APPENDIX A

Literature Review

There is a significant body of literature on pedestrian safety. Pedestrian safety is influenced by both behavioral human factors and physical environmental factors. While this may sound simple, pedestrian safety is a complicated problem due to the many variables that comprise the built environment and the complexity of understanding behavioral decision-making and outcomes. As Kim et al. (2008) note in discussing this challenge, there are a "multiplicity of factors associated with pedestrian accidents. In addition to the behavioral and human factors for both pedestrians and motorists, there are also vehicular, roadway, environmental and other contextual factors that can affect safety" (p.2043). Thus, while there may be a precursor event or action which functions as an initial causal factor, there is rarely a single cause of pedestrian collisions. In addition, while not a focus of US-based research, there is evidence from European research that vehicle factors, specifically vehicle design (see Mohan, 2008), also contribute to pedestrian crashes and may influence severity.

This literature review explores recent research on the roles of human factors and environmental factors in vehicle-pedestrian crashes, including a brief summary of recent sources that address countermeasures to improve the safety of the physical environment for pedestrians. Emphasis throughout this literature review is placed on the relatively few research efforts that have considered the role of bus transit specifically, as well as research specific to factors that contribute to pedestrian collisions in New Jersey. Following this overview, recent research and best practice recommendations on how to develop effective road safety mass media campaigns are addressed, including: a brief summary of the major relevant theories of behavioral change and social persuasion; campaign design and development; the use of threat appeals; advertising exposure; and the evaluation process. The upshot of this overview of educational campaign best practices is that understanding the motivations that drive behavior and attitudes is essential to developing effective campaign messages and that integrating mass media campaigns with enforcement efforts has been shown to increase their effectiveness. Additionally, target audiences of media messages should be segmented into meaningful subgroups, with messages tailored both in terms of content and delivery channels (see Delhomee et al, 2009; Wundersizt et al., 2010).

Prior research on human factors points to both age and sex of motorists as important determinants of accidents with middle-age drivers exhibiting a lower risk of crash involvement compared to younger and older drivers, and male drivers more likely to be involved in serious accidents and fatalities. Physical characteristics including road type, lighting and weather have also been shown to influence crash rates and severity (Kim et al., 2009). Additionally, lower income populations experience greater than average exposure as pedestrians, likely due to greater reliance on walking and transit (Kelly and Hempstead, 2004; Kim 2009).

Many studies have attempted to examine demographic, land use, and roadway characteristics as determinants of crashes involving pedestrians. A study in

Hawaii (Kim et al., 2009), for example, found that the number of people living below the poverty line to be a significant predictor of crashes involving pedestrians and cyclists. The same study also concluded that the number of bus stops, controlling for land use and demographic characteristics, was positively correlated with pedestrian crashes within a given geographic area. Pulurgurtha et al. (2008) consider many of the same environmental factors in identifying hazardous bus stop locations and use GIS to examine crash data, pedestrian crash data, traffic volumes, bus stop locations and transit ridership. Other studies have also shown the importance of bus stops, as well as land use and roadway characteristics. In an analysis of high pedestrian accident locations on state highways in Washington, Hess et al. (2004) use regression analysis to show that bus stop usage, retail land use, traffic volumes, and number of travel lanes are positively associated with pedestrian collisions. A similar analysis at the neighborhood scale conducted in Los Angeles (Loukaitou-Sideris et al., 2007) also showed a higher probability of pedestrian crashes in areas with high traffic volumes and commercial/retail uses, as well as multi-family uses and high population/employment density. In another analysis specific to rates of pedestrian and cyclist injury and fatality in central cities in the UK, Wedagama et al. (2006) also identified specific land uses in downtown areas associated with an increase in pedestrian casualties, namely retail and community facility uses during working hours, and clubs and bars during evening hours. In a global analysis of crash fatality rates in urban areas, Mohan (2008) suggests that land use patterns, modal share split, and exposure of motorists and pedestrians in terms of distance traveled per day all contribute to fatality rates. While perhaps not in exactly the same manner, the physical environment in terms of land use and roadway design characteristics also influence pedestrian crashes in New Jersey. As noted by Knezek et al. (2007):

> *The built environment in NJ presents numerous inherent conflict points between pedestrians and vehicles, such as roads without any dedicated area for walking, or only a narrow shoulder; unprotected midblock crosswalks on high-speed roads; congested intersections that attempt to accommodate both pedestrian crossings and turning movements in the same signal phase; bus stops without pedestrian connections; multiple driveways or ramps that interrupt the continuity of sidewalks, and roads that divide natural centers of activity (p.7-8).*

New Jersey's suburban land use pattern with wide streets, high travel speeds, single-use districts, and limited pedestrian connectivity (NJDOT, 2005) have long been thought to contribute to pedestrian conflicts and thus increase risk of crash exposure. In addition to conflict points, Knezek et al. (2007) point to a second set of causal factors -- those actions or situations that build on the existence of a conflict and directly precipitate a crash, such as jaywalking, a distracted driver texting, sun glare, and double parked cars that block crosswalk visibility. A third set of causal factors are related to the first two sets, but specifically result in

pedestrian deaths and include high vehicle speeds, darkness, alcohol impairment (with some studies reporting as much as 37% of pedestrians and 18% of drivers involved in pedestrian crashes exhibiting alcohol impairment; see Kelly and Hempstead, 2004), and the greater physical vulnerability of the elderly (see also Rosen and Sander, 2009; Henary et al., 2006). Car impact speeds in particular have been shown to increase the risk of pedestrian fatalities with the risk of a fatality at 50km/hour more than twice the risk at 40km/hour (Rosen and Sander, 2009). In an effort to address social and behavioral issues in addition to physical environment and roadway design issues, Knezek et al. (2007) develop a matrix for pedestrian fatalities in New Jersey that categories safety risks into the major causes for pre-event, event, and post-event influencing factors for the persons involved (human factors), the vehicles involved, the physical environment, and the social environment. The resulting matrix of 12 cells identifies the potential causal factor(s) in a fatal pedestrian collision. In Knezek's study, the pre-event factors were determined to be the most relevant, and are excerpted below:

Figure A-1 Modified Haddon Matrix: Sample Factors Contributing to New Jersey Pedestrian Fatalities

Influencing Factors:

Phase	Human Factors	Vehicle Speed & Movement	Physical Environment	Social Environment
Pre-event	▪ Pedestrian crossing street ▪ Intoxicated driver ▪ Pedestrian with osteoporosis ▪ Pedestrian with hearing impairment	▪ Speeding auto	▪ Poor street lighting ▪ Lack of crosswalk signage ▪ Four-lane roadway	▪ Lack of speed limit enforcement ▪ Poor understanding of pedestrian laws ▪ Inadequate investment in crosswalks ▪ Auto-oriented land use pattern

Source: Knezek, et al., 2007.

While not specifically called out by Knezek et al., driver inattention more broadly should also be considered a pre-event human factor, especially given a recent poll by the Pew Internet and American Life Project (2010) that found 47% of adults engaging in text messaging while driving. A similar poll conducted in 2009, also found that 34% of 16 and 17 year-olds texted while driving. Clearly, the behaviors of both pedestrian and motorists can greatly influence the likelihood and severity of collisions.

There are several recent studies that attempt to better understand the relationship between behavior and the physical environment. Nonetheless, researchers (see Kim et al., 2008) still see a need to examine the relationship between pedestrian and driver behavior and the built environment more closely. The following summarizes the most recent studies exploring this relationship, with emphasis on findings relevant for this project:

- *Effects of Crosswalk Removal/Median Installation on Pedestrian Crossing Behavior:* (Kopf and Hallenbeck, 2005): Evaluate motorist and pedestrian behavioral changes resulting from removing crosswalks across 5 lane roadway in Washington State and replacing them with median refuge and relocating bus stops proximate to median refuge. Goal was to increase pedestrian safety, with particular focus on pedestrians and motorists over the age of 65. Majority of pedestrian crossings in the study area are transit related. Conducted before and after analysis and found that the improvements did *not* have the expected positive effect of encouraging pedestrians to use the median refuge for crossing. Pedestrians were more likely to use the marked crosswalks in the before phase than the median refuge in the after phase and motorist yielding actually decreased after the median installation. Note that lack of crosswalk striping might be a factor explaining behavioral changes and that median refuges could be more effective at locations with more frequent crossings.
- *Effect of Subject Norms/Group Pressure in Pedestrian Crossing Behavior* (Rosenbloom, 2009): Investigates pedestrian behavior in crosswalks at traffic lights in Tel Aviv and found that males crossed on a red light with greater frequency than female pedestrians, but that age was not a factor. The presence of other pedestrians waiting at the crosswalk upon a pedestrian's arrival decreased the likelihood of crossing on a red light, suggesting that the power of groups and cultural norms have the ability to positively influence pedestrian behavior. Given the relevance of subjective norms to the behavioral change process, this study suggests that the effect of social norms should be explored further in this project's focus groups.
- *Effect of Age on Crossing Behavior for Different Roadway Types* (Oxley et al., 1997): Conducted hot spot analysis of accident locations and then filmed crossing behavior on two different roadway types in Melbourne, Australia: one-way divided roads and two-way undivided roads. Found that older pedestrians crossed closer moving traffic and generally adopted less safe crossing strategies than their younger counterparts on two-way undivided roads, but that their crossing behavior was considerably more safe and similar to that of younger pedestrians on divided roads. These findings suggest that age-related perceptual and cognitive deficits may play a role in crashes involving older pedestrians and point to countermeasures aimed at simplifying road crossing.

- *Effect of Environmental Factors on Pedestrian Crash Severity* (Holland and Lin, 2007): This study focused on the severity of injuries and fatalities incurred by pedestrians colliding with motor vehicles on state routes in King County, Washington. Data variables included road characteristics, traffic conditions, and land uses at or near collision sites. The results of binary and ordinal logistic models showed that fatal and high injury collisions were strongly and significantly associated with a pedestrian crossings at unsignalized intersections (versus crossing at all other locations or walking along the roadway) and vehicles moving straight ahead on the roadway (versus all other types of vehicle actions). Note that better reports and data on vehicular speed at the time of collision, and on the type of vehicles involved in pedestrian collisions would help to inform effective safety programs, policies, and standards.
- *Characteristics of Pedestrian and Driver At-Fault Behavior* (Kim et al., 2008): Using crash database of accidents in Hawaii from 2002 to 2005, the authors analyze and compare at fault behaviors of both pedestrians and motorists to isolate factors that result in fatalities and serious injuries. The study concludes that drivers are 12.6 times more likely to be at fault than pedestrians, and that more male drivers (66%) than female drivers and more male pedestrians (69.5%) than female were at-fault in accidents. In terms of human factors, inattention was a major causal factor and men were 1.2 times more likely to be seriously injured than women. This study also developed a predictor model to describe pedestrian and motorist fault in accidents, the former referred to as the 'drunk pedestrian model' which shows that males, alcohol use, and summer months are strongly and positively correlated with being declared at-fault. The driver fault model included being male, morning hours, business districts and intersections as strongly correlated with being an at fault motorist. This study illustrates that there is value in looking at fault (provided the data collected on fault is reliable) as it can assist in determining where to focus enforcement and educational efforts. Finally, the authors conclude that there is a need for greater emphasis on addressing and correcting driver behavior since drivers are more often to blame than pedestrians in crashes, though enforcement of jaywalking is also important in reinforcing safer pedestrian crossing behavior.
- *Effect of Automatic Pedestrian Detection/Lighting on Pedestrian Crossing and Motorist Yielding Behavior* (Nambisan et al., 2009): Evaluated effectiveness of an automatic pedestrian detection device and a smart lighting system in improving pedestrian safety at a midblock crossing on an arterial in the Las Vegas metropolitan area. Conducted field observations before and after, first with no crosswalk, then after installation of a crosswalk, which by itself did not improve pedestrian behavior and safety. However, after installation of an automatic detection system to detect presence of a pedestrian and to brighten the crosswalk with high intensity lights, the number of pedestrians observed crossing at

the improved site increased from 44 to 84, thus fewer pedestrians were jaywalking and more were diverted to the facility. Also, percentage of pedestrians trapped in the crosswalk was reduced and percentage of motorists yielding increased from 22 to 35%.

- *Effects of Age, Gender, and Driver Status on Pedestrian Behavior in Risky Crossing Situations* (Holland and Hill, 2007): This study investigates interactions between age, gender and driver status for pedestrians' intention to cross roads in risky situations. The Study's questionnaire found that intention to cross decreased as age increased, and that men had more positive attitudes towards crossing than women. Also found that younger adults, men, and especially younger men who did not drive reported more positive intentions towards crossing in risky situations. While this study confirms that older people are more determined to cross safely than younger people; "the crucial question is … whether this predicts actual behavior," (p.234) pointing to the primary limitation of this study in that stated intentions do not always reflect actual behavior. Nonetheless, this study is relevant to the current NJTPA project in that it suggests that intervention should focus on target groups and to determine what the target group sees as the most potentially powerful formats for communicating a safety mesage (written, multi-media, etc.).
- *Effects of Crosswalks on Road Crossing Behavior of Transit Users* (Jeng and Fallat, 2003): The Study investigated solutions to benefit pedestrian accessibility around bus stops on Route 9 in Monmouth and Middlesex Counties, NJ. Conducted a literature review, field observations, on-site survey and lab study (videos and photographs to explore driver's perception of risk at unexpected pedestrian highway crossings). Based on field observations, conclude that educating pedestrians about different safety devices and signs is important as many do not understand the meaning of the flashing don't walk interval (research shows that symbolic walking pedestrian image and upheld hand offer improved understanding). Researchers hypothesize that marked crosswalks may provide pedestrians with a greater level of comfort and hence pedestrians may be willing to take greater risks crossing at marked locations. In terms of analyzing road-crossing behavior of pedestrians, this study included field observations to document that the majority of bus transit riders would cross one direction of Route 9, wait or walk in the median, and then wait for a gap to cross other direction of the highway. Very few pedestrians crossed at nearby signals, and those who did didn't use the push button, nor did they properly follow the pedestrian signal indications. Note that the majority of transit users on Route 9 drive to the bus stop locations and therefore the proximity of the stop to parking is critical in determining crossing behavior.

While a detailed overview of the various design countermeasures to improve pedestrian safety is beyond the scope of this review, the following sources have been consulted and compiled for use in developing recommendations for the

seven Bus Stop Field Audit Reports and Bus Stop Safety Toolbox. A brief summary of the relevant contents of each source is provided below:

- *A Review of Pedestrian Safety Research in the United States and Abroad* (Federal Highway Administration, 2004): This report is an update of the prior Pedestrian Synthesis Report of 1991 and contains recommendations for crosswalks (should not be installed without other improvements on multilane roads with ADTs over 12,000), and, in general recommends that they be installed along with traffic calming, pedestrian signals, lighting, raised medians, curb extensions, and other improvements. Also contains analysis of impact of Right Turn on Red (RTOR) for pedestrian safety. Suggests that various warning signs, such as 'Yield to Pedestrians When Turning' and 'Pedestrians Watch for Turning Vehicles,' have been found to reduce pedestrian conflicts. Specific to bus stops, recommend bus stops be placed on the far side of an intersection and at locations with good sight distance and alignment (no steep grades or horizontal curves).
- *Pedestrian Safety Guide for Transit Agencies* (Federal Highway Administration, 2008): This guide for transit agencies addresses ways to improve pedestrian safety at or proximate to transit stops and stations. Emphasizes the importance of partnerships with state, county and local agencies to address pedestrian safety on streets not typically under the control of transit providers. Includes a useful bus stop assessment tool to evaluate conditions at and near bus stops. Also includes a sample pedestrian questionnaire used for intercept surveys that can be used in written form, in person, or as an on-line survey. This guide also contains best practices for physical countermeasures, including road crossings, roadway diets, traffic calming, pedestrian warning signals, traffic signals and detailed recommendations about bus stop locations to aid pedestrian safety.
- *Toolkit for the Assessment of Bus Stop Accessibility and Safety* (Easter Seals Project Action, 2006): This toolkit is targeted to transit agencies and public works/engineering departments who are responsible for bus stop design and placement. The toolkit also promotes community partnerships and coordination between bus drivers and planners to implement universal design best practices in bus transit systems. Of particular relevance for this project are sections of the Bus Stop Checklist that relate to pedestrian access, safety and security features, as well as guidelines for creating safe and accessible bus stops. There is also a separate section of the toolkit that addresses considerations for rural bus stops.
- *Pedestrian Facilities User Guide – Providing Safety and Mobility* (Federal Highway Administration, 2002): This guide contains research results on pedestrian crashes as they relate to roadway design elements, as well as tools to address roadway design to improve pedestrian safety and mobility. Crash trends are presented, crashes are grouped into 12 categories (including bus-related crashes, defined as a pedestrian

crossing in front of a stopped transit bus, going to or from a bus, waiting near the bus stop, or going to or from a school bus stop) and a comprehensive list of countermeasures is provided for each crash category (see Chapter 4).

- *Guidelines for the Location and Design of Bus Stops, TCRP Report 19* (Transportation Research Board, 1996): Based on a review of 28 transit agency manuals on bus stop design and location, as well as observations at over 270 bus stops in various regions of the US, this guide puts forth both street-side and curb-side design guidelines that consider bus riders' safety and access to bus stops, as well as safe transit operations and traffic flow. Specific information and guidance about locating bus stops is provided for when to consider the various bus stop configurations (curb-side, nub, bus bay, open bus bay, queue jumper bus bay for BRT applications), along with checklists of factors that should be considered in bus stop design.
- *Evaluation of Bus Bulbs, TCRP Report 65* (Transportation Research Board, 2001): Based on a study of converting bus bay into bus bulbs in San Francisco, this report identifies the effects of bus bulbs on transit operations, vehicular traffic and nearby pedestrian movements and provides guidance on the use of bus bulbs. Appendix A is a review of best practices based on examining the use of bus bulbs by transit providers in San Francisco, Portland, WA, and Vancouver, BC. It should be noted that in 2003, Daniel et al. conducted a study to evaluate how the guidance in TCRP Report 65 applies to potential bus nub locations in New Jersey and to develop criteria to ensure that nubs improve bus operations without significantly affecting roadway operations or resulting in safety concerns for pedestrians or bus riders. The NJ study found that bus nubs have similar effects on roadway delay compared to curbside stops, but further research was needed to better understand how to develop criteria to guide the appropriate application of bus nubs.
- *Pedestrian Safety Management in New Jersey* (NJDOT 2005; revised 2007):This study addresses the current policy and organizational framework in New Jersey to address pedestrian safety. An Appendix to this study includes an excerpt of the FHWA *Pedestrian Facility User's Guide* twelve categories of crashes and corresponding matrix of design countermeasures.
- *Traffic calming: State of the Practice* (ITE/Federal Highway Administration, 1999): While there are many manuals on traffic calming, this resource is widely known and respected as the go to toolbox for traffic engineers. While this resource does not address bus transit per se, it contains a comprehensive toolbox of traffic calming measures designed to reduce vehicle travel speeds, explains appropriate applications, design details and other engineering, liability and cost considerations. Given the well-established relationship between travel speeds and injury severity, traffic

calming measures are often at the top of the list of countermeasures at high crash locations.

- *Designing with Transit, Making Transit Integral to East Bay Communities* (Alameda-Contra Costa Transit District, 2004). This handbook for local officials, local staff and community organizations connects several planning concepts and design tools often addressed in separate manuals, specifically promoting transit-oriented design, developing safe walking routes to transit facilities as part of a community-wide strategy to implement pedestrian networks, and creating transit-friendly streets that function well as multi-modal corridors. The sections on Streets and Bus Stops in Chapter 5 are particularly applicable to this project.

In addition to the wide array of guidance on roadway design countermeasures to improve pedestrian accessibility and safety, an understanding of the motivations behind the behaviors of both motorists and pedestrians, as well as the ability of both to adopt new behaviors are critical steps to developing effective road safety educational campaigns. The following section first presents recommendations for educational outreach in applied research efforts and relevant policy documents that address motorists and pedestrian safety. This is followed by a summary of best practices and findings on the factors that have been shown to improve the effectiveness of mass media road safety campaigns.

Both applied research and policy related studies contain numerous general recommendations for educating the public about roadway and pedestrian safety. Nonetheless, as Holland and Hill (2007) and Knezek et al. (2007) note, there is actually little research on the effectiveness of educational strategies targeted at adults. Furthermore, those educational efforts that have targeted adults tend to emphasize passive changes for older pedestrians, such as wearing bright colors or having current eyeglass prescriptions, rather than the decisions that people make about where to cross roads (Holland and Hill, 2007). Given the importance of decision making as part of the behavioral change process, emphasis on the decisions of both motorists and pedestrians is critical to effective educational outreach efforts. Additionally, enforcement is often viewed as part of the educational process and has been found to increase the effectiveness of mass media safety campaigns. The Federal Highway Administration (2004) calls for the enforcement of laws as an important component of promoting pedestrian safety, including jaywalking and crossing against signals, but also motorist actions like speeding and not yielding. Recognizing the reality of motorist fault as a major contributing factor to pedestrian crashes (Kim et al., 2008; Knezek 2007; NJDOT 2005), researchers recommend driver education that emphasizes pedestrian safety, pedestrian crossing laws, driver responsibility and liability, as well as education on hazardous pedestrian behaviors (see Jeng and Fallat, 2003; Knezek et al., 2007). NJDOT (2005) echoes this with a high priority recommendation for driver education that emphasizes motorists' responsibilities to pedestrians, suggesting that pedestrian safety be incorporated into the state's driver education, driver licensing, and registration/license renewal processes.

Calling out the importance of tailoring educational programs to at risk populations and developing messages in partnership with members of community groups (FHA, 2008), NJDOT warns that a language and/or literacy barrier can impede the effectiveness of educational strategies in the state's urban areas. This point may be relevant to the current NJTPA project as NJDOT identified a specific need for educational materials for adult non-readers in Essex and Hudson Counties where low English proficiency and limited literacy have been documented (NJDOT, 2005).

Despite the fact that most road safety educational programs in the US have received few, if any, formal evaluations (FHA, 2004), there is strong consensus from research conducted outside of the US that enforcement can boost the effectiveness of road safety campaigns (Delhomme et al., 2009; Woolley, 2001). Furthermore, community partnerships have also been found to promote more effective educational efforts (FHA, 2008). Knezek et al. (2007), in their consideration of a public health approach to addressing severe pedestrian crashes, also identify the importance of community partnerships as part of an educational outreach strategy. At the same time, states like New Jersey are advocating a statewide approach for pedestrian risk reduction at major transit facilities, as well as a strong enforcement focus on aggressive driving and speeding (NJDOT, 2005) and training for transit agency staff in pedestrian safety techniques (see also FHA, 2008). However, there is also an often-overlooked component of enforcement – that of providing training of law enforcement officials in pedestrian related laws and best practices for effective enforcement (NJDOT, 2005). Nonetheless, while enforcement can improve educational campaign effectiveness and lead to a greater reduction in crashes (Vaa and Phillips, 2009), behavioral change, whether of motorist or pedestrian actions, tends to come slowly over time from sustained enforcement activity (Knezek et al., 2007). Mass media campaigns, while playing a role in enhancing safety (Woolley, 2001), are unlikely to produce major behavioral changes by themselves. As a result, researchers agree that it is important to integrate mass media campaigns with other activities such as enforcement, community education, and legislative/policy efforts (Delhomme at al., 2009; Woolley, 2001).

There are several comprehensive research efforts that have analyzed the effectiveness of road safety campaigns, with strong consensus on those key elements that contribute to effectiveness (see Woolley, 2001; Delaney et al., 2004; Noar, 2006; Delhomme et al., 2009; Wundersitz et al., 2010). These elements include the importance of conducting formative research with target audiences to clearly understand the problem or behavior, as well as precursors to behavior (such as is proposed with the focus groups and surveys that are part of this project) and motivations that encourage road users to adopt specific behaviors. In addition, effective campaigns are based on well-researched psychological theories of behavior change and social persuasion. Campaign effectiveness has also been shown to improve when audiences are segmented into meaningful subgroups based on demographics, geography, risk, attitudes, or

values. Once segmented, messages can then be tailored based on the motivations and needs of subgroups using delivery channels that appeal to and are widely viewed by these groups. Effective campaigns also tend to be based on a single theme, with related messages having a consistent slogan or tag line and the content of messages being realistic, credible, and clearly identifying actions required by those targeted. The most successful campaigns also pre-test messages via interviews, focus groups, or questionnaires to validate them and to identify any necessary modifications prior to roll-out. Research shows that one consideration particularly relevant for road safety communications is that advertising needs to be close to the point of impulse such as with radio, outdoor advertising, variable message signs, and bus boards (Vaa et al., 2009; Wundersitz et al., 2010). In terms of advertising exposure, best practice recommendations call for three advertising exposures to be included in campaigns; anything over ten exposures can lead potential wear out and fifteen or more may result in negative reactions (Woolley, 2001; Wundersitz et al., 2010). Finally, effective campaigns clearly define campaign objectives and select appropriate variables that can measure whether these objectives were achieved.

While there is significant agreement on these factors, as well as the integration of mass media campaigns with enforcement and other educational efforts, there are a range of opinions on which behavioral theories are most applicable, as well on the use of threat appeals. For example, researchers disagree on whether changes in attitudes lead to behavioral shifts or if the opposite is true (Wundersitz et al., 2010; Delaney et al., 2004). Despite this chicken and the egg conundrum, it is important to remember that behavioral approaches to injury prevention share an interest in answering the same question: “why did the injury occur” (Winston and Jacobsohn, 2010, p.107). Wundersizt et al. (2010), in the most current and detailed literature review on road safety campaigns, present an overview of the theories of behavioral change that they view as most relevant to campaigns, briefly summarized as follows:

- Theories that are based on predictive models of behavior:
  - Theory of Reasoned Action (TRA) – This theory assumes that people make logical and consistent decisions and that attitudes and social normative beliefs are the determinants of intentions. By focusing on intent, this theory assumes that intentions translate into actual behavior.
  - Theory of Planned Behavior (TPB): Builds on TRA by adding perceived behavioral control as a determinant of intentions. This extends the model to explain behavior where one feels they have little control over whether a violation occurs or not. To change behavior, behavioral intentions must first be changed (which are dependent on behavioral beliefs, normative beliefs, and control beliefs).

  - Theory of Interpersonal Behavior (TIB): This theory is similar to TPB as it includes normative factors and perceived consequences of behavior as predictor of intentions and consequently behavior, but also includes habits as a predictor of behavior (habit referring to how automatic a process is, whether behavior is habitual or more intentional). Campaigns that target habitual behaviors like smoking, for example, will have little effect if they concentrate on intentions or factors that influence intentions because people don't consciously consider these with habits that are automatic.
  - Health Belief Model (HBM): This model views people as motivated to take positive action and promote their health due to a desire to avoid negative health outcomes. This model is broader than TPB in that it includes different emotional responses such as perceived susceptibility and perceived seriousness of consequences that together define the perceived threat and must be high for one to consider changing behavior. Under this model, perceived benefits and perceived barriers are compared in a cost/benefit analysis and a high level of efficacy to act is required. In addition, cues to the desired action are needed as motivators to raise the likelihood of action. This theory assumes decision making occurs within a rational actor framework.
  - Protection Motivation Theory: This model, developed by Rogers in 1975, addresses threat appraisals and coping appraisals that can lead to adaptive/maladaptive coping responses. Threat appraisal is a function of perceived severity and vulnerability to the threat and rewards associated with unsafe behavior (e.g. saving time while speeding), while coping appraisal refers to the result of response efficacy, self-efficacy and response costs associated with doing the recommended behavior. The outcome of these appraisals influences one's motivation leading to either adopting the desired behavior or not. If, for example, response efficacy and self-efficacy are low and vulnerability/severity factors are high, one might feel helpless and unable to avert the threat, leading to maladaptive response (note: this is one reason fear appraisals do not always work).
- Theories that explain how persuasion occurs for adoption of new attitudes or behaviors, known as social persuasion theories:
  - Elaboration-Likelihood Model: In this model, two routes of persuasion can result in attitude change, known as central and peripheral elaboration. Motivation and ability are required for central elaboration in cognitive processing – people actively think about campaign messages, judge/evaluate them, and link content to information they already have stored. Individuals might be motivated to process a message if it is perceived as relevant or they feel a high level of personal responsibility. Factors influencing one's ability to process the message via the central processing route include: prior knowledge,

understandability of the message, and the presence of distractions. If motivation and ability are both sufficient, then the right informational cues can result in attitude changes. Persuasion can also occur with low elaboration (peripheral) where simple decision rules are derived from the situation at hand, such as attitude changes based on the attractiveness or expertise of the message presenter.

  - Associative-Propositional Evaluation Method (APE): This is a dual attitude model whereby evaluations of messages are based on implicit or explicit evaluations. Implicit attitudes are based on associative connections such that evaluations are automatic, affective reactions (such as salt is associated with pepper). These evaluations require limited cognitive resources. Explicit attitudes are activated more deliberately, requiring more cognitive effort, as they are derived from evaluative judgments. This model suggests that explicit attitudes are better able to predict behaviors that are under one's voluntary control, like speeding or jaywalking.

- Theories that are based on the process of behavioral change:
  - Theory of Self-Regulation: This theory describes behavioral changes based on people comparing their current situation with a goal or reference situation; if discrepancy is observed (cognitive dissonance), action is taken to minimize the discrepancy. Sometimes people will abandon a goal or exchange it for a more attainable one.
  - Trans theoretical Model of Change (TMC): This model considers the readiness of the individual to change behavior and outlines six stages of change before a new behavior is established and maintained, though people do not necessarily progress through the steps in a linear fashion. The stages are: pre-contemplation (no intention to change/resist change); contemplation (awareness of problem behavior but no real benefits seen to changing); preparation (intention to act is high and some reduction in behavior may occur); action (some change has occurred but effort is required to maintain behavior – this is the most unstable stage and risk to returning to old behavior is high); maintenance (new behavior has started to become habitual); and, termination (new behavior established and not tempted to return to old behavior). To progress to the contemplation stage, people need to become more aware of the problem behavior and what they need to do, which can be achieved by highlighting the conflict between their needs and the general public, resulting in cognitive dissonance, dissatisfaction and a desire to change.

While each of these theories addresses a slightly different component of the behavioral change process and/or has a different take on how behavioral change occurs, taken together they direct us to pay attention to attitudes as an important driver of behavior, as well as those factors that predispose, enable and reinforce targeted behaviors (Delaney et al., 2004; Wundersitz et al., 2010).

Consequently, in this project it will be important to gain an understanding of: (1) the attitudes, knowledge, beliefs, norms, social environment, and values that provide motivation for behavior; (2) behavioral intention or skills that allow an intention to be acted upon (readiness to change and ability to change); and, (3) any reinforcing factors that provide an incentive to carry out the desired behavior. Furthermore, we will need to understand whether social norms are important to the target audiences, and thus whether social persuasion should be incorporated into the campaign strategy.

The literature considering the effectiveness of threat appeals in campaign messages is inconclusive at best. In their literature review on the use of threat appeals in road safety campaigns, Wundersitz et al. (2010) suggest that, while fear appeals can be effective under certain conditions, different approaches should be considered for road safety campaigns. Wundersitz et al. (2010) concluded that for fear appeals to have some impact, they must accomplish several things: (1) describe a threat; (2) suggest a specific plan for reducing or avoiding that threat that is possible to carry out, perceived as effective, and allows the target audience to believe that they are capable of carrying out the safe behavior. Campaigns using fear appeals have been found to be counterproductive without all of these elements; consequently, many researchers caution against their use and advocate for the use of a rational or emotional approach (such as Delhomme et al., 2009; Woolley 2001; Wundersitz et al., 2010). On the other hand, Delaney et al. (2004) conclude that fear appeals have been widely used with positive outcomes. However, there is also some evidence that gender may influence the effectiveness of different types of emotional appeals, with positive emotional appeals (e.g. humorous) being more persuasive for men than fear appeals and the reverse being true for women (Wundersitz et al., 2010). Vaa et al. (2009) suggest that humor or fear, if used, should not detract from the central campaign message.

While researchers provide a plethora of best practice guidance on how to evaluate campaigns, some have observed that it is not practical to conduct rigorous outcome-based evaluations of the effectiveness of media campaigns in road safety; rather, they conclude that the best evidence comes from literature reviews or meta-analyses of mass media campaigns (Delhomme et al., 2009). Wundersitz et al. (2010) warn that it is important to have realistic expectations of road safety campaigns and that campaigns are more effective in conveying information and changing attitudes and beliefs rather than directly altering driver behavior. Furthermore, behavioral change may occur over the long-term, beyond the period during which it is often realistic to study as part of a campaign evaluation. Researchers also caution against using crash data as an outcome measure due to its variability and the challenges in isolating the effects of media campaigns from other educational efforts such as enforcement (Wundersitz et al., 2001). Despite these challenges, where possible, campaigns should be evaluated to determine whether they achieve their stated objectives and to evaluate effectiveness. There are three types of evaluations: process, outcome

and economic. Process evaluations take place during campaigns to determine whether the campaign has been properly implemented. Outcome evaluations measure the effects of the campaign by comparing the target group to a control group not exposed to the campaign. At least two measurements (before and after) should be used for the outcome evaluation, with the 'before' period evaluation done once the campaign has been designed but prior to any implementation. Given the stated concerns regarding the use of crash data as a performance measure, market research can potentially be used to measure self-reported attitudes and behaviors in the absence of other reliable data (Wundersitz et al., 2010). At least two after-period evaluations are also recommended, shortly after the campaign ends and then after several months to assess longer-term effects. It may also be desirable to collect data during the campaign. An economic evaluation helps to determine if the outcomes justify the costs of the campaign (Delhomme et al., 2009). Given the inherent challenges of quantifying the societal benefit of changes in attitudes and beliefs, economic evaluations may prove to be politically problematic in justifying the public cost of safety campaigns unless enforcement activities that result in citations and revenues are part of the campaign.

SELECT CASE STUDIES

The following Appendix includes brief summaries of select case studies on pedestrian safety educational campaigns and is followed by a complete list of references included in this literature review.

"Walk Alert/Drive Alert" Campaign, Victoria, BC:

Multi-media campaign in the Victoria, BC metropolitan area targeted primarily at drivers, but also directed at pedestrian behavior, though motorist behavior was the primary variable analyzed before and after the campaign. The campaign, "Walk Alert-Drive Alert" was aimed at intersection safety and crosswalk safety with the focus on encouraging drivers making left turns to yield to pedestrians and encouraging drivers to not pass another stopped vehicle at a crosswalk. The campaign used radio and television spots, newspaper and magazine ads, bus boards, pamphlets, press kits, promotions by merchants with graphics and visuals an important part of the campaign. The campaign itself used the language of risky behavior, "making a left turn at a traffic light in heavy traffic is like playing Russian roulette…and you're the loaded gun…As a driver making a left turn, YOU set the pace for safety! *Drive alert*. As a pedestrian – *Walk alert* – always keep on looking for traffic as you cross a street. *Walk alert/Drive alert*." Based on a before and after analysis, the probability of yielding to pedestrians increased by around 36% over the 12 month period analyzed, after controlling for other variables (driver gender, age, vehicle type, etc.).

Source: Koenig, Daniel J. and Zheng Wu. 1994. The impact of a media campaign in the reduction of risk-taking behavior on the part of drivers. *Accident Analysis & Prevention* 26(5): 625-633.

"Obey the Yellow" Melbourne, Australia:

Most of Melbourne's 195 km of streetcar tracks is protected by road rules that require traffic to avoid delays to trams. However, the rate of compliance with and the level of understanding of these rules are poor. This public education campaign, called 'Obey the Yellow' ($1 million campaign – two TV ads – one also on You Tube, a series of three radio ads, print ads in newspapers, billboards on trams, and brochures at customer service centers and local municipal buildings) was aimed at increasing the level of awareness of and the rate of compliance with road rules. Community surveys established that the level of awareness of the road rules that apply to tram lanes has improved, with 28% of respondents saying that they changed their behavior after the campaign. Evidence about the tram system's operational performance suggests a small improvement, although this has not conclusively been linked directly to the campaign. Operations staff perceived improved driver compliance, but this impact is thought to have lasted less than 4 months after the campaign. While there was no significant long-term change in the incidence of driving in tram lanes compared to before the campaign, the campaign was successful in meeting its objective of improved community awareness of road rules. Also concluded is that the active involvement of police during the campaign clearly acted to reinforce the message that fines are levied for violating the rules. In addition, the use of eye-catching images and an innovative design acted to create high levels of community penetration of the main messages.

Source: Currie, Graham. 2009. Using a public education campaign to improve driver compliance with streetcar transit lanes. *Transportation Research Record* No. 2112: 62-69.

"Click It or Ticket" Campaign (National):

Using archival data and random before and after telephone surveys, this study summarizes the overall effects of seat belt enforcement/campaign program conducted between 2000 and 2006 that led to increased rates of seat belt compliance nationwide and in almost all States. Click It or Ticket campaign started in the south in 1993 and became nation-wide in 2003. The national campaigns typically last several weeks with earned media generated at the national, state and local levels. Paid media follows a week or so later, followed by high visibility enforcement lasting two weeks. The campaigns resulted in an increase in belt use in 43 out of 50 states. As enforcement programs continued across the country and belt use increased, public awareness and attitudes changed as well with growing support for primary seatbelt laws (those that allow police to pull over motorists exclusively for not wearing seatbelts) and seatbelt enforcement. While average media expenditures were similar, enforcement rates were almost twice as high in the States showing greater increases in belt usage. Note that the key to increasing seatbelt use beyond 83% nationally are Click It or Ticket programs aimed at the general driving population supplemented

by special programs targeting low-use groups such as pick-up truck occupants, residents of rural areas, and nighttime drivers.

Source: National Highway Traffic Safety Administration. 2010. *Analyzing the first years of the ticket or click it mobilizations*. DOT HS 811 232, U.S. Department of Transportation.

"Obey the Signs or Pay the Fines", New Jersey, 2009:

Obey the Signs or Pay the Fines is New Jersey's statewide speed and aggressive driving campaign. Building on the prior year's success in the Division of Highway Traffic Safety's Northern Region (Bergen, Essex, Hudson, Morris, Passaic, Sussex, and Warren Counties), the 2009 campaign extended into DHTS' Central and Southern regions. The campaign pairs concerted speed enforcement of all police agencies with outreach efforts to raise awareness locally and statewide about the dangers of excessive speed and aggressive driving. The campaign benefited from both local and statewide press coverage with television, radio and newspaper exposure, in addition to local police departments issuing their own press releases. Results: 250 police agencies participated issuing 18,087 speeding summonses during the four- week campaign. In addition to speeding, 7,591 seat belt violations were issued, over 5,000 citations were issued for careless driving, and 1,372 DWI arrests made.

Source: Mobilization Report, New Jersey Division of Highway Traffic Safety, July 2009.

Los Angeles County MTA, Califronia, 2003-present:

Metro's transit education programs include presentations, tours, videos and events to promote pedestrian safety near bus and rail. Presentations are scheduled at area schools, as well as senior centers, Head Start groups, and schools teaching ESL. In addition, Metro's Transit Safety team leads tours to demonstrate pedestrian safety on Metro Bus and Rail systems. Metro also provides "The Metro Experience"- an innovative mobile theater that travels to communities to offer safety messages through video, including videos using animation for children, a live action video, a safety video for the Metro Orange Line, and a video of the Gold Line Eastside Extension. The program reached 16.9 million people in 2009. Before the program, 79 people had died on the Metro Blue Line. Since the implementation of the program, accidents have dropped dramatically.

Source: http://beta.metro.net/about/transit-safety

"You Have the Power, Stop for Pedestrians," Missoula, Montana, 2004-Present:

This campaign was designed to address a chronic problem of motorists not stopping for pedestrians in crosswalks. Local crash data showed that 80% of pedestrian-motorist collisions were the driver's fault. Using a CMAQ grant, the City designed an educational campaign using street signs, a media component,

and police enforcement stings, recognizing that the effort needed to address education and enforcement, be sustained over the long haul, and be relevant locally. The signs used have the slogan "You Have the Power, Stop for Pedestrians," and stand out to drivers based on their color scheme and design. In addition, over 300 posters were placed on sign poles and at highly visible, unexpected locations. The same logo and message were also used in radio spots and TV ads. 80% of the messages targeted motorists with the balanced directed at pedestrians. Short messages were also embedded in local organizations' newsletters. These efforts have cost around $90,000 over three years. No formal evaluations have been conducted by the City due to a lack of resources to carry out a statistically valid assessment.

Source: http://www.walkinginfo.org/library/details.cfm?id=2870

"Rushed A Left Turn – Guilty – Case Closed," Edmonton, Canada:

In January 2010, the Capital Region Intersection Safety Partnership (CRISP) began targeting unsafe left turns by reminding motorists that driving is not a game, but a serious responsibility. The overall goal of the campaign is to reduce the number of injuries and fatalities at intersections by showing the real consequences of what can happen when drivers make unsafe left turns in front of oncoming traffic. Unsafe left turns are consistently the second most frequently identified cause of collisions in the Capital Region. The campaign utilizes billboards, transit shelters and radio advertising and complements the Alberta Traffic Safety Calendar's focus on intersection safety for the month of January. The CRISP website contains information on several interesting prior campaigns as well.

Source: http://www.drivetolive.ca/campaign_jan10/Left Turn Tip Sheet.doc

StreetSmart Campaign, Washington, DC, 2003-present:

The purpose of the StreetSmart campaign is to improve bicycle and pedestrian safety in the Washington D.C. metropolitan area. A joint effort by the Transit Authority and Council of Governments, the campaign aims to raise awareness of pedestrian and bicycle safety issues and reduce accidents through education, engineering, and enforcement activities. Enforcement and education activities are targeted to complement engineering projects completed throughout the year by local jurisdictions. Campaign publicity is also timed with increased enforcement of pedestrian traffic laws during one month each spring. Specific campaign elements included: radio and newspaper ads (English and Spanish language publications), outdoor posters on buses and shelters, and brochures (including a 'Cross after the Bus' card, available at http://www.mwcog.org/streetsmart/pdfs/2009/4_crossafterbus_eng.pdf.). The program has resulted in changes in pedestrian and driver behavior with a reduction in the frequently of drivers observed not yielding to pedestrians (76% in 2002 to 54% in 2006), as well as a reduction in drivers swerving to avoid pedestrians (32% in 2004 to 14% in 2006), and reduced jaywalking. In 2008, the

campaign expanded to twice each year. In addition, the Transit Authority expanded its role from participating only in outreach to become a full funding partner.

***Source*:** http://www.mwcog.org/streetsmart/default.asp

Safety City Program, New York City DOT, 1990- present:

Safety City is a traffic safety program for school children that uses both traditional classroom education and a simulated New York City street to teach traffic safety through hands-on experience. There is an outdoor area where students practice their safety skills on a fenced-in street and intersection. Access Safety City on West 158th Street in Manhattan also serves older adults and people of all ages with special needs. Follow-up activities in classrooms reinforce what children have learned. At the conclusion of the program, the children become "Safety Deputies" and share what they have learned beyond the classroom into the community. Since the first Safety City opened at P.S. 92 in Central Harlem in 1990, thousands of children have visited Safety City. Safety City has been recognized nationally with awards and the program has seen the number of children admitted to Harlem Hospital for motor-vehicle related injuries decline by 50 percent.

***Source*:** http://www.nyc.gov/html/dot/html/safety/safecity.shtml

"Cross the Street As If Your Life Depends On It, Because It Does," Toronto:

In response to a high incidence of pedestrian fatalities that occurred in Toronto in 2002, the City's Injury Prevention Coalition developed a campaign to increase citizen awareness about safe street crossing. The Coalition developed the slogan, "Cross the street as if your life depends on it, because it does. Educational and publicity elements included: posters and safety brochures sent to 900 community agencies, bus shelter ads, and a slideshow at movie theaters. All printed materials for the campaign included a dramatic photo of a staged pedestrian fatality street scene. Costs totaled $21,520 with media covered by several city papers. The images and brochures were found to educate readers and viewers and over 867,000 people viewed the pedestrian safety ad in movie theaters.

Source:
http://drusilla.hsrc.unc.edu/cms/downloads/EDU.CrosstheStreetAsIfYourLifeDependsOnIt.pdf

"Toward Zero Deaths, Every 1 Counts," San Francisco, Current:

A joint initiative by the San Francisco Police Department (SFPD) and San Francisco Department of Public Health (DPH), this pedestrian safety program seeks to increase enforcement of dangerous and illegal driver behavior, in conjunction with educational campaigns for seniors and other vulnerable pedestrians. The grant totals just over $300,000. The SFPD will focus on

enforcement of several citation types at or near intersections with disproportionate pedestrian crashes (motorists violating pedestrian right-of-way, violations by pedestrians, speeding, right turn violations, and red light violations), while the DPH will improve their pedestrian injury maps, update their pedestrian safety material and provide mini-grants to advocacy groups engaged in pedestrian safety campaigns.

Source: http://sf.streetsblog.org/2009/10/22/sfpd-and-health-department-announce-pedestrian-safety-campaign/

"Think!" Campaign, UK Transport, Current:

Based on the UK government's objective of reducing road deaths and serious injuries by 40% (50% for children) by the year 2010 (using the average for 1994-98 as the baseline), this campaign focuses on improved road user behavior and engineering and enforcement initiatives that increase road safety. Education and publicity play a key role in raising consumer awareness and acceptance. The road safety publicity efforts of Think! create a high profile for road safety as a matter for general concern, complement police and local authority activities, encourage broader support from private sector partners, get across specific messages to target audiences, and generate media interest in road safety issues. This is accomplished by involving a broad spectrum of society in promoting safer roads for everyone, encouraging and reinforcing attitudes that lead to safer and more considerate behavior by all road users, promoting understanding of the need for better road safety behavior, and contributing to the general aim of reducing road casualties. This program is based on national publicity using a mix of emotion and facts that raise the profile of road safety. Using a range of media channels, including TV, radio, press, posters, etc., the campaign provides a national platform to stimulate complementary regional and local authority activity and to encourage private sector companies to cascade messages to their employees and customers. A range of free publicity material is made available to local authorities and others to promote consistency of messages at national and local level. The Think! Campaign has also entered into sports sponsorships to reach a wider audience using a celebrity based approach. Road Safety advertising has been a key priority for many years. In the past, advertising focused on specific themes, such as drink drive and seat belts, but in recent years, more messages have been incorporated, such as fatigue and the use of mobile phones while driving.

The Think! campaign is not about the motorist as such, or the pedestrians, or cyclists, it is about *people*, about the *citizen* using roads safely. In 2008/9, the campaign developed separate child and adult marketing strategies - although both will continue under the Think! banner. The reason for separation is that in the case of children and young people, the campaign seeks to influence the formation of habits, whereas with adults the goal is to persuade people, mainly drivers, to change entrenched habits. The Think! website contains many excellent examples of campaign images and messages.

Source:
http://www.dft.gov.uk/think/focusareas/driving/?whoareyou_id=&page=Overview

LITERATURE REVIEW REFERENCES

Currie, Graham. 2009. Using a public education campaign to improve driver compliance with streetcar transit lanes. *Transportation Research Record* No. 2112: 62-69.

Daniel, Janice R., Rajat Rajbhandari, Walter Konon, and Rachel Liu. 2003. Identifying locations for bus nub installation on urban roadways. Paper presented at 2nd Urban Street Symposium, Anaheim, California, July 2003.

Delaney, Amanda, Bella Lough, Michelle Whelan and Max Cameron. 2004. *A review of mass media campaigns in road safety*. Monash University, Accident Research Centre.

Delhomme, Patricia, Werner De Dobbeleer, Sonja Forward, and Anabela Simoes, eds. 2009. *Manual for designing, implementing, and evaluating road safety communication campaigns: Part II*. Report D3.2b, CAST Project, European Commission.

Easter Seals Project Action. *Toolkit for the assessment of bus stop accessibility and safety*. Available at: http://projectaction.easterseals.com/site/PageServer?pagename=ESPA_BusStopToolkitAccessed 27 June 2010.

Federal Highway Administration. 2008. *Pedestrian safety guide for transit agencies*. Publication No. FHWA-SA-07-017.

Federal Highway Administration. 2004. *A review of pedestrian safety research in the United States and abroad.* Publication No. FHWA-RD-03-042.

Federal Highway Administration. 2002. *Pedestrian facilities user guide – providing safety and mobility.* Publication No. FHWA-RD-01-102.

Henary, B.Y., J. Ivarsson, and J.R. Crandall. 2006. The influence of age on the morbidity and mortality of pedestrian victims. *Traffic Injury Prevention* 7(2006): 182-190.

Hess, Paul Mitchell, Anne Moudon, and Julie Matick. 2004. Pedestrian safety and transit corridors. *Journal of Public Transportation* 7(2): 73-93.

Holland, Carol and Roslyn Hill. 2007. The effect of age, gender and driver status on pedestrians' intentions to cross the road in risky situations. *Accident Analysis and Prevention* 39(2007): 224-237.

Institute of Traffic Engineers/Federal Highway Administration. 1999. *Traffic calming: State of the practice.*

Jeng, One-Jang and George Fallat. 2003. *Pedestrian safety and mobility aids for crossings at bus stops*. New Jersey Institute of Technology, National Center for Transportation and Industrial Productivity.

Karl, Kim, Pradip Pant, and Eric Yamashita. 2009. Accidents and accessibility: measuring the influences of demographic and land use variables in Honolulu, Hawaii. TRB Annual Meeting (2010).

Kim, Karl, Made Brunner and Eric Yamashita. 2008. Modeling fault among accident-involved pedestrians and motorists in Hawaii. *Accident Analysis and Prevention* 40(2008): 2043-2049.

Knezek, Claudia, Sarah Weissman and Pamela Lebeaux. 2007. *Causality factors review of severe pedestrian crashes, Phase I*. Rutgers University, Center for Advanced Infrastructure and Transportation.

Koenig, Daniel J. and Zheng Wu. 1994. The impact of a media campaign in the reduction of risk-taking behavior on the part of drivers. *Accident Analysis & Prevention* 26(5): 625-633.

Kopf, Jaime and Mark Hallenbeck. 2005. *A motorist and pedestrian behavioral analysis on SR7.* Washington State Transportation Center Research Report.

Loukaitou-Sideris, Anastasia, Robin Liggett, and Hyun-Gun Sung. 2007. Death on the crosswalk: a study of pedestrian-automobile collisions in Los Angeles. *Journal of Planning Education and Research* 26(4): 338-351.

Mohan, D. 2008. Traffic safety and city structure: lessons for the future. *Salud Publica de Mexico* 2008 (50): S93-S100.

Motavalli, Jim. Teenagers not tops in texting. *New York Times* 27 June 2010.

Moudon, Anne and Lin Lin. 2007. *Managing pedestrian safety I: Injury severity*. Seattle: Washington State Transportation Center.

National Highway Traffic Safety Administration. 2010. *Analyzing the first years of the ticket or click it mobilizations*. DOT HS 811 232, U.S. Department of Transportation.

New Jersey Department of Transportation. 2005 (revised 2007). *Pedestrian*

safety management in New Jersey.

Nambisan, Shashi, Srinivas Pulugurtha, Vinod Vasudevan, Mukund Dangeti and Vinay Virupaksha. 2009. Effectiveness of automatic pedestrian detection device and smart lighting for pedestrian safety. *Transportation Research Record* No. 2140: 27-34.

Noar, S.M. 2006. A 10-year retrospective of research in health mass media campaigns: Where do we go from here? *Journal of Health Communications* 11(1): 21-42.

Oxley, Jennie, Brian Fildes, Elfriede Ihsen, Judith Charlton and Ross Day. 1997. Differences in traffic judgments between young and old pedestrians. *Accident Analysis and Prevention* 29(6): 839-847.

Pulugurtha, Srinivas S. and Vinay K. Kanapalli. 2008. Hazardous bus stop identification: An illustration using GIS. *Journal of Public Transportation* 11(2): 65-83.

Rosen, Erik and Ulrich Sander. 2009. Pedestrian fatality risk as a function of car impact speed. *Accident Analysis and Prevention* 41(2009): 536-542.

Rosenbloom, Tova. 2009. Crossing at a red light: Behaviour of individuals and groups. *Transportation Research Part F* 12(5): 389-394.

Transportation Research Board. 1996. *Guidelines for the location and design of bus stops*. Transit Cooperative Research Program Report 19, Federal Transit Administration.

Vaa, T. and R. Phillips, eds. 2009. *Effects of road safety campaigns*. Report D1.3, CAST Project, European Commission.

Wedagama, D.M. Priyantha, Roger N. Bird and Andrew V. Metcalfe. 2006. The influence of urban land-use on non-motorized transport casualties. *Accident Analysis and Prevention* 38(2006): 1049-1057.

Winston, Flaura K. and Lela Jacobsohn. 2010. A practical approach for applying best practices in behavioural interventions to injury prevention. *Injury Prevention* 2010(16):107-112.

Woolley, J.E. 2001. *Literature review on best practice with mass media*. Adeliade: Transport Systems Centre, University of South Australia.

Wundersitz, LN, TP Hutchinson and JE Woolley. 2010. *Best practice in road safety mass media campaigns: a literature review*. Adelaide: Center for