island) was associated with significantly lower pedestrian crash rates at pedestrian crossings
(both marked and unmarked) of busy, multi-lane sites (p. 35).

Another finding from the study completed by Zegeer et al. (2005) offers a cautionary
tail to well-intentioned transportation planners aiming to improve pedestrian safety by
installing crosswalks. Their results indicated that merely installing a marked crosswalk alone
(i.e., with no other pedestrian safety features such as traffic calming, signage, lighting, etc.)
at an already unsafe crossing location (such as at wide, high-volume streets) was associated
with a negative effect on pedestrian safety and a higher rate of crash incidence (p.46). One
possible explanation is that the presence of the marked crosswalk encouraged at-risk
pedestrians such as senior citizens and children to cross at unsafe locations where additional
pedestrian safety provisions were necessary.

With regard to traffic calming and speed management, Retting et al. (2003) conclude
that residential neighborhoods with large numbers of children offer the highest potential for
pedestrian injury prevention. A high percentage of crashes involving child pedestrians are
the result of “child's error”—that is, the fact that children tend to lack the cognitive ability
to asses vehicle speeds and distances and to identify safe moments at which to cross the
street. As such, speed is a primary determining factor in the injury and fatality rates of these
types of crashes due to its affect on drivers’ ability to take evasive action and/or stop in time. Of all the potential crash-reducing countermeasures possible, the installation of modern roundabouts in place of conventional intersections was the most effective speed-control intervention identified by Retting et al. They point to European studies that found that by converting conventional intersections to roundabouts pedestrian crashes were reduced by approximately 75 percent. Additional traffic calming methods found to be effective included lane narrowing, adjustments in roadway curvature, pedestrian refuge islands, speed bumps, and curb extensions at intersections (also called “bulb-outs” or “neck-downs”).

Retting et al. (2003) also recommend engineering and design interventions intended to increase pedestrian conspicuousness. Their recommendations include increased lighting intensity at pedestrian crossings; parking restrictions near intersections (due to the ability of parked cars to obscure motorists’ view of pedestrians approaching the street); relocating bus stops from the near-side to the far-side of intersections (decreasing the number of pedestrians that enter the roadway in front of a stopped bus); and crosswalk pavement markings and signage—though, as to this last point, Retting et al. caution (as did Zegeer et al. 2005) that these markings can be ineffectual, and, in some cases, harmful if not accompanied by additional pedestrian safety provisions.

Finally, Dumbaugh (2005) offers a highly germane discussion of the ways in which the conventional highway design guidelines set forth by the American Association of State Highway and Transportation Officials (AASHTO) are applied to streets in populated areas and
tend to thwart local efforts to increase pedestrian safety and comfort by sending the wrong message to drivers. The AASHTO guidelines are based on principles meant to ensure roadway safety through the provision of “clear zones” on either side of a street or highway, also known as “forgiving roadsides” (the shrewd reader might be inclined to ask, “Forgiving to whom?”). The subtext of these safety provisions seems to be that they ought to provide an air of security from within the vehicle without infringing on a driver's prerogative of maximum speed. Dumbaugh explains that many of the features of a streetscape that make it more attractive and comfortable for pedestrians (shade trees, decorative light posts, benches, etc.) would be considered “obstacles” under the AASHTO guide and would be recommended for removal (if they were ever installed in the first place).

Moreover, Dumbaugh (2005) argues that, contrary to the types of roadways that the AASHTO guide would implement (and which overwhelmingly have been implemented) on many city and town streets, the concepts of “complete,” or “livable,” streets actually create safer environments by informing drivers' behavior in such areas. He goes on to cite multiple studies finding that features in urbanized areas such as narrow lane widths, roadside objects (light poles, benches, mailboxes, trees etc.), and other pedestrian-friendly amenities were associated with decreases in the likelihood of crashes, and that AASHTO-recommended features such as wider lane widths, broad shoulders, and other “clear zone” characteristics were associated with increases in the likelihood of crashes (p. 285). Dumbaugh concludes that, “[complete, livable street] treatments appear to help balance drivers’ sense of security with the real levels of risk in their environment, providing them with more accurate
information on the appropriate level of caution, and resulting in behavioral adjustments that better prepare them for the potentially hazardous vehicle and pedestrian conflicts that one encounters in urban environments” (p. 293).
III. Countermeasure Selection Guide

Overview

In thoroughly reviewing recent academic and scientific literature pertaining to pedestrian safety countermeasures in the United States and around the world, a clear set of countermeasure types emerged (as previously discussed). Though all of the identified types of countermeasures are important to improving pedestrian safety, the frequency of recommendations across all countermeasure types was disproportionate; for example, roadway design and engineering was recommended as a countermeasure by 86 percent of all articles and reports reviewed, while infrastructure maintenance and land-use as countermeasures were only recommended by five percent each.

The great take-away of this analytical review is that, although there are differences and inequalities across countermeasure types in terms of the frequency of recommendation, potential associated costs, time-frames, etc., all of the recommended countermeasures must be viewed as pieces of a larger whole, working together to create a complete picture of pedestrian safety. The following is a discussion of the positive characteristics and potential challenges pertaining to all of the identified countermeasure types. It may be utilized by municipal leaders, elected officials, and pedestrian safety advocates as a means of identifying appropriate pedestrian safety countermeasures and analyzing how these interventions might contribute to a complete picture of pedestrian safety in their communities based on their specific needs.
**Pedestrian Safety Countermeasures**

Every community is unique. Budgetary constraints at all levels of government, the attitudes of organizations and individuals, political structures, and many other critical factors vary widely from one place to another. A combination of pedestrian safety countermeasures in one town or neighborhood may not work in another for a variety of reasons. In short, there is no “one-size-fits-all” solution.

Each identified pedestrian safety countermeasure was evaluated based on an assessment of its potential positive characteristics as well as potential challenges or obstacles to implementation. Countermeasures were assessed based on levels of investment necessary for implementation as well as the need for collective and/or political will. As countermeasures were matched with potential positive characteristics and challenges, a temporal assessment was also performed to determine whether the countermeasure offers the possibility of short-term results or whether a longer view is necessary before results can be observed. See Table II for a summary of these findings.

Table II: Positive characteristics and challenges for each identified pedestrian safety countermeasure

<table>
<thead>
<tr>
<th>Countermeasure</th>
<th>Requires Minimal Investment</th>
<th>Requires Significant Investment</th>
<th>Requires Collective/Political Will</th>
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</thead>
<tbody>
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<td>Automobile Design</td>
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<td>Education &amp; Outreach</td>
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<td>Enforcement</td>
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<td>Infrastructure Maintenance</td>
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<td>Land-Use</td>
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<tr>
<td>Psychology/Way of Thinking</td>
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<td>Roadway Design/Engineering</td>
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Automobile Design

A complex interplay exists between government and private auto-makers when it comes to safety regulations. The negative effects of automobile design on the safety of pedestrians and other vulnerable road-users will not likely be mitigated by the market alone. As previously discussed, the extremely low levels of pedestrian transportation in the United States (due to a host of factors) create an unfortunately low level of “demand” for pedestrian safety. As such, policy interventions are necessary at the Federal level to force auto-makers to design automobiles that are safer for pedestrians. Because of long legislative processes and political gridlock, as well as the time necessary for firms to effectively modify the design and production of their products, this countermeasure requires significant investment and political will and must be considered within a context of longer-term results.

Education and Outreach

Education and outreach programs represent a critical and highly effective pedestrian safety countermeasure. One major factor that contributes to the appeal of education and outreach programs is their effectiveness and ability to bring about short-term results across the spectrum of financial investment and collective/political will. As previously demonstrated, education and outreach programs can be as simple and inexpensive as a school partnering with a non-profit organization to devote a small part of its students' school time (for instance a portion of a study hall, home room, or physical education class)
to learning about and practicing pedestrian safety, or as complex and expensive as a major national advertising campaign. In both cases, results can be immediate.

Collective and political will have a major role to play in the success rates of education and outreach programs. This is true from the perspective of both financial support (whether from government or private sources) as well as the ability of attitudes and behaviors to endure and be embraced over time. In this last case, short-term results are equally possible, but a “longer view”, “big picture” approach is necessary.

**Enforcement**

Enforcement of traffic laws was broadly recognized as a critical element in the effort to guarantee pedestrian safety. Enforcement is noteworthy among other countermeasures due to its unique ability to actually *generate* revenue as it is implemented by way of fines for violations. The incremental increase in revenue can then be re-invested in additional enforcement efforts or other programs intended to improve pedestrian safety. Although there is comparatively less emphasis and value placed on traffic law enforcement in the United States, it represents a tremendous opportunity to improve pedestrian safety in both the short- and long-term.

As previously discussed, the overwhelming dominance of automobility and the correspondingly miniscule proportion of walking trips in the United States—not to mention the sense of entitlement among motorists concerning traffic enforcement engendered by American “car culture”—has contributed not only to a lack of “demand” for better
pedestrian safety conditions, but also to a profound lack of understanding of pedestrian safety issues. For this reason, collective and political will to enforce traffic laws is imperative to improving pedestrian safety in both the short- and long-term.

**Infrastructure Maintenance**

Though not a commonly recommended pedestrian safety countermeasure, infrastructure maintenance can be a simple and cost-effective means of ensuring pedestrian safety over time. One would think that the maintenance of existing good infrastructure (that is, infrastructure that is designed to improve pedestrian safety) would be a highly politically palatable proposition as it represents the responsible stewardship of previous public investments. However, all too often—especially in the United States—maintenance costs are not incorporated into budgets and pedestrian amenities and safety infrastructure deteriorate and fall into disrepair over time.

Pedestrian infrastructure maintenance runs the gamut of financial investment. Simple and inexpensive infrastructure maintenance may include such activities as clearing debris and litter from sidewalks, periodically verifying the functionality of electronic features (pedestrian crossing signals, buttons, beacons, etc.), and re-painting faded crosswalks. However, major repair projects such as replacing cracked, dangerous sidewalks and damaged or dysfunctional traffic signals can require significant investments.

As with other previously discussed countermeasures, American “car culture” and unfamiliarity with pedestrian issues are very real obstacles to efforts to maintain the
integrity of pedestrian infrastructure over time. As such, collective and political will is of utmost importance in ensuring that infrastructure in need of critical maintenance is repaired in the short-term and that the long-term maintenance needs of pedestrian infrastructure are incorporated into budgets and plans.

**Land-Use**

Implementing land-use patterns that support pedestrian safety, comfort, and convenience is an important countermeasure in the effort to improve pedestrian safety and encourage walking. In some cases, the task of completely rewriting zoning and land-use regulations can seem daunting and is often limited by a municipality's ability to allocate resources and funds to that effort. For this reason, changes in land-use patterns and regulations require collective and political will and a consensus among the community to take the necessary steps and actions to bring about these changes. Even once pedestrian-friendly zoning and land-use regulations are in place, the physical changes that are desired can be slow in coming due to their general dependance on local demand for new construction (whether in the form of infill or greenfield development). For this reason, land-use countermeasures require a focus on longer-term results.

**Psychological/“Way of Thinking”**

Of all the pedestrian safety countermeasures discussed, a change in collective “way of thinking” is perhaps the most elusive and challenging to “implement” due to the intangible, abstract nature of the imperative. Nonetheless, the need for adjustment in
societal attitudes and thought processes regarding pedestrian safety is acute. Although collective psychology and way of thinking can be influenced and driven by some of the other recommended interventions (education/outreach and enforcement, for example), it stands on its own as a countermeasure because of its ability to occur over time independently of other efforts. This countermeasure is highly tethered to the ebbs and flows of societal zeitgeists and can be influenced by diverse factors including pop culture and economic and environmental realities. As such, this countermeasure is completely dependent on collective and political will and has the ability to create profound results in both the short- and the long-term. It represents the empowerment of individuals—as well as groups—to influence and drive change, even leading to the implementation of some of the other countermeasures discussed in this paper; as such, it embodies a very powerful and important “starting point” for improving pedestrian safety.

*Roadway Design and Engineering*

The way in which roadways are designed to accommodate and ensure the safety of pedestrians and other vulnerable road-users encompasses a variety of types of interventions—at varying scales—and was perhaps the most broadly ranging and definitely the most frequently recommended type of pedestrian safety countermeasure. In terms of costs and time-frames, roadway design and engineering interventions can range from relatively inexpensive, quick solutions to extremely expensive infrastructure overhauls that may spend years or even decades in planning and construction phases.
A growing trend in recent years has been the popularity of so-called “pop-up urbanism” (which has applications and connotations above and beyond pedestrian or transportation planning). These are small projects that change or improve upon the built environment—sometimes temporarily—in clever, inexpensive, and often-unexpected ways. These types of projects tend to be encouraged and carried out by non-profit groups or activists seeking to demonstrate improvements that can be made to public spaces that increase pedestrian amenity and safety. Such projects may be carried out with the blessing of local government, or may take the form of clandestine or surprise projects meant to playfully, if subversively, showcase the benefits of certain types of infrastructure modifications (sometimes called “hacktivism”). An example of the former is San Francisco's “parklets”—mini parks created out of on-street parking spaces that increase pedestrian comfort and safety by creating attractive outdoor spaces that also buffer sidewalks from traffic (Styler 2012). These types of interventions require minimal investment and have the ability to produce short-term results.

In spite of the growing popularity of quick, clever interventions like those discussed above, most roadway design and engineering countermeasures consist of large, publicly funded capital projects—such as roadway resurfacing and new road construction projects—that can take a long time to be completed. Though these projects require significant investment, they have the ability to create significant results in both the short- and long-term, especially if necessary maintenance is taken into account when planning for the...
future, as previously discussed. In general, projects that have a bearing on the physical, built environment tend to call for strong collective and political will.
IV. Conclusions

Pedestrian safety is a growing public health concern which planners and policy-makers can play a vital role in solving. In this regard, the United States has not performed well by comparison and has lamentably been outshone by many countries around the world that have been extremely earnest in their treatment of pedestrian safety. The unfortunate truth is that there is not a single list of superlatives related to pedestrian safety—“most livable,” “most walkable,” “highest pedestrian mode share,” “fewest pedestrian fatalities,” “most pedestrian trips per capita,” etc.—that the United States would top, or even come close to topping. It is difficult to quantify just how far we have fallen as a society, though some of the articles and reports reviewed in this paper offer evidence that aids in the emergence of a more complete picture.

In this paper, I have identified and detailed broad categories of pedestrian safety countermeasures along with examples of successful programs. There are countries that have demonstrated, with spectacular success, the ability of these countermeasures to quell pedestrian fatalities and injuries due to automobiles, increase the attractiveness and comfort of walking as a mode of transportation, and increase the amount of total walking (and bicycling) trips. As Pucher and Dijkstra (2003, p. 1512) make plain, “...the necessary techniques and programs already exist and have been proven to work extremely well.”

The sagacious reader might be inclined to ask, “If we know what needs to be done to improve pedestrian safety, why haven’t we seen more meaningful and substantial
improvements?” But then, maybe the sagacious reader already knows the answer. Pucher and Dijkstra (2000) explain, “The real problem in the United States is lack of willingness to do anything that infringes on the prerogatives of motor vehicle users.”

In the “Countermeasure Selection Guide” section of this paper, I assessed the potential positive characteristics and challenges associated with each identified pedestrian safety countermeasure. The goal was to provide a framework for decision-makers and citizens to select the types of projects that are the right fit for improving pedestrian safety in their communities. In that assessment, the one factor that was universal across all countermeasure types—regardless of ability to bring about short-term versus long-term results—was the indispensability of collective and political will. Communities—us, people, citizens, Americans—have to want to improve pedestrian safety in our neighborhoods, towns, states, and country.

There is much the citizens of the United States can learn from the examples of other countries. Many of the great walking (and bicycling) cities of Europe weren’t always such sanctuaries for pedestrians. Fischer et al. (2010, p. 13) shed light on the European experience, explaining that there was “...a key turning point in the early 1970s, when a consensus emerged from the general public and elected officials that transportation policies that excessively favored the private automobile needed to change; therefore, what [we] saw in several of the host cities is the cumulative effect of 30 to 40 years of experience and culture change...” We needn’t despair; a great shift in American ethos will not happen over night. However, part of that shift will involve the need to overcome our pridefulness as
Americans and learn from the examples of other, more advanced societies so that we can move forward by following in their footsteps.

At the moment, there is a great deal of uncertainty and unrest among Americans regarding our collective future. Healthcare and environmental factors, economic realities, and baleful political dysfunction have cast doubt on our ability to continue on as we have, and, indeed, on the ability of our political system to rectify this problem even if everyone came together and decided to do it—and that's a big “if.”

The silver lining may be that these realities have given rise to emergent and changing viewpoints among Americans concerning the need for better, safer transportation options. They have acted as the catalyst for a long-overdue discourse regarding the unintended, negative consequences of an over-dependence on automobiles. Having hit the proverbial “rock bottom” in terms of how profoundly pedestrian safety, comfort, and convenience could be degraded in the United States, the tides may finally be ready to turn. Americans may now be more cognizant than they have been in generations of the myriad reasons to improve the safety and convenience of walking. Further, they may be more willing than ever to actually take the steps necessary to create a safer America for pedestrians.
Works Cited


